Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy elektroniczne**
Name in English: **Electronic circuits**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARE001030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Gain knowledge about design, operation and basic properties of electronic systems and development trends in this area
C2. Gaining competence to analyze and design simple electronic circuits
C3. Gaining basic competence to design electronic circuits
C4. Learning how to start and measurements of the simple electronic circuits
C5. Improving the presentation of experimental results in a transparent manner

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student can describe the construction and operation of basic electronic circuits.
PEK_W02 - The student knows the basic methods and techniques in the design of analog circuits

II. Relating to skills:
PEK_U01 - The student can, in accordance with the set specifications and using appropriate methods, design elementary electronics.
PEK_U02 - Students can perform a simple electronic circuit, run it and measure its basic parameters.
PEK_U03 - The student is able to write in a clear report of the experiments

III. Relating to social competences:
PEK_K01 - Able to work in a group
PEK_K02 - Acquires the ability to take responsibility for assigned tasks

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basics of semiconductor devices - diodes, transistors	4
Lec2	Power supplies, rectifiers, voltage and current stabilizers	4
Lec3	Transistor amplifiers with BJT transistors, FETs, MOSFETs (polarization / small signal model / amplifiers pulse / broadband / DC)	6
Lec4	Operational Amplifier and its applications (non-inverting and inverting amplifier / integrator and differentiator / filters / use of non-linear / comparators)	10
Lec5	Sine wave generators and flip-flops.	4
Lec6	The basic logic	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction: - introduce students with the principles of safety in the laboratory;- introduce students with support equipment	3

Lab2	Takes four measurement exercises from the list in the Electronic Systems Laboratory: Operational Amplifier - basic configurations; Operational amplifier - the differentiator and integrator; Operational amplifier - active filter; Instrumentation Amplifier; EC transistor amplifier; Keys transistor; Rectifier with a filter capacitor; Linear voltage regulator; Boost converter; Buck converter; Reversing voltage converter; Low-frequency power amplifier; Generators quartz; 555 astable flip-flop; Monostable 555; The pressure sensor in the system microprocessor (advanced); PLL - frequency synthesis (advanced); The parameters of light sources (advanced); LED parameters (advanced); The parameters of photodetectors (advanced);	12
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	The final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Preliminary small exam and / or project evaluation given circuit.
F2	PEK_U02, PEK_U03	The implementation of the system, running the system, measurement and report on the measurements
P = 0,49F1+0,51F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

U. Tietze, Ch. Schenk, Electronic Circuits --- Handbook for Design and Applications, 2008; Course materials on the website

SECONDARY LITERATURE

C Kitchen L Counts, A Designers Guide to Instrumentation Amps, 2004 Analog Devices

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronic circuits
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W02	K1AIR_W10	C1		N1-N3
PEK_U01 - PEK_U03	K1AIR_U08, K1AIR_U09, K1AIR_U10	C3		N3-N5
PEK_K01 - PEK_K02	K1AIR_K03, K1AIR_K05	C5		N3-N5

SUBJECT SUPERVISOR

dr inż. Remigiusz Mydlikowski email: remigiusz.mydlikowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy elektroniczne**
Name in English: **Electronic circuits**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARE001030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Acquire basic skills to design electronic circuits
C2. Knowledge of computer tools for design and simulation of a SPICE

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic methods and computational techniques in the design of analog circuits

II. Relating to skills:
PEK_U01 - The student can, in accordance with the set specifications and using appropriate methods, techniques and tools (eg, computer simulation), design a simple electronic circuit

III. Relating to social competences:
PEK_K01 - Acquires the ability to take responsibility for assigned tasks to be performed
PEK_K02 - Able to work in a group

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Transistor amplifier - Calculation of the Q-point, the calculation of the parameters ac-model, computer analysis (SPICE)	4
Proj2	Operational Amplifier - calculations and computer analysis	4
Proj3	AC adapter and voltage stabilizers - calculations and computer analysis	4
Proj4	Project presentation	3
		Total hours: 15

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_W01	quiz/project presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

U. Tietze, Ch. Schenk, Electronic Circuits --- Handbook for Design and Applications, 2008; Course materials on the website

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronic circuits
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1AIR_U07, K1AIR_U08	C1 - C2		N1 - N4
PEK_W01	K1AIR_U07, K1AIR_U08	C1 - C2		N1 - N4
PEK_K01 - PEK_K02	K1AIR_K03, K1AIR_K05	C1 - C2		N3 - N4

SUBJECT SUPERVISOR

dr inż. Remigiusz Mydlikowski email: remigiusz.mydlikowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy laserowe**
Name in English: **Laser systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031000**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has a basic knowledge of solid state physics, optics and electronics

SUBJECT OBJECTIVES

C1. Introduction to the issues related to the basics of laser technology
C2. Presentation of structure and parameters of the most popular lasers
C3. Introduction to basic applications of lasers in manufacturing, metrology, telecommunications and medicine

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has an extended knowledge of the physics needed to understand the physical phenomena in the field of laser technology.
PEK_W02 - He understands the mechanisms occurring in lasers' operation.
PEK_W03 - He knows the basic parameters of lasers, their types and applications.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Physical phenomena used in laser technology	2
Lec2	The theoretical basis of the laser	2
Lec3	Construction of laser resonators	2
Lec4	Gas lasers	2
Lec5	Solid-state lasers	2
Lec6	Semiconductor lasers	2
Lec7	Pulse lasers	2
Lec8	Fundamentals of fiber optic telecommunications	2
Lec9	Fiber lasers	2
Lec10	Laser safety	2
Lec11	The use of lasers in metrology	2
Lec12	Laser as a tool for materials processing	2
Lec13	Applications of lasers in the production	2
Lec14	The use of lasers in medicine and the army	2
Lec15	Test	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

B. Ziętek, Optoelektronika, Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 2011
K. Shimoda, Wstęp do fizyki laserów, PWN,Warszawa, 1993
F. Kaczmarek, Wstęp do fizyki laserów, PWN, Warszawa, 1878

SECONDARY LITERATURE

J. Kusiński: ”Lasery i ich zastosowanie w inżynierii materiałowej”, Wydawnictwo Naukowe Akapit, 2000.
E. Kannatey-Asibu: “Principles of Laser Materials Processing”, Wiley, 2009.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K1AIR_W02	C1-C3	Lec1-Lec15	N1-N3
PEK_W03	K1AIR_W07	C3	Lec12-Lec13	N1-N3

SUBJECT SUPERVISOR

dr inż. Tomasz Baraniecki tel.: 26-62 email: tomasz.baraniecki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska - geometria wykreślna**
Name in English: **Engineering graphics - descriptive geometry**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	30			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry
2. Student has ability to use of the drawing utensils.
3. Student has ability to draw basic geometric structures, such as division of a line's segment into n equal parts, plotting a regular hexagon.

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane as the basis for design recording (engineering drawing).
C2. Knowledge in the field of the geometric structures restitution based on Monge's projections.
C3. Preparation for the design recording (engineering drawing) application.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge on geometric structure mapping onto drawing's plane using Monge's projection method and elementary knowledge in the field of axonometry.
PEK_W02 - Student can indicate an appropriate solution algorithm of mapping of the position and the relationship of the geometric formations in the space, as well as identifying the measures relationship.
PEK_W03 - Student can interpret the drawing, made by the Monge's method, showing localization of the element or geometric structure in the space.

II. Relating to skills:
PEK_U01 - Student can practically apply the principles of the Monge's projection method to map the elements and geometric structures (including solids) on the drawing plane.
PEK_U02 - Student can set the size of the dimensions characterized measuring tasks of geometry.
PEK_U03 - Student can provide restitution of the geometric structure on the basis of Monge's projection and submit the result by axonometric projection.

III. Relating to social competences:
PEK_K01 - Student is to work independently and solve problems involving Monge projection method.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions and principles of the parallel, rectangular projection by Monge's projection, the mapping of basic geometric elements (points, line, plane).	2
Lec2	Common elements - edges and breakdown points; parallel and perpendicular elements.	2
Lec3	Transformation of the position (rotation, revolved section, increasing of the revolved section) and the reference system transformation (additional projection plane).	2
Lec4	Solids - definitions; solid section as a set of common elements of the solid cutting plane, solid's breakdown points by a straight line.	2
Lec5	Cutting of the solids with projecting planes set - a modification of the initial solid's view, developed views.	2
Lec6	Penetration of the solids - transmission lines definition, the use of auxiliary cutting planes and reference system transformation.	2
Lec7	Projection in the three orthogonal planes; axonometry basis; completion of the missing solid projection - use of the axonometric projection.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Information on the drawing utensils and principles of the geometric structures drawing. Projection of a point and straight line, the mapping of a plane using her traces, identification of the basic elements localization in space using two orthogonal projection planes.	2

Cl2	Belonging of the basic geometric elements, completion of the missing projection; particular localization of the geometric elements.	2
Cl3	Edge as common element of two planes. Breakdown point as common element of straight line and plane. Particular cases of a common elements.	2
Cl4	Edge between flat figures (auxiliary projection planes application); breakdown point of the flat figure by straight line. Identification and construction of the parallel and orthogonal relationship between basic geometrical elements.	2
Cl5	Rotation and revolved section of the basic geometrical elements (rotation of a line's segment and plane); application of the localization transformation for measuring tasks (determination of the real size of a line's segment, angle, flat figure).	2
Cl6	Determination of the projections of plane geometrical structures with selected parameters and the desired position in space (increasing of revolved section of a plane figure). Application of the reference system transformation in measuring tasks and identification of the position (angle relative to the projecting plane, distance of the point from the plane, setting the points projections at a set distance from the plane).	2
Cl7	Test K1 (includes classes's 1 - 6 material).	2
Cl8	The mapping of the elementary solids using Monge's projection, points and lin's segments belonging to the solid's walls identification; determination of the cross sections of polyhedra with projection planes.	2
Cl9	Determination of the polyhedra cross sections cutted by arbitrary planes. Determination of the cross section of the solids with surfaces. Solid's breakdown points by lines (use of auxiliary cutting planes containing penetrating straight line) determination.	2
Cl10	Developed view of a polyhedron and solid containing ruled surface. Cutting of the solid with projection planes as a modification of the initial form of solid - cutting of the polyhedron.	2
Cl11	Cutting of a solid of revolution. Polyhedra transmission lines determination.	2
Cl12	Solids (containing surfaces) transmission lines determination.	2
Cl13	Solid mapping onto three orthogonal projectionl planes. Solid modyfying using projection plane.	2
Cl14	Solid mapping using axonometric projection. Determination of the missing solid projection modified by cutting planes. Relationship between Monge's projection and axonometric projection.	2
Cl15	Test K2 (includes classes's 8 - 14 material).	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. problem exercises
N3. tutorials
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W02, PEK_U01, PEK_U02	test no. 1, good rating is nedeed (min.3.0)
F2	PEK_W02, PEK_U01, PEK_U02, PEK_U03	test no. 2, good rating is nedeed (min.3.0)
F3	PEK_K01	evaluation of n projects (sheets) preparation, n= min.4 - max. 8, good rating of each project is nedeed, F3 = (P1+...+ Pn)/n
P = [(F1+F2)/2]*4/5+F3*1/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania),
[2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998,
[3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001,
[4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005

SECONDARY LITERATURE
[1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania),
[2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997,
[3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997,
[4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering graphics - descriptive geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1AIR_W03	C1-C3	Lec1-Lec7	N1, N3
PEK_UO1, PEK_UO2, PEK_UO3	K1AIR_U03	C1-C3	Cl1-Cl6, Cl8-Cl14	N2. N3. N4
PEK_K01	K1AIR_K06	C1-C3	Lec1-Lec7, Cl1-Cl6, Cl8-Cl14	N4

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ergonomia i BHP**
Name in English: **Ergonomics and safety**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases, estimate of professional risk on work positions	2
Lec3	Ergonomics as interdisciplinary science	2
Lec4	Labor biomechanics - science about threats for employee health discovering, being result of executable work	2
Lec5	Dangerous and harmful agents in work environment - mechanical agents and electric power	2
Lec6	Dangerous and harmful agents in work environment - noise, vibrations and lighting	2
Lec7	Dangerous and harmful agents in work environment - chemical and biological agents	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03;	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE

D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ergonomics and safety
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W13	C1	Lec1, Lec2	N1, N2, N3, N4
PEK_W02	K1AIR_W13, K1AIR_W17	C2	Lec3	N1, N2, N3, N4
PEK_W03	K1AIR_W13	C3	Lec4, Lec5, Lec6, Lec7	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo I**
Name in English: **Materials Science I**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031008**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic chemical knowledge about constitution of matter. Ability to make use of chemical terminology. Ability to determine properties of elements and chemical compounds.
2. Basic knowledge in the fields of classical mechanics and thermodynamics.
3. Knowledge and ability to use elements of vector calculus.

SUBJECT OBJECTIVES

C1. Getting acquainted with basic groups of engineering materials and methods of their testing, as well as gaining ability to understand their properties
C2. Gaining ability to understand interrelations between structure and manufacturing method, and properties of basic groups of engineering materials to act reasonably at selecting materials for applications in specific conditions of mechanical loads and environmental influence.
C3. Gaining and consolidating social competences covering: ability to collaborate in a student group, responsibility, honesty and reliability of behaviour, as well as observing customs valid in academic environment and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Ability to distinguish, define and characterize basic kinds of engineering materials. Knowledge of criteria and principles of material selection and ability to find information relating to material properties.
PEK_W02 - Knowledge of basic methods of material testing and ability to define properties determined by those methods.
PEK_W03 - Knowledge of methods of forming material properties and ability to describe the related strengthening mechanisms.

II. Relating to skills:
PEK_U01 - Ability to evaluate material properties on the ground of their cracking way and structural features in macro- and microscopic scale.
PEK_U02 - Ability to describe quantitatively chemical and phase compositions, as well as microstructures of binary system alloys using phase equilibrium diagrams.
PEK_U03 - Ability to plan and execute basic metallographic examinations.

III. Relating to social competences:
PEK_K01 - Ability to search-out information and subject it to critical evaluation.
PEK_K02 - Ability to work and cooperate in a group, performing the assigned task.
PEK_K03 - Observing principles and habits valid in the academic environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to engineering materials.	2
Lec2	Materials structure. Properties depending on phase structure.	2
Lec3	Mechanical properties of materials and methods of their determining.	2
Lec4	Corrosion of materials.	2
Lec5	Crystalline structure of materials. Polymorphism.	2
Lec6	Defects of crystalline structure and their influence on plasticity of metals.	2
Lec7	Characteristics of phases occurring in alloys of metals.	2
Lec8	Phase equilibrium diagrams of binary systems.	2
Lec9	Metastable phase equilibrium diagram of the iron-cementite system.	2
Lec10	Methods of strengthening of metals.	2
Lec11	Classification and methods of forming metals.	2
Lec12	Polymeric materials. Strengthening methods. Shape memory.	2
Lec13	Forming products of polymeric materials.	2
Lec14	Engineering ceramics. Glasses.	2
Lec15	Principles of material selection. Information sources about material properties.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Methods of material testing. Introduction.	2

Lab2	Macroscopic examinations of fracture surface – case studies.	2
Lab3	Examination of macrostructure of metals. Identification of manufacturing defects.	2
Lab4	Examination of macro- and microstructures of polymers and polymer matrix composites.	2
Lab5	Analysis of phase equilibrium diagrams of binary systems.	2
Lab6	Examination of microstructure of metals. Identification of phases.	2
Lab7	Analysis of phase equilibrium diagram of the iron-cementite system.	2
Lab8	Crediting the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03PEK_U02; PEK_K01; PEK_K03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_K01	Class admission tests, oral answers,
F2	PEK_U01, PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03	Reports of the performed tasks
P = 0,5 F1+0,5 F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Blicharski M.: Introduction to material engineering. Editorial Office WNT Warszawa, 1998 (in Polish)
2. Dobrzański L.A.: Basics of material science and physical metallurgy. Editorial Office WNT Warszawa, 2002 (in Polish)
3.Haimann R.: Physical metallurgy. Editorial Office of Wrocław University of Technology, 2000 (in Polish)
4. Collective work edited by Dudziński W. and Widanka K.: Laboratory classes of material science. Editorial Office of Wrocław University of Technology, 2005 (in Polish)

SECONDARY LITERATURE
1. Grabski M.W., Kozubowski J.A.: Material engineering. Editorial Office of Warsaw University of Technology, 2003 (in Polish)
2. Michael F., Ashby D., Jones R.H.: Engineering materials. vol. 1 and 2, Editorial Office WNT Warszawa, 1996 (in Polish)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W04, K1AIR_W05, K1AIR_W07	C1, C2	Lec1, Lec11-Lec15	N1, N2, N3
PEK_W02	K1AIR_W04, K1AIR_W05	C1, C2	Lec2, Lec3, Lec4	N1, N2, N3
PEK_W03	K1AIR_W04, K1AIR_W07	C2	Lec5-Lec10, Lec12	N1, N2, N3
PEK_U01	K1AIR_U12, K1AIR_U25	C1, C2	Lec3, La2-La4,	N3, N4, N5
PEK-U02	K1AIR_U03, K1AIR_U12	C2	Lec7-Lec9, La5-La7	N1-N5
PEK_U03	K1AIR_U02	C1, C2	Lec2, Lec3, La1-La3, La6	N4, N5
PEK_K01	K1AIR_K09	C1, C3	Lec1, Lec15	N1, N3, N5
PEK_K02	K1AIR_K03, K1AIR_K05	C3	La5-La7	N5
PEK_K03	K1AIR_K04	C3	Lec1, La1, La8	N2, N4, N5

SUBJECT SUPERVISOR
dr inż. Bogumiła Kuźnicka tel.: 320-27-67 email: bogumila.kuznicka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika I**
Name in English: **Mechanics I**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031009**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differentiation, integration)
2. algebra (at secondary level) + linear algebra (matrices, determinants)
3. Euclidean geometry and trigonometry

SUBJECT OBJECTIVES

C1. Solving of practical static and kinematic problems based on the laws of classical mechanics
C2. Implementing of static analysis of strength of machine elements
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define the basic concepts in mechanics (force, moment of force). He knows the classical mechanics equations in statics. He knows some selected methods of solving trusses, beams and frames
PEK_W02 - Has a knowledge of the geometry of the masses (static moments, moments of inertia and deviation)
PEK_W03 - He has a knowledge of the basic concepts of particle kinematics and the kinematics of a rigid body (speed, acceleration, number of degrees of freedom, the trajectory and motion equations)

II. Relating to skills:
PEK_U01 - He is able to solve typical engineering structures (trusses, beams, frames) under static load: reactions at the supports, the internal forces (as an analytic functions and their graphs)
PEK_U02 - He is able to determine the position of centre masses, static moments and moments of inertia of basic mechanical systems and the principal axes and moments of inertia
PEK_U03 - He can calculate the velocity and acceleration of any points of typical mechanical systems and their components

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Outline of vector algebra	2
Lec2	Force, moment of force, the main vector and main moment of forces, equilibrium conditions, the axioms of statics. Changing of the moment’s pole	2
Lec3	Concurrent force system. Trusses. Method of separated nodes	2
Lec4	Determination of the reaction forces in the case of coplanar force systems (applying in the beams, trusses, plane frames, etc.)	2
Lec5	Ritter’s method to determining the forces in selected truss members. The reduction of coplanar force system. Culmann’s method.	2
Lec6	The internal forces in statically determinate beams (analytical method)	2
Lec7	Determination of internal forces in the frames	2
Lec8	Centre of masses in discrete and continuous systems. Static moments	2
Lec9	Moments of inertia, parallel and rotational transformation	2
Lec10	Principal axes and moments of inertia in coplanar system	2
Lec11	Particle kinematics (trajectory, velocity, acceleration). Curvilinear motion, tangential and normal acceleration. Kinematics in the natural and polar coordinate system	2
Lec12	The notion of a rigid body. Degrees of freedom. Classification of the motion of a rigid body. Formulas for calculation the velocity and acceleration in the general motion case.	2

Lec13	Kinematics of rigid body rotation. Rotational velocity and acceleration. Plane motion. Methods for determining the velocity of the plane motion (instantaneous center of rotation, centroid)	2
Lec14	Acceleration in plane motion of a rigid body. Instantaneous center of accelerations.	2
Lec15	Kinematics of particle in movable system. The relative motion. Coriolis acceleration.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Basic operations on vectors: analytical and graphical summation, scalar and vector multiplication, etc.	2
Cl2	Determination of forces in the bars of planar systems (trusses) by separated nodes method using equilibrium equations and polygon of forces	2
Cl3	Determination of reaction forces of bearings in any planar systems by analytical methods	2
Cl4	Determination of reaction forces in bearings of spatial systems (one example)	1
Cl5	Determination of forces in freely selected truss rods (by Ritter's method)	1
Cl6	Test 1: vectors, trusses	1
Cl7	Determination of internal forces in beams	1
Cl8	Determination of internal forces in beams (cont.). Articulated beams.	2
Cl9	Determination of internal forces in frames (simple planar frames at most with one node)	2
Cl10	Test 2: the internal forces in planar systems	1
Cl11	Determination of mass centres and static moments in discrete multi-mass systems.	1
Cl12	Determination of mass centres and static geometrical moments in static continuous planar systems.	2
Cl13	Determination of the moments of inertia in planar discrete-continuous systems and deviation moments relative to any axis by application Steiner's law.	2
Cl14	Determination of the position of the principal central axis of inertia and values of the principal inertial central moments for planar systems (one example).	2
Cl15	Test 3: centres of masses, static and inertial moments.	1
Cl16	Solving the problems of particle kinematics in the Cartesian coordinate system.	2
Cl17	Solving the kinematic problems of rotation and translatory motion of rigid body.	2
Cl18	Determination of velocity in rigid body plane motion	2
Cl19	Test 4: kinematics	1
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. 4 tests instead of two colloquia forcing students to more systematic own work during the semester, including greater use of consultation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03 , PEK_K01, PEK_k02, PEK_K03	written and oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test 1 and 2 and/ or oral replies
F2	PEK_U02	test 3 and/ or oral replies
F3	PEK_U03	test 4 and/ or oral replies
P = P=2 jeśli ocena F1=2. Jeśli nie to P=(2F1+F2+F3):4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. B. Gabryszewska, A. Pszonka: "Mechanics", Part 1: Statics, WUT, 1988
2. J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
3. J. Misiak: "General Mechanics. Statics and Kinematics ". Volume I, WNT, Warsaw, 1993
4. M. Kulisiewicz St. Piesiak: "The dynamics of mechanical systems in technical tasks" Part I: "Fundamentals of Kinematics", WUT, 2002
5. C. Witkowski, "Exercises in mechanics." Part I. "Kinematics". WUT. 1999
6. Z. Jaśniewicz , "Exercises in statics “ WUT. 1996

SECONDARY LITERATURE
1 J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
2 B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
3 J. Leyko: "General Mechanics", WNT, Warsaw, 1980
4 S. Piasecki, J. Rżysko: "Mechanics" WNT, Warsaw, 1977,
5 W. Siuta: "Engineering Mechanics", WNT, Warsaw, 1968

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1AIR_W01, K1AIR_W02	C1, C2, C3	Lec 1 to Lec 15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1AIR_U02, K1AIR_U07	C1, C2, C3	Cl 1 to Cl 19	N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe zwyczajne**
Name in English: **Ordinary differential equations**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student is familiar with the differential and integral calculus of function of one variable and other branches of mathematics used in this calculus, particularly linear algebra.
2. Student is able to calculate derivatives of functions of one variable, indefinite and definite integrals using methods by parts and by substitution.
3. Student is able to calculate determinants, eigenvalues and eigenvectors of matrix.

SUBJECT OBJECTIVES

C1. To gain basic knowledge of first-order and second-order ordinary differential equations, and systems of differential equations.
C2. To learn how to choose the appropriate method of solving ordinary differential equations and systems of differential equations.
C3. To develop and consolidate the ability to access information and its analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has theoretical knowledge of differential equations and about methods of their solving.
PEK_W02 - Student has knowledge about methods of solving of systems of differential equations.
PEK_W03 - Student has knowledge about applying differential equations as the mathematical model for a physical phenomenon.

II. Relating to skills:
PEK_U01 - Student is able to formulate theorems and definitions of differential equations in oral and written, friendly manner.
PEK_U02 - Student is able to solve first-order and second-order differential equations.
PEK_U03 - Student is able to solve systems of differential equations.

III. Relating to social competences:
PEK_K01 - Student understands the necessity of systematical work on all tasks and can estimate the time needed for solving the exercise.
PEK_K02 - Student is aware of the scope of his/her knowledge and abilities, is able to identify lack of knowledge and complete it using the literature.
PEK_K03 - Student acts ethically and understands the importance of intellectual honesty.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	First-order differential equations: the basic definitions. Issues from various fields leading to differential equations.	2
Lec2	First-order differential equations: the equations with separated variables and homogeneous equations.	2
Lec3	First-order linear homogeneous and heterogeneous differential equations. Method of variation of constant. Integrating factor method.	2
Lec4	Bernoulli's equation. Orthogonal curves.	2
Lec5	Second-order equations. Reducible second-order equations.	2
Lec6	Second-order linear homogeneous differential equations. Wronskian.	2
Lec7	Second-order linear homogeneous differential equations with constant coefficients. Second-order linear heterogeneous differential equations with constant coefficients. Method of undetermined coefficients.	2
Lec8	Second-order linear heterogeneous differential equations with constant coefficients. Method of variation of constants.	2
Lec9	Systems of differential equations. Method of elimination.	2
Lec10	Homogeneous linear system of equations with constant coefficients.	2
Lec11	Heterogeneous linear system of equations with constant coefficients. Method of variation of constants.	2
Lec12	Stability of equilibrium points.	2
Lec13	Elements of operational calculus: the Laplace transform.	2
Lec14	The Laplace transform method of solving differential equations.	2
Lec15	Properties of the Laplace transform.	2

		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Solving first-order differential equations with separated variables and homogeneous equations.	2
Cl2	Solving first-order linear homogeneous and heterogeneous differential equations.	2
Cl3	Solving reducible second-order differential equations.	1
Cl4	Solving second-order linear homogeneous and heterogeneous differential equations with constant coefficients.	2
Cl5	Solving second-order linear heterogeneous differential equations with constant coefficients with method of undetermined coefficients and method of variation of constants.	2
Cl6	Solving heterogeneous linear systems of equations with constant coefficients.	2
Cl7	Solving differential equation with the Laplace transform method.	2
Cl8	Final test (short tests take 2 hours during semester).	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture
N2. calculation exercises
N3. tutorials
N4. work on preparing for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 + PEK_W02 PEK_U02 + PEK_U03	Written and oral exam.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U02 + PEK_U03	Final test or short tests.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. M. D. Greenberg, Ordinary differential equations, John Wiley & Sons, 2012.
2. R. Carlson, Linear ordinary differential equations, Society for Industrial and Applied Mathematics, Philadelphia, 1997.
3. R. E. O'Malley, Thinking about ordinary differential equations, Cambridge University Press, 1997.
4. A. Jeffrey, Linear algebra and ordinary differential equations, CRC Press, 1993.
5. G. Birkhoff, G. C. Rota, Ordinary differential equations, John Wiley & Sons, 1989.
6. R. M. M. Mattheij, J. Molenaar, Ordinary differential equations in theory and practice, John Wiley and Sons, 1996.
7. R. K. Miller, A. N. Michel, Ordinary differential equations, Academic Press, 1982.

SECONDARY LITERATURE
J. H. Hubbard, B. H. West, Differential equations: a dynamical systems approach, Cambridge University Press, Cambridge 2003.
2. N. Finizio, G. Ladas, Ordinary differential equations with modern applications, Wadsworth Publ. Co., 1989.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ordinary differential equations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K02	K1AIR_U01	C3	Lec1 - Lec15, Cl1- Cl7	N3, N4
PEK_U02, PEK_U03, PEK_W03	K1AIR_U07	C2	Cl1 - Cl7	N2, N4
PEK_W01, PEK_W02	K1AIR_W01	C1	Lec1 - Lec15	N1, N3

SUBJECT SUPERVISOR

dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane materiały funkcjonalne**
Name in English: **Advanced functional materials**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031011**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				15
Number of hours of total student workload (CNPS)	30				30
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	1				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. chemistry and physics on high school level

SUBJECT OBJECTIVES

C1. Introduction with relationship of materials structure, properties and method of synthes.
C2. Introduction with basic knowledge of nanotechnology and nanomaterials
C3. Providing opportunities for students to combine their knowledge of chemistry, ecology, physics, meterial scicnce

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student should have basic knowledge associated with functional ceramic, metallic, polymer and composites materials
PEK_W02 - The student should have basic knowledge associated with possible applications of functional materials.
PEK_W03 - The student should have basic knowledge associated with nanomaterials and their functionalization. Student knows prospective applications of nanomateirals.

II. Relating to skills:
PEK_U01 - The student should have a competence of using modern achievements of science in engineer practice especially in material selection for optoelectronics, biotechnology, construction, automotive industry, medical sciences
PEK_U02 - The student should knows basic nanotechnology and functional materials terms. The student can assess relationship between the type of material, its structure and properties.
PEK_U03 - The student can characterize benefits of functional materials applications to world, economy, environment and society.

III. Relating to social competences:
PEK_K01 - Student can think and act in imaginative way. Student can search for information and analyse them
PEK_K02 - Student obeys academic rules.
PEK_K03 - Student can relate effects of industry with the environmental impact.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction with the functional materials question.	2
Lec2	Nanotechnology and nanomateirals.	3
Lec3	Functional polymer materials.	2
Lec4	Functional metallic materials	2
Lec5	Functional ceramic materials	2
Lec6	Functional composite materials	2
Lec7	Qualifying class –test	2
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Structure and properties of engineering materials	3
Sem2	Structure and properties of nanomateirals	4
Sem3	Functional polymer materials.	2
Sem4	Functional metallic materials.	2
Sem5	Functional ceramic materials.	2
Sem6	Functional composite materials.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	oral answers, discussions, activity
F2	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	presentation of demanded problem, an essay on selected problem
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Nanomateriały Inżynierskie. Konstrukcyjne i Funkcjonalne, Redakcja naukowa: Krzysztof Kurzydłowski, Małgorzata Lewandowska, Wydawnictwo Naukowe PWN, 2010
2. Materiały inżynierskie i projektowanie materiałowe, Leszek DobrzańskiWydawnictwo: Wydawnictwa Naukowo-Techniczne, 2006

SECONDARY LITERATURE

web pages, lectures notes

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced functional materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1AIR_W02, K1AIR_W04	C1,C2,C3	Lec1-Lec6, Sem1-Sem6	N1, N2, N3, N4,
PEK_U01 , PEK_U02, PEK_U03	K1AIR_U01, K1AIR_U02, K1AIR_U06, K1AIR_U12	C1,C2,C3	Lec1-Lec6, Sem1-Sem6	N1, N2, N3, N4,
PEK_K01, PEK_K02, PEK_K03	K1AIR_K02, K1AIR_K06	C1,C2,C3	Lec1-Lec6, Sem1-Sem6	N1, N2, N3, N4,

SUBJECT SUPERVISOR

dr hab. Agnieszka Baszczuk tel.: 320-32-21 email: agnieszka.baszczuk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo II**
Name in English: **Materials Science II**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031012**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in the fields of classical mechanics and thermodynamics.
2. Knowledge about basic metals with technical importance, their properties and methods of determining. Ability to describe crystalline structure of metals using Bravais lattice nomenclature and Miller's indices.
3. Understanding of nature of phases occurring in solid alloys. Ability to describe quantitatively chemical and phase compositions, as well as microstructures of binary system alloys using phase equilibrium diagrams.

SUBJECT OBJECTIVES

C1. Acquiring knowledge about technically important groups of metal alloys, their designation systems and their application criteria in specific service conditions
C2. Gaining ability to understand the balance between strength and plasticity of metallic materials, as well as possibility to control these properties by chemical composition and microstructure formed in manufacturing process of finished products.
C3. Gaining and consolidating social competences covering: ability to collaborate in a student group, responsibility, honesty and reliability of behaviour, as well as observing customs valid in academic environment and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Ability to define and characterize basic kinds of alloys based on iron, aluminium, copper and titanium. Knowledge about designation of their grades acc. to EN.
PEK_W02 - Understanding of phase transitions occurring in metal alloys and knowledge about their effect on selection of thermal and thermochemical treatment parameters. Knowledge about role of alloying elements
PEK_W03 - Understanding of information given in material standards concerning delivery conditions, recommended heat treatment and achievable properties.

II. Relating to skills:
PEK_U01 - Ability to select kind and parameters of heat treatment for specific alloys in order to obtain preset properties.
PEK_U02 - Ability to interpret microstructures of products after various manufacturing processes and to relate them to properties.
PEK_U03 - Ability – at the design stage – to select a material, as well as to consciously select a manufacturing method and delivery condition.

III. Relating to social competences:
PEK_K01 - Ability to search-out information and subject it to critical evaluation.
PEK_K02 - Ability to work and cooperate in a group, performing the assigned task.
PEK_K03 - Observing principles and habits valid in the academic environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Solidification of metals and alloys.	2
Lec2	Plastic deformation of metals and recrystallization.	2
Lec3	Phase transformations in iron-carbon alloys during heating.	2
Lec4	Phase transformations in iron-carbon alloys during cooling.	2
Lec5	Basic kinds of annealing iron-carbon alloys.	2
Lec6	Quench hardening and tempering. TTT diagrams. Hardenability.	2
Lec7	Surface treatment: surface hardening, carburizing, nitriding.	2
Lec8	Influence of alloying elements for phase transitions in iron-carbon alloys.	2
Lec9	General classification of steels. Principle of designation of steel grades. Structure and properties of unalloyed steel. Thermomechanical rolling.	2
Lec10	Structure and properties of alloyed steels. Constructional and tool alloyed steels. Thermomechanical processing .	2
Lec11	Steels with special properties: corrosion-resisting steel, creep-resisting and heat-resisting steels, high speed steel.	2
Lec12	Casting iron alloys.	2
Lec13	Microstructure and properties of copper alloys.	2
Lec14	Light metals and light metal alloys. Precipitation hardening.	2
Lec15	Titanium alloys. Alloys with shape memory effect.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Influence of carbon content and manufacturing methods on microstructure and mechanical properties of steels.	2
Lab2	Influence of thermal treatment on microstructure and properties of steels.	2
Lab3	Microstructure of surface-hardened steel products.	2
Lab4	Microstructure and properties of corrosion-resisting steels.	2
Lab5	Microstructure and properties of cast iron.	2
Lab6	Microstructure and properties of cast and wrought copper alloys.	2
Lab7	Microstructure and properties of cast and wrought aluminium alloys.	2
Lab8	Crediting the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02 ; PEK_ U01; PEK_K01	Written / oral examination
P = 0,9F1+0,1F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_ W01; PEK_W02; PEK_ U01; PEK_K01; K03	Class admission test, oral answers
F2	PEK_W03; PEK_ U02; PEK_ U03; PEK_K01; PEK_K02	Reports of the performed tasks
P = 0,5F1+0,5F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Haimann R.: Physical metallurgy. Editorial Office of Wrocław University of Technology, 2000 (in Polish)
2. Dobrzański L.A.: Physical metallurgy with basics of material science. Editorial Office WNT Warszawa, 1996 (in Polish)
3. Blicharski M.: Material engineering. Steel. Editorial Office WNT Warszawa, 2004 (in Polish)
4. Collective work edited by Dudziński W. and Widanka K.: Laboratory classes of material science. Editorial Office of Wrocław University of Technology, 2005 (in Polish)
5. Collective work edited by Dudziński W.: Construction materials in machine building. Editorial Office of Wrocław University of Technology, 1994 (in Polish)

SECONDARY LITERATURE
1. Dobrzański L.A.: Basics of material science and physical metallurgy. Editorial Office WNT Warszawa, 2002 (in Polish)
2. Adamczyk J.: Engineering of metallic materials. Part I and II. Editorial Office of Silesian University of Technology, Gliwice 2004 (in Polish)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W04	C1, C2	Lec9, Lec11-Lec15	N1-N4
PEK_W02	K1AIR_W04, K1AIR_W07	C1, C2	Lec1-Lec8, Lec4	N1-N4
PEK_W03	K1AIR_W04, K1AIR_W05	C1, C2	Lec9-Lec15	N1, N2
PEK_U01	K1AIR_U03, K1AIR_U12	C1, C2	Lec5-Lec7, La2-La4	N4, N5
PEK_U02	K1AIR_U03, K1AIR_U12	C2	Lec9, Lec11-Lec15	N1, N4, N5
PEK_U03	K1AIR_U01, K1AIR_U12	C1, C2	Lec9, Lec11-Lec15	N1, N4, N5
PEK_K01	K1AIR_K09	C3	Lec9, Lec5	N2, N4, N5
PEK_K02	K1AIR_K03	C3	La1, La2, La5	N5

PEK_K03	K1AIR_K04	C3	Lec1, La1. La8	N2, N4, N5

SUBJECT SUPERVISOR
dr inż. Bogumiła Kuźnicka tel.: 320-27-67 email: bogumila.kuznicka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika II**
Name in English: **Mechanics II**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. mathematical analysis (differentiation, integration)
2. differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of the principles of classical dynamics for typical mechanical systems (discrete systems: a material point, system of material points with holonomic constrains, rigid body).
C2. Resolving some technical problems of structure and mechanical systems under dynamic loads.
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define key concepts in the dynamics of mechanical systems (momentum, angular momentum, force of inertia, work, kinetic and potential energy)
PEK_W02 - He knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance)
PEK_W03 - He knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert's principle). He is familiar with the term of conservative system and with energy conservation law. He knows the dynamics equations of rotational motion and
plane motion of a rigid body.

II. Relating to skills:
PEK_U01 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion of a point. He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using Newton's second principle.
PEK_U02 - It can calculate the frequency of free vibration for systems with one degree of freedom of the linear viscous damping and without damping. He can derive the equations of motion and calculate its parameters (rotational velocity and acceleration) for rigid body loaded by torque and moves rotation.
PEK_U03 - He can determine the reaction force constraints under dynamic loads. It can calculate the kinetic and potential energy for complex mechanical systems. He is able to apply the energy conservation law to determine the differential equations of conservative system motion

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. The basic principles of classical mechanics. Kinematics and dynamics. Models of discrete and continuous dynamical systems in mechanics. A brief reminder of the kinematics of the material from the previous semester.	2
Lec2	Newton's second law (applicable in the dynamics of the free and constrained point)	2
Lec3	The vibrations of the one-mass single degree of freedom system with the linear viscous damping and without damping. Complex notation. Free vibrations.	2
Lec4	Harmonically forced vibration, frequency characteristics, resonance. Dynamic and kinematic excitations	2
Lec5	The forces of inertia and d'Alembert's principle. Momentum, and momentum principle. Angular momentum and angular momentum principle.	2
Lec6	The notion of work. Elementary work. The kinetic and potential energy. The principle of work and kinetic energy equivalence.	2
Lec7	The principle of conservation of energy. Conservative systems. Examples of applications.	2

Lec8	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems	2
Lec9	The principle of the center of mass motion and the principle of momentum in multi-mass systems	2
Lec10	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation.	2
Lec11	Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness	2
Lec12	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces.	2
Lec13	Angular momentum in the plane motion of a rigid body and dynamics of plane motion.	2
Lec14	The kinetic energy of a rigid body in a general motion. König's theorem. Determination of the differential equations of motion and natural frequency of the dynamical conservative systems based on the energy conservation law.	2
Lec15	Test	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Practical problems of kinematics and rotation of a rigid body	2
Cl2	Practical problems of plane motion of rigid body	2
Cl3	Practical problems of kinematiks of relative motion of point	2
Cl4	Solving examples of tasks with dynamic free material point using Newton's second law (rectilinear and curvilinear motion excited by forces: constant, time-varying, depending on the velocity of movement).	2
Cl5	Solving examples of tasks in dynamics of a constrained point using Newton's second law	2
Cl6	Colloquium I: kinematics of point and rigid body. Application of Newton's second law to determine the equations of a material point motion	2
Cl7	Examples of tasks from free vibration of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations)	2
Cl8	Examples of tasks from harmonically forced vibrations of simple mechanical systems with one degree of freedom.	2
Cl9	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy)	2
Cl10	Examples of the tasks of the dynamics and rotational motion of the rigid body using the rules of the center of mass, angular momentum and the principle of dynamic equation of rigid body rotation.	2
Cl11	The tasks to calculations of dynamic reactions in supports of the rotating rigid body	2
Cl12	Examples of determining the motion equations for rigid bodies moving in plane motion	2

Cl13	The technique for calculating the kinetic energy of a rigid body using the formula König (examples of tasks). Application of the principle of conservation of energy to derive the differential equations of motion in complex conservative systems.	2
Cl14	Colloquium II: the dynamics of particles and rigid bodies, vibratory systems with one degree of freedom	2
Cl15	Assessment, colloquia improvement	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. self study - self studies and preparation for examination
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02, PEK_K03	written and oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	I test, oral answers
F2	PEK_U02, PEK_U03	II test, oral answers
P = (F1+F2):2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1 B. Gabryszewska, A. Pszonka: "Mechanics", Mon. II "Kinematics and dynamics", WUT, 1998
2 J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
3 J. Misiak: "General Mechanics. Dynamics ". Volume II, WNT, Warsaw, 1993

SECONDARY LITERATURE
1 J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
2 B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
3 J. Leyko: "General Mechanics", WNT, Warsaw, 1980
4 M. Klasztorny: "Mechanics" Lower Silesia Ed. Education, Wrocław 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1AIR_W02	C1	Lec. 1 to Lec.15	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K1AIR_U01, K1AIR_U06, K1AIR_U07	C2	Cl 1 to Cl 15	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K1AIR_K01, K1AIR_K03, K1AIR_K04, K1AIR_K05	C3	Lec. 1 to Lec. , 15Cl 1 to Cl 15	N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031015**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Examination				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the complex functions and differential equations.

SUBJECT OBJECTIVES

C1. Getting knowledge about the description methods of automatic systems.
C2. Getting knowledge about the basic analysis methods of automatic systems.
C3. Getting knowledge about the basic synthesis methods of automatic systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of methods for describing automation systems.
PEK_W02 - Knowledge of basic methods to analyze automation systems.
PEK_W03 - Knowledge of methods to synthesize automation systems.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic terms, the structure of control systems and their classification.	2
Lec2	Description of linear automation systems: differential equations, transfer function, time characteristics, frequency response, frequency characteristics.	4
Lec3	Dynamic objects: proportional, inertial, differentia, integral, oscillating, delay.	4
Lec4	Stability. Theorem stability. Properties of stable and unstable systems.	2
Lec5	Hurwitz, Michajlow and Nyquist stability criterion	2
Lec6	State-space representation. State-space concept. Controllability and observabilityof linear dynamic system	4
Lec7	Automatic control system. Requirements. Static control. Floating control	4
Lec8	Mathematical description of discrete dynamical systems.	2
Lec9	Stability of discrete dynamical systems	2
Lec10	Stability criterion for discrete system	2
Lec11	State-space representation for discrete system	4
Lec12	Discrete automatic control.	2
Lec13	Nonlinear Systems. Methods of description and analysis.	2
Lec14	Nonlinear Systems. Stability criterion	2
Lec15	Mathematical description of logical system	2
Lec16	Logic combinational systems.	2
Lec17	Logic sequential systems.	3
		Total hours: 45

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Automatic Control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W01	C1	LEC1,LEC2,LEC6, LEC8,LEC11, LEC13,LEC15,	N1
PEK_W02	K1AIR_W09	C2	LEC3,LEC4,LEC5, LEC9,LEC10, LEC14,	N1
PEK_W03	K1AIR_W09	C3	LEC7,LEC12, LEC16,LEC17,	N1

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów I**
Name in English: **Strength of materials I**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031016**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2	2			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Statics and connected with it basic mechanical definitions - forces, reactions, bonds, Newton's law.
2. Moment of force relative to point, balance/reduction of the spatial arrangement of forces, definitions of internal forces in rod, algebra of vectors and mass geometry, first and second degree moments in the 2D and 3D.
3. Skill of counting internal forces in rod, static moments and moments of inertia of complex figures and simple solids, parallel and rotation transformation of coordinate system.

SUBJECT OBJECTIVES

C1. Solving technical problems on the basis of the laws of mechanics.
C2. Perform static stress analysis of machine elements.
C3. The acquisition and consolidation of social competence , emotional intelligence cooperation among students who aims at efficient solution. Responsibility, honesty and reliability in behaviour; observance customs in academic society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Basics of vector analysis and its application in the theory of continuum.
PEK_W02 - The most important group of mechanics equations describing a continuum: geometric relationships, constitutive equations and equilibrium equations.
PEK_W03 - Formulas and solutions of classical tasks of solid mechanics.

II. Relating to skills:
PEK_U01 - the use of equations of vector analysis to issues of strength of materials.
PEK_U02 - Calculation of stress and displacement in the thin-walled or compact rod cross-section, loaded normal force, bending moment, torque, shear, as well as combinations of rods - welds, screws, rivets, bolts.
PEK_U03 - Strut design is resistant to loss of stability in a state of elastic and inelastic.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis.
PEK_K02 - Objective assessment of the arguments, rational translations and justify their point of view on the knowledge of mechanics.
PEK_K03 - Observance and respecting rules in academia.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic assumptions and concepts. Basic experimental strength of materials.	2
Lec2	Hooke's law. Calculation of tension and compression rods.	2
Lec3	Transformation of strain and stress. The use of the extensometry. The material constants.	2
Lec4	Transformation of strain and stress. The use of the extensometry. The material constants.	2
Lec5	Torsion rods of circular cross section. Calculation of helical springs.	2
Lec6	Torsion rods of any cross-section. Thin rods.	2
Lec7	Bending clean. Field of stresses and displacements in bending angles.	2
Lec8	Complex load rod. Superposition of stress. Bending oblique.	2
Lec9	Bending and tension and compression. The core cross-section.	2
Lec10	Bending and shear force participation. Pattern Zurawski.	2
Lec11	The general case of bending beam. Measure shear.	2
Lec12	Differential equation of the deflected axis. The integration of the differential equation deflected axis. Clebsch method.	2
Lec13	Strength theories.	2
Lec14	Buckling strut.	2
Lec15	Test.	2
		Total hours: 30
Form of classes – Classes		Number of hours

Cl1	The equations of statics. The internal forces in the rod.	2
Cl2	Rod statically determinate system thermal loads and normal force.	2
Cl3	Statically indeterminate systems.	2
Cl4	Transformation of stress. Mohr's circle.	2
Cl5	Torsion rods of circular cross section. Calculation of helical springs.	2
Cl6	Shear clean and Technology. Calculation of riveted joints, welded, bolt and slot nuts.	2
Cl7	Test 1	2
Cl8	Bending the simple determination of normal stress. Shear clean and Technology. Calculation of riveted joints, welded, bolt and slot nuts.	2
Cl9	Calculation of the rods bent at an angle.	2
Cl10	Determination of the core cross section.	2
Cl11	Determination of shear stress in the bars bent with the participation of the lateral force.	2
Cl12	Determination of normal stress in bending a straight beam with a typical cross-section. Determination of shear.	2
Cl13	Determination of deflections of beams with typical cross-section.	2
Cl14	The use of hypotheses wytężeniowych. Calculations strut buckling.	2
Cl15	Test 2.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - self studies and preparation for examination
N5. self study - self studes and preparation for exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Test.
F2	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Exam.
P = 0,2F1+0,8F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Replies oral, discussions, written tests.
F2	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Test 1, test 2.
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Z. Dyląg , A. Jakubowicz, A. Orłoś: Wytrzymałość materiałów, WNT, W-a 1996.
[2] M. E. Niezgodziński, T. Niezgodziński: Wytrzymałość materiałów, PWN, W-a 1998.
[3] M.E. Niezgodziński, T. Niezgodziński: Zadania z wytrzymałości materiałów, WNT, Warszawa, 2012.
[4] M. Zakrzewski, J Zawadzki : Wytrzymałość materiałów, PWN, Warszawa 1983.

SECONDARY LITERATURE

[1] T. Rajfert, J. Rżysko: Zbiór zadań ze statyki i wytrzymałości materiałów, PWN, Warszawa 1974.
[2] N. N. Malinin, J. Rżysko: Mechanika materiałów, PWN , Warszawa, 1981.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of materials I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 PEK_W02 PEK_W03	K1AIR_W02	C1		N1,N4,N5
PEK_U01 PEK_U02 PEK_U03	K1AIR_U12	C2		N2-N5
PEK_K01 PEK_K02 PEK_K03	K1AIR_K01, K1AIR_K04, K1AIR_K07	C3		N1-N5

SUBJECT SUPERVISOR

dr inż. Waldemar Morzuch tel.: 320-33-93 email: waldemar.morzuch@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031020**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed a course: Fundamentals of Automatic Control

SUBJECT OBJECTIVES

C1. Learning to design control systems.
C2. The practical skills to build and run basic automation systems.
C3. Skills to evaluate the performance of control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of basic methods for describing automation systems.
PEK_W02 - Knowledge of methods to synthesize automation systems.
PEK_W03 - Knowledge of basic methods to analyze automation systems.

II. Relating to skills:
PEK_U01 - Can design automation system.
PEK_U02 - Can build and run the automation system
PEK_U03 - Can evaluate the performance of automation systems, taking into account criteria.

III. Relating to social competences:
PEK_K01 - Can to work in a group.
PEK_K02 - Can independently acquire knowledge

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Static characteristics of automatic objects.	2
Lab2	Dynamic characteristics of automatic objects.	2
Lab3	Frequency characteristics of automatic objects.	2
Lab4	Identification of the control object.	2
Lab5	On-off control.	2
Lab6	Discrete control	2
Lab7	Research property control system with PID controller.	2
Lab8	Tuning of PID controller	2
Lab9	Simulation tests of automatic objects in Matlab-Simulink system.	2
Lab10	Simulation tests of automatic objects in Matlab-Simulink system.	2
Lab11	Contactor-relay control systems.	2
Lab12	Pneumatic control systems.	2
Lab13	Logic combinational systems.	2
Lab14	Synthesis of logic sequential systems.	2
Lab15	The implementation of control systems using PLCs	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Average grade
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Praca zbiorowa, tytuł: Laboratorium podstaw automatyki i automatyzacji,wydawnictwo: Oficyna Wydawnicza Politechniki Wrocławskiej, rok: 2005

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Automatic Control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_U01	K1AIR_U07, K1AIR_U08, K1AIR_U14	C1	LA1, LA2, LA3, LA4, LA5, LA6, LA9, LA10, LA13, LA14, LA15	N1, N2
PEK_W02, PEK_U02	K1AIR_U07, K1AIR_U14	C2	LA5, LA6, LA7, LA8, LA11, LA12, LA13, LA14, LA15	N1, N2
PEK_W03, PEK_U03	K1AIR_U07, K1AIR_U09	C3	LA5, LA6, LA8, LA9, LA10	N1, N2
PEK_K01, PEK_K02	K1AIR_K03	C1, C2, C3	LA1 - LA15	N1, N2

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-obróbka bezubytkowa**
Name in English: **Manufacturing techniques -- chipless forming**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031021**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Examination				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students should have a basic knowledge of mathematics, physics and materials science and basic properties of engineering materials.
2. Students should have knowledge of the basics of automation.
3. Students should read and interpret drawings and schematics used in technical documentation.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of manufacturing techniques of welding methods, casting and wrought.
C2. Learning how to select proper bonding technology, casting and wrought from the viewpoint of mechanization and automation.
C3. The acquisition and consolidation of responsibility, honesty and fairness in the proceedings and compliance with applicable customs in academia and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the basic methods of bonding, plastic processing and preparation of alloys and their advantages and disadvantages.
PEK_W02 - He knows the basic technologies bonding material forming processes in engineering and manufacturing molds.
PEK_W03 - It has a basic knowledge about the use of non-cutting machining processes.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Types of weld joints determination. Weldability of materials. Carbon equivalent. Stress and strain.	2
Lec2	Flame of gas, welding gas. Arc welding. Welding power source. MMA.	2
Lec3	TIG arc welding, MAG, MIG and submerged arc welding. Automation and robotics basic methods of welding.	2
Lec4	Bonding, soldering soft and hard materials engineering.	2
Lec5	Resistance welding and friction. Thermal cutting.	2
Lec6	Basic concepts and algorithms for producing castings. Methods melting alloys and determination of their basic properties.	2
Lec7	Construction and design principles of foundry equipment.	1
Lec8	Methods for producing and testing the properties of molding and core. Methods for manual production of foundry molds and cores.	2
Lec9	Automated production of foundry molds and cores.	2
Lec10	Production of molds and cores with masses of chemo-and thermosets. Production of castings in molds and equipment.	3
Lec11	The meaning and use of plastic processing methods	3
Lec12	Forming sheet metal and cutting, bending and cutting.	2
Lec13	Rolled metal sheets and profiles, rods and tubes drawing.	2
Lec14	Forging and extrusion machinery parts and drawing processes.	3
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03;	written exam
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Ambroziak A. (red.): Techniki Wytwarzania. Spawalnictwo. Laboratorium. Pwr, Wrocław 2011, http://www.Dbc.Wroc.Pl/Content/7156/Techniki_Wytwarzania_Spawalnictwo_A.Ambroziak_Linkowane.Pdf
2. Perzyk M. i inni; Odlewnictwo, WNT Warszawa 2000.
3. Granat K. Laboratorium z odlewnictwa, skrypt PWr., Wrocław 2007.
4. Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skrypt P. Warszawska, Warszawa 1981.
5. Gronostajski J. (red.): Obróbka Plastyczna Metali, skrypt PWr, Wrocław 1973.

SECONDARY LITERATURE

1. Pilarczyk J. (red.): Poradnik Inżyniera. Spawalnictwo. T. 1 i 2, WNT ,Warszawa 2003, 2005.
2. Klimpel A.: Spawanie, Zgrzewanie i ciecie metali, WNT, Warszawa 1999.
3. Lewandowski J. L., Tworzywa na formy odlewnicze, Wyd. „Akapit”, Kraków 1997.
4. Poradnik inżyniera – Odlewnictwo, WNT, Warszawa 1986.
5. Gabryszewski Z., Gronostajski J.: Mechanika Procesów obróbki Plastycznej, PWN, Warszawa 1991.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing techniques -- chipless forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K1AIR_W04, K1AIR_W07, K1AIR_W13	C1; C2; C3		N1; N2; N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Zbigniew Mirski tel.: 21-42 email: zbigniew.mirski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów II**
Name in English: **Strength of materials II**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031022**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2		1		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic understanding of the study of the internal forces in bodies and know how to respond the question whether under the influence of load data in any area of the body internal forces do not reach very high values, or body "strength" to the charge, and has expertise in the analysis of deformation of bodies and structures, is able to assess the usefulness of the structure on the basis of stress and strain.
2. Can make use of the general laws of mechanics to deformable body mechanics problems. Put establish clear links between the deformation and strength.
3. Able for each item used to build a model of the body as a bar, plate, shell. It can be calculated given the structure based on the theory of stretching and compression, bending or twisting.

SUBJECT OBJECTIVES

C1. Troubleshooting based on the laws of mechanics.
C2. Perform static stress analysis of machine elements.
C3. The acquisition and consolidation of social skills including emotional intelligence involving the ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in the procedure observance force in academia and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basics of vector analysis and its application in the theory of continuum.
PEK_W02 - Knows the most important group of mechanics equations that describe a continuum: geometric relationships, constitutive equations and equilibrium equations.
PEK_W03 - Know how they are formulated and solved the task classic solid mechanics.

II. Relating to skills:
PEK_U01 - Can use the equation of vector analysis to issues of strength of materials.
PEK_U02 - Is able to calculate the stress and displacement in a pipe, plate, shield, sheath.
PEK_U03 - Energy methods can be used in the calculation of basic movements of solid models.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis.
PEK_K02 - Objectively examine the arguments, rational translations and justify their point of view on the knowledge of mechanics.
PEK_K03 - Compliance with customs and rules in academia.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Strongly curved rods.	2
Lec2	Strain energy. The system Clapeyron.	2
Lec3	The principle of Castigliano.	2
Lec4	Principle Menabre'a. Scheme of solving the hiperstatic system.	2
Lec5	The issue of Lame.	2
Lec6	Large pipes.	2
Lec7	Wheel discs loaded with circularly symmetric.	2
Lec8	Rectangular plates.	2
Lec9	Rotating discs.	2
Lec10	Coatings axially symmetric.	2
Lec11	Load time dependent element.	2
Lec12	Basic calculations of fatigue.	2
Lec13	Shock loading bar elements.	2
Lec14	Elementary calculations creep strength and relaxation.	2
Lec15	Basic use of the finite element method.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction.	2
Lab2	Tensile test in metals and plastics.	2
Lab3	Strain gauge analysis.	2

Lab4	Fatigue strength analysis.	2
Lab5	Combined loading in members (torsion + bending).	2
Lab6	Bucking of slender columns. Compression test.	2
Lab7	Straight and skew bending. Summary and pass of the laboratory.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_K01 - PEK_K03	Written and oral exam.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Short test, report from the laboratory.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Z. Dyląg, A. Jakubowicz, A. Orłoś: Wytrzymałość materiałów. WNT Warszawa 1996.
[2] M. E .Niezgodziński ,T. Niezgodziński: Wytrzymałość materiałów .PWN. W-a 1998.
[3] M. Zakrzewski, J Zawadzki : Wytrzymałość materiałów .PWN .Warszawa 1983.
[4] Laboratorium wytrzymałości materiałów, Praca pod red. Z. Rechula i J. Ziaji, Oficyna Wydawnicza PWr., Wrocław, 2001.

SECONDARY LITERATURE
[1] T. Rajfert, J. Rżysko: Zbiór zadań ze statyki i wytrzymałości materiałów. PWN,W-a,1974.
[2] Brzoska Z.: Wytrzymałość materiałów, PWN, Warszawa, 1979
[3] Niezgodziński M.E. Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe, WNT, Warszawa, 2009
[4] N.N. Malinin, J. Rżysko: Mechanika materiałów, PWN, Warszawa, 1981.
[5] Kocańda S., Szala J.: Podstawy obliczeń zmęczeniowych, PWN, Warszawa, 1985

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of materials II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 PEK_W02 PEK_W03	K1AIR_W02	C1	Lec1-Lec15	N1-N5
PEK_U01 PEK_U02 PEK_U03	K1AIR_U12	C2	La1-La7	N2-N5
PEK_K01 PEK_K02 PEK_K03	K1AIR_K01, K1AIR_K04, K1AIR_K07	C3	Lec1-Lec15 La1-La7	N1-N5

SUBJECT SUPERVISOR

dr inż. Waldemar Morzuch tel.: 320-33-93 email: waldemar.morzuch@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji maszyn I**
Name in English: **Fundamentals of Machine Design I**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031023**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45			15	
Number of hours of total student workload (CNPS)	90			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	3			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge:
- student has knowledge on the mechanics, strength of materials and materials technology;
- student knows the rules of technical drawing.
2. Skills:
- student can use the knowledge on mechanics, strength of materials and materials technology in practice, draw models of technical objects as well as make calculations of the models.
3. Competences:
- the student understands and is aware of what the technological activity is and how it influences the environment.

SUBJECT OBJECTIVES

C1. To familiarize students with the design and operation principle of basic machine components, units and systems.
C2. To familiarize students with the machine design methodology.
C3. To prepare students for independent work on designing machine units and systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the classes, the student is supposed to be able to describe the design and explain the operation principle of the basic machine elements, units and systems.
PEK_W02 - As a result of the classes, the student is supposed to be able to describe the flow of energy, mass and information in the objects.

II. Relating to skills:
PEK_U01 - As a result of the course, the student should be able to prepare the technical drawings of basic mechanical components, units and systems.
PEK_U02 - As a result of the classes, the student is supposed to be able to make engineering calculations of machine elements, units and systems.

III. Relating to social competences:
PEK_K01 - Strengthening and developing the ability to recognize the social needs relating to technology and to define ways of satisfying the needs by means of technology.
PEK_K02 - Strengthening the ability to critically evaluate the design process results received in the designing by an example of a conducted design.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Design and construction process	3
Lec2	Welded joints and load-carrying structures	3
Lec3	Soldered, pressure welded, glue and riveted joints	3
Lec4	Screw joints and mechanisms	3
Lec5	Forced-in, spring and shape joints	3
Lec6	Axes	3
Lec7	Shafts	3
Lec8	Slide bearings	3
Lec9	Rolling bearings and sealings	3
Lec10	Couplings	3
Lec11	Breaks	3
Lec12	Synthesis I – machine shaft system	3
Lec13	Geometry, kinematics and strength calculations of gears	3
Lec14	Geometry, kinematics and strength calculations of gears	3
Lec15	Geometry, kinematics and strength calculations of gears	3
		Total hours: 45
Form of classes – Project		Number of hours
Proj1	Selection of the design parameters (geometrical quantities) for the built drive system	2
Proj2	Determination of the loads working on the built drive system	3

Proj3	Making the necessary engineering calculations of the elements of the built drive system	4
Proj4	Making the technical documentation of the built drive system made of the assembly drawing and the working drawings indicated by the teacher. The working drawings must be made by means of CAD software.	6
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. tutorials
N3. self study - self studies and preparation for examination
N4. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	Examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01, PEK_K02	Report, defence of the project
F2	PEK_U01, PEK_U02	Evaluation of the computational part of the project
F3	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	Final evaluation of the project on the basis of F1 and F2
P = F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Osiński i inni.: Podstawy konstrukcji maszyn, PWN, Warszawa 1999.
Kurmaz L., Kurmaz O.: Projektowanie węzłów i części maszyn. Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.

SECONDARY LITERATURE
Dietrich M i inni: Podstawy konstrukcji maszyn, WNT, Warszawa 1995.
Mazanek E i inni.: Przykłady obliczeń z podstaw konstrukcji maszyn, WNT, Warszawa 2005.
Stryczek J.: Koła zębate maszyn hydraulicznych. Wyd. Politechniki Wrocławskiej, Wrocław 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machine Design I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W02, K1AIR_W03, K1AIR_W04, K1AIR_W06	C1	Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec9, Lec10, Lec11	N1-N3
PEK_W02	K1AIR_W02, K1AIR_W03, K1AIR_W04, K1AIR_W06	C2	Lec1, Lec8, Lec12, Lec14	N1-N3
PEK_U01	K1AIR_U01, K1AIR_U03, K1AIR_U04	C2, C3	Lec14, Proj1-Proj3	N1-N3
PEK_U02	K1AIR_U01, K1AIR_U03, K1AIR_U04	C2, C3	Proj1-Proj3	N1-N3
PEK_K01	K1AIR_K02, K1AIR_K03	C3	Proj1-Proj3	N1-N3
PEK_K01	K1AIR_K02, K1AIR_K03	C3	Proj1-Proj3	N1-N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jarosław Stryczek tel.: 71 320-20-70 email: Jaroslaw.Stryczek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria maszyn i mechanizmów**
Name in English: **Theory of Machines and Mechanisms**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031024**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	3			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of fundamental rules in statics, kinematics and dynamics
3. Skill in fuction analysis, derivatives, basic matrix and vector operations

SUBJECT OBJECTIVES

C1. Acquire knowledge in topology, kinematics and dynamics of basic mechanisms including manipulators
C2. Acquire methods of kinematic and dynamic analysis of multibody systems
C3. Getting skills in determining kinematic and dynamic quantities

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Understands theoretical fundamentals of mechanism of machines and robot topology
PEK_W02 - Has the knowledge of multibody systems kinematic and dynamic analysis methods
PEK_W03 - Is able to commentate results of analysis, evaluate their correctness

II. Relating to skills:
PEK_U01 - Is able to evaluate topological carrectness of kinematic systems (redundant costraints)
PEK_U02 - Is able to determine kinematic and quantities
PEK_U03 - Is able to create models of mechanisms and manipulators

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms: links, joints, mobility, mechanism and machine. Redundant costraints	3
Lec2	Tasks of kinematics, methods. Position analysis, instant centers of rotation. Structural calssifiation of mechanisms	2
Lec3	Vector kinematic equations for planar systems	3
Lec4	Analytical methods of kinematics: vector loop equations - projections, velocity and acceleration equations	2
Lec5	Introduction to dynamics - forward and inverse dynamics. Inertia forces, point mass method. Joint forces	2
Lec6	Staticaly determined groups. Virtual works method.	2
Lec7	Friction in joints	3
Lec8	Planetary gear trains - characteristics, velocity ratio	2
Lec9	Serial and parallel planar manipulators. Numerical solution of parallel manipulator kinematics	2
Lec10	Matrix notation of planar serial manipulators	2
Lec11	Spatial serial manipulators - topology, properties. Matrices for 3D systems	2
Lec12	Denavit-Hartenberg notation. Kinematic equations	3
Lec13	Analitycal force analysis - mechanisms and manipulators	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction, presentation of Adams system - examples of analysis	2
Proj2	Rules of drawing digrams of mechanisms, topology analysis, mobility (test, project)	2
Proj3	Introduction to modelling mechanisms in Adams	2
Proj4	Rules of creating models of mechanisms in Adams, part 1	2
Proj5	Rules of creating models of mechanisms in Adams, part 2 (test)	2

Proj6	Mechanism position determination, instant centers of rotation (test, project)	2
Proj7	Kinematic analysis of linkages - velocity and acceleration determination using vector methods (test, project)	2
Proj8	Kinematic analysis of linkages - analytical methods (project)	2
Proj9	Inertia forces, kinetostatic analysis (test, project)	2
Proj10	Kinematics and kinetostatics in Adams (project)	2
Proj11	Planar manipulators - matrix method in kinematics (project)	2
Proj12	Modelling of manipulators using Adams - forward and inverse tasks, driving forces (project)	2
Proj13	Modelling of manipulators cont.	2
Proj14	Planetary transmission analysis - velocity ratio (project)	2
Proj15	Planetary transmission analysis cont.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. self study - preparation for project class
N3. individual project solution
N4. tutorials
N5. preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03PEK_U01, PEK_U02, PEK_U03	written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project defence
F2	PEK_U01, PEK_U02, PEK_U03	test

P = średnia wszystkich ocen

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002; Miller S.: Theory of machines and mechanisms. Analysis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1996; Miller S.: Kinematic systems. Basics of design (in Polish). WNT Warszawa 1988; Gronowicz A. et al: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE

Frączek J., Wojtyra M.: Kinematics of multibody systems (in Polish). WNT Warszawa 2008Olędzki A.: Fundamentals of theory of machines and mechanisms (in Polish). WNT 1987Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory of Machines and Mechanisms
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1AIR_W06	C1 - C3	Lec1 - Lec15	N1 - N5
PEK_U01 - PEK_U03	K1AIR_U07	C2, C3	Pr1 - Pr15	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Antoni Gronowicz tel.: 71 320-27-10 email: antoni.gronowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy i algorytmy przetwarzania sygnałów**
Name in English: **The basics of signal processing algorithms**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031025**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting					
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a knowledge of the basics of calculus, complex functions, ordinary differential equations, Laplace and "Z" transforms, the theory of probability, high-level programming language, knows the simple analog electronic circuits (current and voltage dividers, filters and amplifiers).
2. Students can integrate complex functions, solve differential equations by operators , has abilities in in "C programming".

SUBJECT OBJECTIVES

C1. Gettnig the ability to analyze signals in time and frequency domain and frequency.
C2. Acquisition of basic knowledge of algorithms and signal processing effects of one and two-dimensional signals (sampling, quantization, Fourier series, FFT, digital filtering, aliasing, image processing algorithms).
C3. Acquiring skills to design digital filters, FIR and IIR and their application in practice, learning methods for encoding and compression of data (images and 1D signals).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has knowledge of the parameters of continuous and discrete signals (power, energy, mean and efficient, medium, amplification, attenuation).

PEK_W02 - knowledge of the basic signal processing algorithms (sampling, quantization, encoding, reproduction analog signal from a digital signal, Fourier series, FFT, convolution, DCT).

PEK_W03 - Knowledge of the principles of digital filtering and FIR and IIR filter design.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Prerequisites. Literature. The content of the lecture. The main terms of the signals processing. Deterministic and random signals. Kinds of signals (analog, digital, binary, with finite and infinite energy and power, finite and the infinite duration, finite and infinite amplitude).	2
Lec2	Definitions and calculation of power, energy, average and RMS value of chosen analog signals.	2
Lec3	Fourier series. The definition of the trigonometric and the complex Fourier series. Notation a periodic signal of infinite duration and finite amplitude as a superposition of sinusoidal components. Calculation of the complex and trigonometric Fourier coefficients. The concept of discrete spectral signal. Amplitude and phase spectra of periodic signals.	2
Lec4	Continuous Fourier transform. The properties of the continuous Fourier transform. The concept of a continuous spectrum, power spectral density and the phase of the analog signal. Examples for the calculation of power spectral density for selected non-periodic signals. Inverse Fourier transform.	2
Lec5	Transfer function linear systems. The concept of the impulse response and the stability of the system.	2
Lec6	Digital signals. Notation discrete signals. Basic concepts of digital signal processing - the frequency and the sampling rate.	2
Lec7	Analog to Digital processing. The concept of sampling, quantization and coding.	2
Lec8	Ambiguity discrete signals in the time domain and frequency domain. Aliasing phenomenon. Kotielnikov-Shannon-Nyquist theorem.	2
Lec9	Algorithms of discrete (DFT) and fast (FFT) Fourier transform.	2
Lec10	Reconstruction the analog signal from the digital signal.	2
Lec11	Finite (FIR) and infinite (IIR) impulse response digital filters.	2
Lec12	Methods and algorithms for encoding and compression of digital signals.	2
Lec13	The basics of image processing , part 1	2
Lec14	The basics of image processing , part 2	2
Lec15	Test grade	2

	Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	test grade
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Smith S.W - Cyfrowe przetwarzanie sygnałów - praktyczny poradnik dla inżynierów i naukowców. BTC Warszawa 2007

SECONDARY LITERATURE
Lyons, R.G. -Wprowadzenie do cyfrowego przetwarzania sygnałów. WNT Warszawa 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The basics of signal processing algorithms
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1AIR_W10	C1-C3	Lect1 - Lect14	N1,N2

SUBJECT SUPERVISOR

dr inż. Marcin Korzeniowski tel.: 42-55 email: marcin.korzeniowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji maszyn II**
Name in English: **Fundamentals of Machine Design II**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031029**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15	30	
Number of hours of total student workload (CNPS)	30		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	1		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge:
- student has knowledge on the design and operation principle of the fundamental machine elements, units and systems;
- student has knowledge on the methodology of machine design.
2. Skills:
- student can graphically present the fundamental machine elements, units and systems;
- student can make the basic calculations of machine elements, units and systems.
3. Competences:
- student is able to identify the social needs relating to technology and to define ways of satisfying the needs by means of technology;
- student has a skill of evaluating the results of the design process.

SUBJECT OBJECTIVES

C1. Use of the knowledge, skills and competences relating to the fundamentals of machine design acquired at the lectures for the development of the conceptual design of a complex drive system.
C2. Application of the machine design methodology learned at the lectures for the preparation of the abovementioned conceptual design.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the classes, the student is supposed to be able to formulate ways and methods of designing and building machine elements, units and systems.
PEK_W02 - As a result of the classes, the student is su pposed to be able to explain the machine design methodology.

II. Relating to skills:
PEK_U01 - As a result of the classes, the student is supposed to be able to make engineering calculations of machine elements, units and systems using typical software.
PEK_U02 - As a result of the classes, the student is supposed to be able to make technical documentation concerning carrying out of an engineering task in a form of manual drafts or those created by means of typical software.

III. Relating to social competences:
PEK_K01 - The classes provide an opportunity to strengthen and develop the ability to recognize the social needs relating to technology and to define ways of satisfying the needs by means of technology.
PEK_K02 - The classes privide an opportunity to strengthen the ability to critically evaluate the design process results received in the designing by an example of a conducted design.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Spur cylindrical gears	1
Lec2	Helical cylindrical gears	1
Lec3	Bevel gears	1
Lec4	Worm gears	1
Lec5	Planetary gears	1
Lec6	Harmonic gears	1
Lec7	Cycloidal gears	1
Lec8	V-belt gears	1
Lec9	Toothed belt gears	1
Lec10	Synthesis II – simple drive systems	1
Lec11	Synthesis III – complex drive systems	2
Lec12	Example of the how to conduct a design and construction process	2

Lec13	Reserve	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Health and safety training. Identifying the standardized machine elements.	2
Lab2	Defining the static rigidity, the received and dispersed energy of the elements.	2
Lab3	Defining the friction characteristics of the radial slide bearing.	2
Lab4	Defining the resistance of the cone rolling bearing motion.	2
Lab5	Defining the shaft's transverse vibrations.	2
Lab6	Examination of the interference fit.	2
Lab7	Examination of the belt transmission.	2
Lab8	Assessment.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Development of the design assumptions for the built drive system.	3
Proj2	Development of the conceptual diagrams (at least 3) of the built drive system – handwritten drafts.	3
Proj3	Selection of the criteria and evaluation. Selection of the final solution for further development.	3
Proj4	Making the necessary engineering calculations of the elements and systems of the built drive system with the use of original dedicated software.	10
Proj5	Making the technical documentation of the built drive system made of the assembly drawing and the working drawing.	10
Proj6	Summary and conclusions.	1
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. tutorials
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	Examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Quiz
F2	PEK_U01	Final note based on the individual notes F1
P = F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01	Partial evaluation of the project
F2	PEK_K02	Final evaluation of the project
P = F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Osiński i inni.: Podstawy konstrukcji maszyn, PWN, Warszawa 1999.
Kurmaz L., Kurmaz O.: Projektowanie węzłów i części maszyn. Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.

SECONDARY LITERATURE

Dietrich M i inni: Podstawy konstrukcji maszyn, WNT, Warszawa 1995.
Mazanek E i inni.: Przykłady obliczeń z podstaw konstrukcji maszyn, WNT, Warszawa 2005.
Stryczek J.: Koła zębate maszyn hydraulicznych. Wyd. Politechniki Wrocławskiej, Wrocław 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machine Design II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W06	C1, C2	Lec1-Lec13 Lab1-Lab8 Proj1-Proj6	N1-N3
PEK_W02	K1AIR_W06	C1, C2	Lec1-Lec13 Lab1-Lab8 Proj1-Proj6	N1-N3
PEK_U01	K1AIR_U01, K1AIR_U02, K1AIR_U13	C1, C2	Lec1-Lec13 Lab1-Lab8 Proj1-Proj6	N1-N3
PEK_U02	K1AIR_U01, K1AIR_U02, K1AIR_U13	C1, C2	Lec1-Lec13 Lab1-Lab8 Proj1-Proj6	N1-N3
PEK_K01	K1AIR_K02, K1AIR_K03	C1, C2	Lec1-Lec13 Lab1-Lab8 Proj1-Proj6	N1-N3
PEK_K02	K1AIR_K02, K1AIR_K03	C1, C2	Lec1-Lec13 Lab1-Lab8 Proj1-Proj6	N1-N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jarosław Stryczek tel.: 71 320-20-70 email: Jaroslaw.Stryczek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia w produkcji przemysłowej**
Name in English: **Ecology in industrial manufacturing**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has systematized secondary school knowledge of biology, chemistry and physics; knows the principles of engineering drawing; can interpret the basic relationship between human activity and the behaviour of living organisms and the whole environment; understands the necessity of developing industry and implementing novel solution in the construction, operation and modernization of machines in accordance with the principles of sustainable development and the protection of natural resources and the environment.

SUBJECT OBJECTIVES

C1. The student is to learn about the structure and functioning of living nature, the effect of ecotoxins, and the greenhouse effect; to acquaint herself/himself with the hazards arising from the escalation of human industrial activity and with the legal regulations concerning environmental protection; to understand the environmental management systems, the ISO 14000 standard.
C2. The student is to acquaint herself/himself with the hazards involved in and the ways of acquiring energy from conventional and renewable sources and the principles of waste management – waste minimization and recycling, the LCA method.
C3. The student is to acquaint herself/himself with the principles of constructing, operating and modernizing machines, conducive to the protection of natural resources and the environment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows and understands the hazards arising from the greenhouse effect, the development of technology, energy acquisition and waste production and recycling.

PEK_W02 - The student understands the necessity of introducing environmental regulations; knows the environmental management systems; has knowledge relating to the implementation of ISO 14000.

PEK_W03 - The student knows and understands the hazards arising from the escalation of human activity; knows the principles and advantages of implementing the environment-friendly rules of constructing and operating machines.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, literature, what everyone can do to protect the environment; the sources of hazards arising from industrial activity and from the operation of machines, ecotoxins, the greenhouse effect, energy acquisition.	2
Lec2	The international conventions and the Polish laws relating to environmental protection; environmental management; environmental management systems, the current standards: BS, EMAS, ISO 14000	2
Lec3	The environmental consequences of acquiring energy from conventional sources, hazards.	2
Lec4	Environment-friendly methods of acquiring energy from renewable sources.	2
Lec5	Waste minimization, recycling, the rational and eco-friendly way of managing wastes, examples of recycling in selected branches of industry, recycling in the automotive industry.	2
Lec6	Environment-friendly materials in machine operation – oils, lubricants, greases; biodegradability, toxicity, carcinogenicity and mutagenicity of consumable materials; polychlorinated biphenyls.	2
Lec7	New environment-friendly techniques in machine operation, sparing lubrication techniques, lubrication management in industry; seals and their effectiveness; the energy aspects of machine operation; the environmental aspects of the construction, use and modernization of machines.	2
Lec8	Final test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 ÷ PEK_W03	Written final test, oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Konspekty przekazane przez prowadzącego,
2. Lewandowski W: Proekologiczne odnawialne źródła energii, WNT W-wa 2010,
3. Mackenzie A., i inni: Ekologia, PWN W-wa 2009,
4. Nierzwicki W: Zarządzanie środowiskowe, Polskie Wyd. Ekonomiczne, W-wa 2006,
5. Rosik-Dulewska Cz: Podstawy gospodarki odpadami, PWN2007

SECONDARY LITERATURE

Czasopisma: "Czysta Energia", „Utrzymanie ruchu", „Recykling", „Nasze Środowisko" , "Ekotechnika"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology in industrial manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1AIR_W21	C1	Wy1 ÷ Wy7	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Zbigniew Wasiak tel.: 27-81 email: zbigniew.wasiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie procesów technologicznych**
Name in English: **Design of Manufacturing Processes**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031032**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students should have knowledge of technical drawing, marking dimensions and tolerances of form and position tolerances, surface roughness and computer graphics.
2. Students should have knowledge of machining and cutting tools.
3. Able to interact and work in a team and have the ability to solve simple problems.

SUBJECT OBJECTIVES

C1. Gaining knowledge of design processes typical of machine parts and standardization of working time
C2. Gaining knowledge of the accuracy and referencing instrumentation in the machining operations
C3. Mastering the skills in the preparation of technical documentation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define the basic concepts of design processes
PEK_W02 - The student knows the rules of excess material selection, machining bases and have knowledge about the standardization of working time
PEK_W03 - Student can identify and characterize the treatments of class: shaft, gear and body.

II. Relating to skills:
PEK_U01 - Can analyze manufacturability design, taking into account specific manufacturing
PEK_U02 - It can develop a treatment plan, taking into account the order of operations, choice of lathes, machining parameters, tools and holders
PEK_U03 - Has the ability to prepare technical documentation

III. Relating to social competences:
PEK_K01 - Students should be aware of their responsibility for their own work, and the whole team.
PEK_K02 - Students should understand the need for continuous learning and deepen their knowledge and skills with the changing technical and social considerations.
PEK_K03 - Students should objectively evaluate arguments rationally explain and justify their point of view.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic terms of technology, design and technological documentation, production program	2
Lec2	Technological preparation of production, manufacturability design, types of semi-finished products, preparation semi-finished products for machining	2
Lec3	Types of excess material, the factors affecting the size of the excess material, machining base, base selection rules	2
Lec4	Instrumentation machining operation, setting the cutting conditions, normalization process, the structure of the standard working time for the task	2
Lec5	The treatments of class body treatments flat elements	2
Lec6	The treatments of class shaft machining processes of class gear	2
Lec7	The costs of the product. Ingredient cost. Calculating the cost of producing	2
Lec8	Colloquium qualifying	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Manufacturability analysis of the structure for a particular type of production	4
Proj2	A drawing of taking into account the current method of marking	4
Proj3	A drawing semi-finished products on the basis of selected with polish standards and other norms of final machining	4
Proj4	Develop an initial treatment plan (the sequence of operations, choice of lathes, tools and fixtures)	4
Proj5	For some operations to determine processing parameters and time standards	6

Proj6	The final development plan	8
		Total hours: 30

TEACHING TOOLS USED
N1. tutorials N2. self study - preparation for project class N3. project presentation N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03;PEK_K01; PEK_K02; PEK_K03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01;PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	evaluation of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Autor: Feld M., tytuł: Projektowanie procesów technologicznych typowych części maszyn, wydawnictwo: WNT, Warszawa, rok: 20092. Autor: Choroszy B., tytuł: Technologia maszyn, wydawnictwo: Oficyna Wydawnicza Politechniki Wrocławskiej, rok: 2000

SECONDARY LITERATURE
1. Autor: Cichosz P., tytuł: Narzedzia skrawajace, wydawnictwo: WNT, Warszawa, rok: 20062. Praca zbiorowa, tytuł: Poradnik mechnika - obróbka skrawaniem, wydawnictwo: WNT, Warszawa, rok: 1995

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of Manufacturing Processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K1AIR_W07	C1; C2	Lec1 to Lec8	N1; N4
PEK_U01; PEK_U02; PEK_U03	K1AIR_U02, K1AIR_U03	C1; C3	Pr1 to Pr6	N1; N2; N3
PEK_K01; PEK_K02; PEK_K03	K1AIR_K03, K1AIR_K04	C1; C2; C3	Lec1 to Lec8 Pr1 to Pr6	N1; N2; N3; N4

SUBJECT SUPERVISOR

dr inż. Maciej Kowalski tel.: 41-81 email: maciej.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy czasu rzeczywistego i sieci komputerowe**
Name in English: **Real-time systems and computer networks**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031035**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses	X				
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about construction of computers, components and their purpose.
2. Basic knowledge about programming e.g. C/C++, HTML, PHP.
3. The ability to use popular software packages such as Office and SQL databases.

SUBJECT OBJECTIVES

C1. Familiarizing of the students with the basics of the design and operation of computer networks, as communities interconnected computer systems, contributing to the exchange of information.
C2. Acquiring skills to design computer networks, their configuration and administration basics.
C3. Learn how to search for information and critical analysis of them.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the nomenclature for the construction and operation of computer networks.
PEK_W02 - The student knows the principles of communication protocols in liner,network and transport layer and basic functions of higher layer protocols.
PEK_W03 - The student knows the principles of cooperation in network systems and basic operation of network services (DNS, mail, http). Network services - mail, web, file transfer, transmission of multimedia data.

II. Relating to skills:
PEK_U01 - The student can select the components of the network, taking into account the specifications of the solution.
PEK_U02 - The student can use modern tools for design and management of computer networks and real-time systems.
PEK_U03 - The student can design networks with services such as mail, web, file transfer, transmission of multimedia data.

III. Relating to social competences:
PEK_K01 - Deepening teamwork skills.
PEK_K02 - Increasing the efficiency of the design process (development time).
PEK_K03 - Arranging for the knowledge from the current level of knowledge and skills.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Computer Networks - Network equipment	2
Lec2	Network Software	2
Lec3	Examples of the networks (Ethernet, wireless networks, ATM networks)	2
Lec4	Basics of data transmission in computer networks	2
Lec5	Applications in computer networks (domain, DNS, Web, Internet Mail)	2
Lec6	Embedded systems, bases of the QNX6 Neutrino system	2
Lec7	Processes and Threads in the Real-Time system	2
Lec8	Process management	2
Lec9	Thread management	2
Lec10	Communication between processes	2
Lec11	Messages in the QNX6	2
Lec12	Interrupts in a real-time system	2
Lec13	Parallel transmission maintenance	2
Lec14	Summary	2
Lec15	Graduation	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Entering students with design issues and discussion	3

Proj2	Description of the network devices	4
Proj3	Presentation of the project assumptions by the students	4
Proj4	Projects presentation	4
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. project presentation
N3. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	pek_w01, pek_w02, pek_w03	graduation
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	pek_u01,pek_u02, pek_u03	verbal statements, participation in discussions of problem, the defense of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Tanenbaum A. S., tytuł: Sieci komputerowe, wydawnictwo: Helion, rok: 2004
Ułasiewicz J., tytuł: Systemy czasu rzeczywistego QNX6 Neutrino, wydawnictwo:BTC, rok: 2007

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Real-time systems and computer networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
pek_w01 - pek_w03	K1AIR_W12	c1 - c3	w1 - w15	n3
pek_u01 - pek_u03, pek_k01 - pek_k03	K1AIR_K03, K1AIR_U01, K1AIR_U08, K1AIR_U14	c1 - c3	pr1 - pr4	n1, n2

SUBJECT SUPERVISOR

dr inż. Paweł Kustroń email: pawel.kustron@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Historia wojen a postęp technologii**
Name in English: **War History and Progress in Engineering**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031040**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of history of Poland, Europe and the world in a basic range of high school
2. Ability to use literature and preparation of notes
3. Ability to create opinions and synthesis of given information

SUBJECT OBJECTIVES

C1. Familiarization with history of war and its influence on the technological progress in all branches and particularly in technology of machines and metals
C2. Familiarization with relationships between technical activities and the arms race. Internalization of stimulating influence of the arms race on the technological progress. Uderstanding of the resposibility of engineer for the use of results of his work for military applications. Familiarization with links between technological progress, economical factors, demography and politics
C3. Getting of an ability to assess information concerning history, pinpointing links between technical and social matters. Understanding personal responsibility for activities in the social-political context

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - student is able to define the meaning of terms: war, war law, combattant. Is able to recognize common features of armed conflicts in the past. Explain the influence of war on the technological progress
PEK_W02 - student is able to describe the evolution of different kinds of land, naval and airborne armament. Can identify key technical inventions which changed ways of conducting of war and influenced heavily the technological and social progress
PEK_W03 - student is able to explain technical, economical and social effects of arms race in the entire history

II. Relating to skills:
PEK_U01 - student is able to get, analyze and assess information concerning technology and history
PEK_U02 - student can find and interprete links between technical activity and economical, technical and social processess. Can connect the technical and historical knowledge
PEK_U03 - student is able to assess the influence of technological progress on the development of the civilization and uderstand the role of development of military technologies in the technological progress

III. Relating to social competences:
PEK_K01 - student understands the non-technical aspects of technical activities in the context of military conflicts, is aware of responsibility for non-technical effects his own technical activities
PEK_K02 - student can see dilemas connected with military applications of technology and is able to explain the stimulating influence of military needs on the technological progress
PEK_K03 - student can find, organize and assess historical and technical information

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, literature, schedule of the lecture. Basic terms connected with the war. The earliest conflicts and wars	2
Lec2	The earliest weapons. First applications of metals, the eve of metallurgy. Methods of fighting and commanding in ancient times	2
Lec3	Types and evolution of cold arms. Wars conducted with exclusive use of it. Development and use of protective equipment	2
Lec4	Throwing machines and its influence on methods of fighting. Development of applied mechanics	2
Lec5	Invention of gun powder, the role of firearms in the history of wars. Evolution of artillery	2
Lec6	Wars conducted with mass use of artillery in the XVIII-XX century	2
Lec7	Small calibre firearms and its influence on wars	2
Lec8	War at sea. Evolution of construction and propulsion of combat ships	2
Lec9	Progress in naval weapons and its influence on the war at sea	2
Lec10	Vehicles and its role in wars of XIX-XX century	2
Lec11	War in the air. Baloons, airships and aircraft in military applications	2
Lec12	Rocket and missile weapons and its influence of the globalization of conflicts	2
Lec13	Fortifications and its role in wars sice ancient times	2
Lec14	Military aspects of space race	2

Lec15	An attempt of forecast. Test	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-03, PEK_U01-03, PEK_K01,03	test
P = P		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Mała Encyklopedia Wojskowa I-III MON Publ. Warsaw 1991 SECONDARY LITERATURE Encyklopedia Techniki Wojskowej MON Publ. Warsaw 1978

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **War History and Progress in Engineering** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1AIR_W14	C1, C2, C3	Lec1 - Lec14	N1
PEK_U01, PEK_U02, PEK_U03	K1AIR_U01	C1, C2, C3	Lec1 - Lec14	N1

PEK_K01, PEK_K02, PEK_K03	K1AIR_K02, K1AIR_K05, K1AIR_K08, K1AIR_K09, K1AIR_U01	C1, C2, C3	Lec2 - Lec14	N1

SUBJECT SUPERVISOR
dr inż. Tomasz Szulc tel.: 21-25 email: tomasz.szulc@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie parametryczne 3D**
Name in English: **3D Parametric Design**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in the use of CAD systems to creative and innovative design

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students should be know the rules of the modeling 3D of the machines parts and assemblies with using CAD systems
PEK_W02 - Students should be know the methods of analysis and testing the parameters of machines and equipment carried on 3D virtual models (virtual prototypes).
PEK_W03 - Students should be know the using of CAD systems for creative and innovative design.

II. Relating to skills:
PEK_U01 - Students should be able to build 3D models of machine parts
PEK_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEK_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:
PEK_K01 - Student gains the skills to take responsibility for their work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	Basic solid modeling - Advanced operations on 2D sketches - function relationships of parameters, solid modeling with rotation, solid editing - shell models	2
Proj5	Basic solid modeling - solid modeling with rotation, one and multibody modeling	2
Proj6	Advanced solid operations - sweep, loft, split, scroll	2
Proj7	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj8	The project of assembly: preparing to create an assembly- parts assembling, bonds and relationships in the assembly	2
Proj9	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj10	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj11	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision)	2
Proj12	The project of assembly: analysis of the assembly, rectify design faults	2
Proj13	The project of assembly: loads analysis, reactions and forces at the nodes, the presentation of the model	2

Proj14	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings, assembly drawings	2
Proj15	Completion of the course: work during classes	2
		Total hours: 30

TEACHING TOOLS USED

N1. project presentation
N2. problem discussion
N3. self study - preparation for project class
N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	test, participate in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
[2]Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE
[1]http://autodesk-inventor-pl.typepad.com/
[2]http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
3D Parametric Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02, PEK_W03, PEK_U01, PEK_U02	K1AIR_KE_U02	C1, C2, C3	Pr1-Pr13	N1 - N4
PEK_U03	K1AIR_U13	C3	Pr14	N3, N4
PEK_K01	K1AIR_K02	C3	Pr11, Pr12	N2

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika płynów**
Name in English: **Fluid Mechanics**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031103**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses	X				
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics, including algebra, analysis required to understand of the phenomena in the field of fluid mechanics.
2. Student has a basic knowledge of physics, mechanics and chemistry required to understand of the phenomena in the field of fluid mechanics.

SUBJECT OBJECTIVES

C1. The aim of the course is to learn the basic laws of mechanics in relation to the flow fluids and their use in the technique.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to explain basic laws and the phenomena of fluid mechanics.

II. Relating to skills:
PEK_U01 - Student is able to explain the principles of machines operation and the phenomena utilized in their construction.

III. Relating to social competences:
PEK_K01 - Student is aware of the possibility of analysis and synthesis of technical systems that use the law of fluid mechanics using a proper mathematical model, which helps to reduce costly experimental studies.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of liquids and gases, forces and stresses in fluids,basic concepts of field theory.	1
Lec2	Newtonian and non-Newtonian fluids, fluid motion analysis method, streamlines , potential and rotational flow.	1
Lec3	The basic equations of fluid mechanics, the continuity equation, the conservation of momentum equation for the ideal and real fluids (Euler equation and Navier-Stokes equations).	2
Lec4	Hydrostatic equations, communicating vessels, the pressure forces of the liquid on the walls, buoyancy.	1
Lec5	Euler equation integrals - Bernoulli's equation, examples of applications: measurements of velocity, the flow of liquid through the holes, Venturi effect	2
Lec6	Real fluids, laminar and turbulent flow, the Bernoulli's equation for real fluids.	2
Lec7	Examples of solutions of N-S equations , flows in the axially-symmetric pipes , major losses and their calculation, the effect of roughness. Flows through the narrow gaps.	2
Lec8	Flow in pipes, pipelines characteristics, the unsteady phenomena - water hammer.	1
Lec9	A one-dimensional gas flow in closed conduits, the gas flow out of tank.	2
Lec10	Numerical methods in fluid mechanics.	1
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	The solution of the basic fluid properties problems and Pascal's law.	2
Cl2	Calculation of pressure forces on the walls.	2
Cl3	Application of the Bernoulli's equation and the continuity equation for calculating ideal fluid flow.	2
Cl4	Application of the conservation of momentum equation and moment of momentum equation to calculate the hydrodynamic forces.	2

Cl5	Calculation of the pressure loss in closed in pipelines. Determination of pipeline characteristics.	2
Cl6	Calculation of the flow through the narrow gaps.	2
Cl7	Calculation of the simple cases of water hammer.	1
Cl8	Final Test.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_WO1	test
P = 0.5*F1+0.5*FC		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test
P = F1=FC		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Bukowski J., Kijkowski P.: Kurs mechaniki płynów. PWN Warszawa 1980.
Jeżowiecka-Kabsch K., Szewczyk H.: Mechanika płynów. Oficyna Wydawnicza PWr, Wrocław 2001.
Troskolański A.T.: Hydromechanika, WNT, Warszawa 1967.

SECONDARY LITERATURE

Prosnak W.J.: Mechanika płynów. Tom I. PWN, Warszawa 1970.
Burka S.E., Nałęcz T.J.: Mechanika płynów w przykładach. PWN, Warszawa 1994.
Zieliński A.: Wybrane zagadnienia z mechaniki płynów. Oficyna Wydawnicza PWr, Wrocław 2011.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fluid Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_KE_W01	C1	Lec1-Lec10	N1
PEK_U01	K1AIR_KE_U03	C1	Cl1-Cl8	N2
PEK_K01	K1AIR_K01, K1AIR_K03, K1AIR_K10	C1	Lec1-Lec10, Cl1-Cl8	N1, N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jan Kulczyk tel.: 71 320-25-70 email: Jan.Kulczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy impulsowe**
Name in English: **Discrete time systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basics of algebra, mathematical and formulating and solving simple design tasks related to control systems. Knowledge of basics of continuous control systems. Basic knowledge of MATLAB / Simulink software.
2. Practical skills of using MATLAB software. Is capable of implementing digital algorithms based on difference equations.
3. Is able to cooperate with a team during realization of a complex engineering task. Is able to think and act in a creative way

SUBJECT OBJECTIVES

C1. Acquaintance of knowledge related to: description of discrete signals and systems, appropriate sampling time selection, analysis of the discrete system stability, equivalent transfer function determination (block-diagram algebra), the role of the hold elements (extrapolators), types of digital filters, types and structures of control system.
C2. Practical skills to analyze and design of both finite and infinite impulse response filters.
C3. Practical skills to: PID digital controller tuning, design of series corrector to particular object.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Possesses knowledge related to solve linear difference equations and linear systems with discrete data (transfer function and frequency transfer function of discrete systems), analysis of the discrete system stability.

PEK_W02 - Has knowledge concerning types of digital filters, processing of analogue signals, Shannon sampling theorem.

PEK_W03 - Possesses knowledge related to types and structures of control system, components of control systems, structures of PID controller, effect of pole location on system response, state observer.

II. Relating to skills:

PEK_U01 - Is able to represent continuous control system (transfer function of continuous object) with use of discrete transfer function and discrete state space model and develop closed-loop and open-loop control systems.

PEK_U02 - Is able to select appropriate sampling time and model and perform analysis and synthesis of digital recursive filters (using bi-linear transformation method). Is able to model and perform analysis and synthesis of digital non-recursive filters (using the Fourier transformation).

PEK_U03 - Is able to tune digital PID controller using various methods.Is able to design dead-beat digital controller and robust digital controller of a given output transient performance indices. Is able to design state variable feedback controller and digital controller with a state observer.

III. Relating to social competences:

PEK_K01 - Is able to carry out a complex engineering project in a competent way, unaided as well as to cooperate with a team if required

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Discrete signal and Z transform.	3
Lec2	Discrete system representation in steady-state model.	1
Lec3	Block-diagram algebra.	2
Lec4	Extrapolators and steady state errors in discrete systems.	2
Lec5	Stability of discrete control systems.	4
Lec6	Shannon sampling theorem	2
Lec7	Digital filters	4
Lec8	Discrete modeling of continuous systems.	2
Lec9	Correction of discrete systems.	4
Lec10	Robust digital regulators.	2
Lec11	Design methods of state variable feedback controller and controller with a state observer.	4
		Total hours: 30

Form of classes – Laboratory	Number of hours

Lab1	Introduction. Setting rules of course crediting. Acquaintance with lab stands, safety rules and available software.	2
Lab2	Methods of describing the control systems - discrete control of continuous object, digital model of the continuous object.	2
Lab3	Closed-loop and open-loop control systems.	4
Lab4	Analog and digital signal processing: Shannon sampling theorem, A/D transducers.	2
Lab5	Design and analysis of recursive digital filters based on analog lowpass filters transformation.	4
Lab6	Design of nonrecursive digital filters using the inverse DFT.	4
Lab7	Tuning of the digital PID regulator.	4
Lab8	Design of dedicated and robust digital regulators.	4
Lab9	Design of state variable feedback controller. State variable feedback controller with a state observer.	4
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. informative lecture
N3. report preparation
N4. MATLAB/Simulink software.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Attendance on lectures
F2	PEK_W01, PEK_W02, PEK_W03	Pass test
P = 0,1*F1+0,9*F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Activity during the classes
F2	PEK_U01, PEK_U02, PEK_U03	Presentation of the reports done

P = 0,3*F1+0,7*F2

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Kaczorek T., Teoria sterowania i systemów, PWN, Warszawa 1999. [2] Kaczorek T.,Teoria układów regulacji automatycznej, WNT, Warszawa 1997. [3] Kaczorek T., Dzieliński A., Dąbrowski W., Łopatka R., Podstawy teorii sterowania, WNT, Warszawa 2009. [4] Takahashi Y., Rabins M., Auslander D., Sterowanie i systemy dynamiczne, WNT, Warszawa, 1976. [5] Rumatowski K., Podstawy regulacji automatycznej, Wydawnictwo Politechniki Poznańskiej, Poznań 2008. [6] Kaczorek T., Teoria układów regulacji automatycznej, Wydawnictwa Naukowo-Techniczne, Warszawa 1977.

SECONDARY LITERATURE
[1] Lyons R.G., Wprowadzenie do cyfrowego przetwarzania sygnałów, Wydawnictwa Komunikacji i Łączności, Warszawa 2010. [2] Mrozek B., Mrozek Z., MATLAB i Simulink. Poradnik użytkownika., Wydawnictwo Helion, 2004.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Discrete time systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W09	C1	Lec1, Lec2, Lec3, Lec4, Lec5	N1, N2
PEK_W02	K1AIR_W09	C1	Lec6, Lec7	N1, N2
PEK_W03	K1AIR_W09	C1	Lec8, Lec9, Lec10, Lec11	N1, N2
PEK_U01	K1AIR_U14, K1AIR_U16	C1	Lab1, Lab2, Lab3	N3, N4
PEK_U02	K1AIR_U14, K1AIR_U16	C2	Lab4, Lab5, Lab6	N3, N4
PEK_U03	K1AIR_U14, K1AIR_U16	C3	Lab7, Lab8, Lab9	N3, N4
PEK_K01	K1AIR_K03, K1AIR_K05	C2, C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9	N3, N4

SUBJECT SUPERVISOR

dr inż. Krzysztof Solak email: krzysztof.solak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **CAD/MES**
Name in English: **CAD/FEM**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031106**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength materials. Analysis of beam, plate and shell structures. Fundamentals of engineering materials.
2. Matrix algebra
3. kills for solving basic engineering elements with use of classical elastic theory.

SUBJECT OBJECTIVES

C1. Have knowledge in the fundamentals of finite element method
C2. Have the ability to build proper discrete model
C3. Skills to perform simulations of basic mechanical elements like beam, truss, frame.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Have knowledge in the fundamentals of finite element method
PEK_W02 - Know the principles of creating geometrical and discrete model form MES calculatiosn
PEK_W03 - Have the knowledge no the possible application of FEM.

II. Relating to skills:
PEK_U01 - Skills in software for the FEA
PEK_U02 - Skills for solving basic engineering elements with use of classical elastic theory.
PEK_U03 - Is able to perform FEA in the field of liner and nonlinear statics, dynamics, vibrations and linear buckling.

III. Relating to social competences:
PEK_K01 - Learn the responsibility for his work.
PEK_K02 - Creative thinking and acting
PEK_K03 - Learn team work due to the necessity of information flow during project realisation

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Learn the basics of the finite element method theory. Application examples	1
Lec2	Approximation functions, classifications of finite elements, convergence conditions	2
Lec3	3D finite elements (tetra)	2
Lec4	Rod and beam finite element. Presentation of the basic characteristics.	2
Lec5	Truss and frame structures. Introduction to the stiffness matrix.	2
Lec6	2D elements, plates, shells	2
Lec7	Mehtodics of discrete model creation	2
Lec8	Numerical analysis with use of MES	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of the software	2
Proj2	Discrete model creation principles. Assumptions and simplifications of the model	2
Proj3	Solid models discretization. Analysis of the parameters (type of the element, mesh density) and its influence on the results.	2
Proj4	Modeling of pin elements, welded and riveted connections in solid models	2
Proj5	Plain stress, accuracy analysis	2
Proj6	Pane and 3D truss in FEA	2
Proj7	Frame, undercarriage, cross section definition, optimization.	4
Proj8	Principles of shell models creation. I-beam, optimization.	4

Proj9	Modeling of thin walled cylindrical, spherical and conical elements with use of symmetry	2
Proj10	Box girders, optimization.	4
Proj11	Modal analysis, buckling of thin walled elements	2
Proj12	Individual modeling of shell construction. Stress analysis.	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. problem exercises
N3. multimedia presentation
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	exam
P =		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02, PEK_U03	simulation part assessment
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusiński E., Metoda elementów skończonych. System COSMOS/M, WKiŁ Warszawa 1994
Rusinski E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE

Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wyd. PWr Wrocław 2002
Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005
Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
CAD/FEM
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_KE_W03	C1		N3
PEK_W02	K1AIR_KE_W03	C2		N3
PEK_W03	K1AIR_KE_W03	C3		N3
PEK_U01	K1AIR_KE_U04	C1		N1, N2
PEK_U02	K1AIR_KE_U04	C2		N1, N2
PEK_U03	K1AIR_KE_U04	C3		N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Eugeniusz Rusiński tel.: 71 320-42-85 email: Eugeniusz.Rusinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.
PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2

Lec2	Measurement, measurement types, method and measurement principle.	2
Lec3	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec4	Dimensions, tolerance of linear dimensions nad fits.	3
Lec5	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	3
Lec6	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec7	Tolerance and machine parts measurement.	6
Lec8	Tolerating and measurements of machines parts manufactured in the process of: casting, plastic forming, welding, plastics processing.	2
Lec9	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec10	Mehods and means of mechanization and automation of measurements.	2
Lec11	Analysis of dimension. Basics of statistical control of dimensions.	2
Lec12	Basics of coordinate measurement techniques.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Measurements of linear dimensions.	2
Lab3	Measurements of angular dimensions, direct and indirect measurements of cones.	2
Lab4	Identification and measurement of threads.	2
Lab5	Assessment of the geometrical structure of the surface.	2
Lab6	Identification and measurement of cylindrical gears.	2
Lab7	Measurements of selected shape deviations and displacement.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03; PEK_K01; PEK_K02; PEK_K03;	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE

[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01; PEK_W02; PEK_W03;	K1AIR_W05	C1; C2; C3; C4; C5; C6	Wy1-Wy12	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1AIR_U09, K1AIR_U10, K1AIR_U11	C1; C2; C3; C4; C5; C6	La1 - La7	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1AIR_K05, K1AIR_K06	C1; C2; C3; C4; C5; C6	Wy1-Wy12; La1 - La7	N1; N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy mikrosterowników**
Name in English: **Basics of microcontrollers**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031108**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Information
2. The electronics

SUBJECT OBJECTIVES

C1. Understanding the basics of construction, operation and control principles and microcontrollers and their peripheral devices.
C2. Understanding the basic principles of programming microcontrollers.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basics of construction microcontrollers and peripherals.
PEK_W02 - The student knows the basics of programming microcontrollers.

II. Relating to skills:
PEK_U01 - Students can program a simple microcontroller-based systems.
PEK_U02 - Students can choose to operate the peripherals and microcontrollers

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group.
PEK_K02 - He can think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Atmega AVR microcontroller core	1
Lec2	I/O Ports	2
Lec3	microcontroller peripheral devices	2
Lec4	Memory addressing modes	2
Lec5	Tools hardware and software	2
Lec6	Programming using assembly part 1	2
Lec7	Programming using assembly part 2	2
Lec8	Sample programs	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Getting to the construction of the boot board	1
Lab2	Get to know the programming environment	2
Lab3	Running and debugging the sample programs	2
Lab4	Get to know the assembly instructions	2
Lab5	Programming I/O port	2
Lab6	Time management	2
Lab7	Interrupt support	2
Lab8	Support LED display	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	average of the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. J. Doliński, "Microcontrollers AVR in practice", Publisher BTC. Warsaw 2004

SECONDARY LITERATURE
1. R. Baranowski. "Microcontrollers AVR ATmega in practice", Publisher BTC. Warsaw 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of microcontrollers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02	K1AIR_W12	C1	Lec1-Lec8	N1
PEK_U01, PEK_U02	K1AIR_K03, K1AIR_U16	C2	Lab1-Lab6	N2
PEK_K01, PEK_K02	K1AIR_K03, K1AIR_K05	C1,C2	Lab1-Lab6, Lec1-Lec8	N1,N2

SUBJECT SUPERVISOR

dr inż. Daniel Nowak tel.: 44-42 email: daniel.nowak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania układów sterowania pojazdów przemysłowych**
Name in English: **Fundamentals of industrial vehicle control systems design**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031112**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses			X		
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of sensors and measuring systems confirmed by the completion of course: Sensors and measuring systems
2. Has basic knowledge of microcontrollers confirmed by the completion of course: Basics of microcontrollers
3. Has basic knowledge of automation confirmed by completion of course: Fundamentals of automatics

SUBJECT OBJECTIVES

C1. To gain basic knowledge of the structure and principles of operation of typical control systems used in industrial vehicles
C2. Gaining skills in designing and programming simple control systems for use in industrial vehicles
C3. The acquisition of teamwork skills in order to effectively solve complex multidisciplinary tasks taking into account the non-technical aspects

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has basic knowledge of the structure and mode of operation of the typical control systems used in industrial vehicles
PEK_W02 - has basic knowledge of the typical elements of control systems of industrial vehicles
PEK_W03 - has basic knowledge of programmable controllers, micro-controllers and operator panels used in control systems of industrial vehicles

II. Relating to skills:
PEK_U01 - is able to assemble a typical control system for industrial vehicle with components available on the market
PEK_U02 - is able to program selected types of controllers, microcontrollers and operator panels used in control systems of industrial vehicles
PEK_U03 - is able to program and test the built by himself simple control system

III. Relating to social competences:
PEK_K01 - understands the need and knows the possibilities of lifelong learning in the field of control systems industrial vehicles
PEK_K02 - is able to cooperate and work in a group to carry out interdisciplinary project implementation
PEK_K03 - is aware of and understands the non-technical aspects of mechanical engineering, such as health and safety, environmental impact

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introduction to the design of control systems working machines and vehicles	2
Lec2	Programmable controllers in control systems industrial vehicles and their programming	2
Lec3	Programmable microcontrollers in control systems industrial vehicles and their programming	2
Lec4	Operator panels for industrial vehicles and their programming	2
Lec5	Typical actuators and adjusting devices used in control systems of working machines and vehicles	2
Lec6	Data buses in vehicle control systems - the basics	2
Lec7	Standardized arrangements for addressing messages on the CAN bus of the vehicle. Creating and sending messages on the CAN bus and the acquisition and processing of such communications by using a sample programmable controller	2
Lec8	Operating parameters, load and kinematics of manipulators of industrial vehicles	2
Lec9	Fundamentals of design of control systems of industrial vehicles manipulators	2
Lec10	Hydrostatic and hydromechanical drives of industrial wheeled vehicles - construction, requirements	2
Lec11	Fundamentals of design of control systems for hydrostatic and hydromechanical drive systems of industrial vehicles	2

Lec12	Hydrostatic and hydromechanical drives of industrial tracked vehicles - construction, requirements	2
Lec13	Fundamentals of design of control systems for hydrostatic and hydromechanical drive systems of industrial tracked vehicles	2
Lec14	Fundamentals of design of industrial vehicle diagnostics systems	2
Lec15	Principles of documentation creation of control systems. Design of wiring of control systems. Testing of control systems	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Create and test a simple control systems based on Plus1 controllers	2
Lab2	Create and test a simple control systems based on microcontrollers	2
Lab3	Programming of exemplary operator panels	2
Lab4	Creation and testing of control systems containing industrial joysticks	2
Lab5	Creation and testing of control systems of hydraulic proportional valves	2
Lab6	Creation and testing of control systems acting with the different measuring transducers	2
Lab7	Creating and testing control systems consisting of several controllers working together	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. tutorials
N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03, PEK_K01	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K02÷PEK_K03	programs written for controllers, laboratory reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r.

SECONDARY LITERATURE

[1] Janiczek J., Stępień A.: Systemy mikroprocesorowe. Wydawnictwo Centrum Kształcenia Ustawicznego, Wrocław 1997r.[2] PLUS+1 GUIDE - User Manual. Sauer-Danfoss 2012r.[3] Dudczak A.: Koparki - teoria i projektowanie. Wydawnictwo Naukowe PWN, 2000r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of industrial vehicle control systems design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_KE_W06	C1	Lec8÷Lec15	N1, N4
PEK_W02	K1AIR_KE_W06	C1	Lec1÷Lec7	N1, N4
PEK_W03	K1AIR_KE_W06	C1	Lec2÷Lec4, 7	N1, N4
PEK_U01	K1AIR_KE_U03	C2	La1÷La7	N2, N3, N5
PEK_U02	K1AIR_U16	C2	La1÷La7	N2, N3, N5
PEK_U03	K1AIR_KE_U03	C2	La1÷La7	N2, N3, N5
PEK_K01	K1AIR_K01	C1	Lec1÷Lec7	N1, N4
PEK_K02	K1AIR_KE_K01	C3	La1÷La7	N2, N3, N5
PEK_K03	K1AIR_K02	C3	La1÷La7	N2, N3, N5

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Hydromechanika techniczna**
Name in English: **Hydromechanics**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM031202**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses	X				
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics, including algebra, analysis required to understand of the phenomena in the field of fluid mechanics.
2. Student has a basic knowledge of physics, mechanics and chemistry required to understand of the phenomena in the field of fluid mechanics.

SUBJECT OBJECTIVES

C1. The aim of the course is to learn the basic laws of mechanics in relation to the flow fluids and their use in the technique.
C2. Gaining ability to use basic laws of fluid mechanics in the construction and design of the machines and the machinery operation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define and explain basic laws and the phenomena of fluid mechanics.

II. Relating to skills:
PEK_U01 - Student is able to explain the principles of machines operation and the phenomena utilized in their construction.

III. Relating to social competences:
PEK_K01 - Student is aware of the possibility of analysis and synthesis of technical systems that use the law of fluid mechanics using a proper mathematical model, which helps to reduce costly experimental studies.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of liquids and gases, forces and stresses in fluids,basic concepts of field theory.	1
Lec2	Newtonian and non-Newtonian fluids, fluid motion analysis method, streamlines, potential and rotational flow.	1
Lec3	The basic equations of fluid mechanics, the continuity equation, the conservation of momentum equation for the ideal and real fluids (Euler equation and Navier-Stokes equations).	2
Lec4	Hydrostatic equations, communicating vessels, the pressure forces of the liquid on the walls, buoyancy.	1
Lec5	Bernoulli's equation, examples of applications: measurements of speed, the flow of liquid through the holes, Venturi effect.	2
Lec6	Real fluids, laminar and turbulent flow, the Bernoulli's equation for real fluids.	1
Lec7	Flow in axial-symmetric pipes, major losses, the principles of calculation of major looses, the effect of roughness, flows through the narrow gaps.	2
Lec8	Flow in pipes, pipelines characteristics, the unsteady phenomena - water hammer.	2
Lec9	A one-dimensional gas flow in closed conduits, the gas flow out of tank.	2
Lec10	Numerical methods in fluid mechanics.	1
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	The solution of the basic fluid properties problems and Pascal's law.	2
Cl2	Calculation of pressure forces on the walls.	2
Cl3	Application of the Bernoulli's equation and the continuity equation for calculating ideal fluid flow.	2
Cl4	Application of the conservation of momentum equation and moment of momentum equation to calculate the hydrodynamic forces.	2
Cl5	Calculation of the pressure loss in closed in pipelines. Determination of pipeline characteristics.	2

Cl6	Calculation of the flow through the narrow gaps.	2
Cl7	Calculation of the simple cases of water hammer.	1
Cl8	Final Test.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = 0.5*F1 +0.5*FC		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test
P = F1=FC		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Bukowski J., Kijkowski P.: Kurs mechaniki płynów. PWN Warszawa 1980.
Jeżowiecka-Kabsch K., Szewczyk H.: Mechanika płynów. Oficyna Wydawnicza PWr, Wrocław 2001.
Troskolański A.T.:Hydromechanika, WNT, Warszawa 1967.

SECONDARY LITERATURE
Prosnak W.J.: Mechanika płynów. Tom I. PWN, Warszawa 1970.
Burka S.E., Nałęcz T.J.: Mechanika płynów w przykładach. PWN, Warszawa 1994.
Zieliński A.: Wybrane zagadnienia z mechaniki płynów. Oficyna Wydawnicza PWr, Wrocław 2011.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydromechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_PT_W01	C1, C2	Lec1-Lec10	N1
PEK_U01	K1AIR_PT_U03	C1, C2	Cl1-Cl8	N2
PEK_K01	K1AIR_K01, K1AIR_K03, K1AIR_K10	C1, C2	Lec1-Lec10, Cl1-Cl8	N1, N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jan Kulczyk tel.: 71 320-25-70 email: Jan.Kulczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie 3D**
Name in English: **3D modeling**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031204**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in range of technical drawing based on 3D models

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students should be know the rules of the modeling 3D of the machines parts and assemblies with using CAD systems
PEK_W02 - Students should be know the methods of analysis and testing the parameters of machines and equipment carried on 3D virtual models (virtual prototypes).
PEK_W03 - Students should know the rules of execution 2D technical drawing based on 3D models

II. Relating to skills:
PEK_U01 - Students should be able to build 3D models of machine parts
PEK_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEK_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:
PEK_K01 - Student gains the skills to take responsibility for their work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - Advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	Basic solid modeling - Advanced operations on 2D sketches - function relationships of parameters, solid modeling with rotation, solid editing - shell models	2
Proj5	Basic solid modeling - solid modeling with rotation, one and multibody modeling	2
Proj6	Advanced solid operations - sweep, loft, split, scroll	2
Proj7	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj8	The project of assembly: preparing to create an assembly- parts assembling, bonds and relationships in the assembly	2
Proj9	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj10	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj11	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults, loads analysis	2
Proj12	The project of assembly: loads analysis, reactions and forces at the nodes, the presentation of the model	2

Proj13	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings	2
Proj14	The project of assembly: 2D technical drawings of assembly - assembly drawings	2
Proj15	Completion of the course: work during classes	2
		Total hours: 30

TEACHING TOOLS USED

N1. project presentation
N2. problem discussion
N3. self study - preparation for project class
N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	test, participate in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
[2]Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE
[1]http://autodesk-inventor-pl.typepad.com/
[2]http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
3D modeling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_U01, PEK_U02	K1AIR_PT_U03, K1AIR_PT_W04	C1, C2	Pr1 - Pr12	N1, N2, N3, N4
PEK_W03, PEK_U03	K1AIR_U13	C3	Pr13, Pr14	N3, N4
PEK_K01	K1AIR_K02	C2	Pr8, Pr11	N2

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie laserowe**
Name in English: **Laser Technology**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031205**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of optics and optical systems impact on the light beam
2. Basic knowledge of electromagnetic radiation's interaction with matter
3. Knowledge of the heat treatment's issues and its impact on the changes taking place in the material

SUBJECT OBJECTIVES

C1. Acquiring knowledge of the construction and the laser processing operation's
C2. Acquiring the ability to select the appropriate laser system to the task in
C3. Independent acquisition of information and its use to solve engineering problems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the construction of high-power lasers
PEK_W02 - He knows the laser beam forming systems and the interaction of radiation with matter
PEK_W03 - He is familiar with the scope of lasers in manufacturing

II. Relating to skills:
PEK_U01 - He can choose the right laser system for a given treatment process
PEK_U02 - Acting in an appropriate way with the specialized laser equipment
PEK_U03 - Depending on the desired process he is able to select the appropriate beam forming system

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basics of high-power lasers	2
Lec2	Measurements of the laser beam	2
Lec3	Laser beam forming systems and laser safety	2
Lec4	Impact of the laser beam with matter	2
Lec5	Cutting with laser beam	2
Lec6	Use of laser to welding	2
Lec7	Laserl cladding and micromachining	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Overview of laser radiation generators	2
Lab2	Monitoring of the laser beam	2
Lab3	Laser cutting	2
Lab4	Welding using the laser beam	2
Lab5	Laser cladding	2
Lab6	Use of laser scanning head for machining	2
Lab7	Engraving and laser micromachining	2
Lab8	Evaluation	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
N4. demonstration of laser processes
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	short exam
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Kusiński: ”Lasery i ich zastosowanie w inżynierii materiałowej”, Wydawnictwo Naukowe Akapit, 2000.
E. Kannatey-Asibu: “Principles of Laser Materials Processing”, Wiley, 2009.

SECONDARY LITERATURE
J.C. Ion: „Laser Processing of Engineering Materials”, Elsevier, 2005.
W.M. Steen:, “Laser Material Processing”, Springer-Verlag, 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1AIR_PT_W01, K1AIR_PT_W03, K1AIR_W07	C1	Lec1-Lec7	N1, N3, N5
PEK_U01, PEK_U02, PEK_U03	K1AIR_PT_U01, K1AIR_PT_U02	C2, C3	Lab1- Lab7	N2, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Baraniecki tel.: 26-62 email: tomasz.baraniecki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia w procesach wytwarzania**
Name in English: **Metrology in manufacturing techniques**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031207**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement of geometrical quantities
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining the ability to analyze the results of measurements, measurement errors and expressing measurement uncertainty
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to identify and define the quantity of the measuring machine parts. He knows and is able to determine the arrangements for ensuring the measurement integrity.
PEK_W02 - Can name the elements of the measurement system and define its functional characteristics. He knows the characteristic values measured in different types of machines.
PEK_W03 - He knows the principles governing the creation of tools, components and measuring systems.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use literature related to the assessment of the geometry of the product. Can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can create documents for the implementation of the measurements on the test bench.
PEK_U03 - Can use industrial measuring equipment management systems.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, measurement itegrity.	2
Lec2	Elements of measurenment systems and their properties.	2
Lec3	The method of determining the measurement uncertainty.	2
Lec4	Distribution of the variability of dimensions for typical processes.	3

Lec5	Toleration of machines in various technological processes.	3
Lec6	Designing of measuring devices's heads .	2
Lec7	Design and control tests for checking the geometry of the product.	2
Lec8	Integration of measuring stands.	2
Lec9	Mechanization and automation of measurement processes.	2
Lec10	Methods of measurement systems analysis.	2
Lec11	Methods and tools for monitoring measurement equipment.	2
Lec12	Elements of statistical control of manufacturing processes.	2
Lec13	Organization and documentation of the process control of machines.	2
Lec14	Analysis of tolerance and interchangeability of parts.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	1
Lab2	Checking selected metrological characteristics of measuring instruments.	2
Lab3	Selection of equipment for specific measurement tasks.	2
Lab4	Design and dimensional control of the tests.	2
Lab5	Pneumatic measurement methods.	2
Lab6	Analysis of the measurement system.	2
Lab7	Measurement in the integrated measurement environment.	2
Lab8	Analysis and implementation of the CMM measurement tasks.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03; PEK_K01; PEK_K02; PEK_K03;	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.

SECONDARY LITERATURE

[1] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[2] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012) [3]Humienny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004 [4] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009. [6] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[7] Zelczak A.:" Pneumatyczne pomiary długości". WKŁ, Warszawa 2006. [8] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology in manufacturing techniques
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1AIR_W05	C1; C2; C3; C4; C5; C6	Wy1-Wy14	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1AIR_U10, K1AIR_U11	C1; C2; C3; C4; C5; C6	La1 - La8	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1AIR_K03, K1AIR_K05, K1AIR_PT_K01	C1; C2; C3; C4; C5; C6	Wy1-Wy14; La1 - La8	N1; N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowniki PLC**
Name in English: **PROGRAMMABLE LOGIC CONTROLLERS**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031208**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the principles of operation of semiconductor electronic components.

SUBJECT OBJECTIVES

C1. Making familiar with the construction of a PLC.
C2. Making familiar with the operation of the PLC.
C3. Making Familiar with PLC programming languages.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has a basic knowledge of building a PLC.
PEK_W02 - Has a basic knowledge of the operation of the PLC.
PEK_W03 - Has a basic knowledge of PLC programming

II. Relating to skills:
PEK_U01 - Is able to use suitable PLC for selected application.
PEK_U02 - Is able to configure the control system PLC.
PEK_U03 - Is able to program the PLC.

III. Relating to social competences:
PEK_K01 - Can think and act creatively.
PEK_K02 - Can work on tasks independently and in groups.
PEK_K03 - Can broaden their knowledge by using additional aids.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Principles of assessment of the course. Introduction. History of the PLC. Market PLC. Basic definitions.	2
Lec2	Architecture of PLC	2
Lec3	The principle of operation of the PLC. Program Structure and organization of memory.	2
Lec4	PLC programming - LD language	2
Lec5	PLC programming - FBD language	2
Lec6	PLC programming - IL language	2
Lec7	PLC communication	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	ILC 130 - software tools, configuration	2
Lab3	ILC 130 - programming.	2
Lab4	Logo! - programming	2
Lab5	S7-1200 - software tools, configuration	2
Lab6	S7-1200 - programming	2
Lab7	Distributed control systems - Profibus	2
Lab8	Distributed control systems - Profinet	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	grade point average.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legierski T., Kasprzyk J., Wyrwał J., Hajda J.: Programowanie Sterowników PLC, Wyd. Prac. Komp. J. Skalmierskiego, Gliwice, 1998.Kwasniewski J.: Sterowniki PLC w praktyce inżynierskiej, Wyd. BTC, 2008.

SECONDARY LITERATURE

Simatic S7. Programowalny sterownik S7-1200. Podręcznik systemu. Siemens 2009.Logo!. Podręcznik. Siemens 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
PROGRAMMABLE LOGIC CONTROLLERS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W09	C1	Lec1, Lec2,	N1
PEK_W02	K1AIR_W09	C2	Lec3,	N1
PEK_W03	K1AIR_W09	C3	Lec4, Lec5, Lec6, Lec7,	N1
PEK_U01	K1AIR_U16	C1,C2	LA2,LA4, LA5,LA7	N2,N3,N4
PEK_U02	K1AIR_U16	C1,C2	LA2,LA4, LA5,LA7	N2,N3,N4
PEK_U03	K1AIR_U16	C3	LA3, LA4, LA6, LA7, LA8	N2,N3,N4
PEK_K01, PEK_K02, PEK_K03	K1AIR_K01, K1AIR_K03	C1,C2,C3	LA2,LA3, LA4,LA5, LA6,LA7,LA8	N3,N4

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Interfejsy HMI i systemy SCADA**
Name in English: **HMI INTERFACES AND SCADA SYSTEMS**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031211**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PROGRAMMABLE LOGIC CONTROLLERS

SUBJECT OBJECTIVES

C1. Explain the construction of HMI and SCADA systems
C2. Explain the operation and design of HMI and SCADA systems
C3. Explain the use of HMI and SCADA systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the construction of HMI and SCADA systems
PEK_W02 - Can explain the operation and design an HMI and SCADA system
PEK_W03 - He can propose the appropriate system for a specific application

II. Relating to skills:
PEK_U01 - Can design a system Scada
PEK_U02 - Can program the HMI or SCADA system
PEK_U03 - He can operate the HMI and SCADA systems

III. Relating to social competences:
PEK_K01 - Is able to work in a group.
PEK_K02 - Is able to realize the works according to the schedule

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The issue of electronic monitoring and control of industrial processes applications	2
Lec2	Construction and operation of SCADA package for example packages In Touch Wonderware Corporation and Siemens WinCC.	2
Lec3	Features and components of packages.	2
Lec4	Tools and methods for creating synoptic screens.	2
Lec5	Animation of graphical objects and the creation and use of libraries of objects	2
Lec6	Scripting language.	4
Lec7	Timing diagrams in real time and present the history of the process charts.	2
Lec8	Alarms: definition, presentation, service, validation, view, save and print ..	2
Lec9	Operator Panels - construction, operation, maintenance, programming	2
Lec10	Communication protocols, communication driver	2
Lec11	Industrial Databases	2
Lec12	Sample Applications for various industries	4
Lec13	Test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety. Configure the SCADA system	2
Lab2	Introduction to the programming environment and its basic functions.	2
Lab3	Tools and methods for creating synoptic screens.	2
Lab4	Animation of graphical objects and the creation and use of libraries of objects.	2
Lab5	Scripting language ..	2

Lab6	Timing diagrams in real time and present the history of the process on the charts	1
Lab7	Alarms, definition, presentation, service, validation, view, save and print.	2
Lab8	Communication protocols, communication drivers.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U01, PEK_U01,	Test, REPORT OF LABORATORY PRACTICE
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Programowanie systemów SCADA. WPK J. Skalmierskiego, Gliwice 2002

SECONDARY LITERATURE
Wonderware InTouch Podręcznik Użytkownika, Invensys Systems, Inc. 2005SIMATIC HMI WinCC flexible, Siemens, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
HMI INTERFACES AND SCADA SYSTEMS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W09	C1	Lec, Lec,	N1
PEK_W02	K1AIR_W09	C2	Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11,	N1
PEK_W03	K1AIR_W09	C3	Lec12	N1
PEK_U01	K1AIR_U14	C1	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_U02	K1AIR_U14	C2	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_U03	K1AIR_U14	C2	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_K01, PEK_K02	K1AIR_PT_K01	C1,C2,C3	Lec1-Lec12, LA1-LA8	N1,N2,N3

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przetwórstwo tworzyw sztucznych**
Name in English: **Processing of plastics**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031212**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The Student has got a basic knowledge in the field of materials science and chemistry.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of construction, preparation, modification and properties of polymeric materials.
C2. Acquisition of basic knowledge about the technology used for plastics processing.
C3. Acquisition of basic knowledge on the use of peripherals and tools for processing plastics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows the basic groups of polymers, their structure, properties.
PEK_W02 - Student knows the technology used for processing plastics.
PEK_W03 - Student knows peripherals and tools for processing plastics.

II. Relating to skills:
PEK_U01 - Able to identify polymeric materials
PEK_U02 - Can indicate the processing technology for producing a selected product from the plastic material,
PEK_U03 - Can place the selected devices to a specific processing technology.

III. Relating to social competences:
PEK_K01 - Searches of information and its critical analysis,
PEK_K02 - Team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group,
PEK_K03 - Team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group,

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basics, nomenclature. Classification, distribution and preparation of polymeric materials.	2
Lec2	Construction of polymers, polymeric transition state, rheology, the impact of environmental conditions on the behavior of polymeric materials.	2
Lec3	The basic group of polymeric materials and their specific properties.	2
Lec4	Methods for modifying polymer materials, preparation of polymer composites, the preparation of materials for processing.	2
Lec5	Technologies primary processing of polymeric materials.	4
Lec6	Technologies secondary processing of polymeric materials.	2
Lec7	Peripherals and automates the processing.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Polymeric materials and methods for their identification	2
Lab2	Technologies of plastics parts joining	2
Lab3	Primary processing technology - injection molding	2
Lab4	Primary processing technologies - extrusion	2
Lab5	Secondary processing technologies - vacuum thermoforming	2
Lab6	Thermosetting plastics processing technologies - casting and pressing	2
Lab7	Peripherals and tools for processing plastics	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	quiz
F2	PEK_U02	quiz, oral answer, report
F3	PEK_U03	quiz, oral answer
F4	PEK_K01, PEK_K02, PEK_K03	oral answer, report
P = F1+F2+F3+F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Robert Sikora, Przetwórstwo tworzyw wielkocząsteczkowych, Warszawa : "Żak", 1993; 2.Wojciech Kucharczyk, Wojciech Żurowski, Przetwórstwo tworzyw sztucznych dla mechaników, Radom : Politechnika Radomska. Wydawnictwo, cop. 2005; 3. Izabella Hyla, Tworzywa sztuczne : własności, przetwórstwo, zastosowanie, Gliwice : Wydawnictwo Politechniki Śląskiej, 2000.

SECONDARY LITERATURE

Piotr Jasiulek, Łączenie tworzyw sztucznych metodami spawania zgrzewania, klejenia i laminowania, Krosno, Wydaw. i Handel Książkami "KaBe", 2004;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Processing of plastics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01,	K1AIR_W07	C1	Lec1-Lec3,	N1, N2, N3
PEK_W02,	K1AIR_W07	C2	Lec4-Lec6,	N1-N4
PEK_W03,	K1AIR_W07	C3	Lec7	N1-N4
PEK_U01	K1AIR_U01	C1	Lab1	N3, N4
PEK_U02,PEK_U03 PEK_K01, PEK_K02, PEK_K03	K1AIR_K03, K1AIR_K05, K1AIR_U02	C3	Lab2-Lab6, Lab7	N3, N4

SUBJECT SUPERVISOR

dr inż. Roman Wróblewski tel.: 320-21-70 email: r.m.wroblewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Współrzędnościowa technika pomiarowa**
Name in English: **Coordinate measuring technique**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARM031221**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.
3. Student has basic knowledge in the linear and angular dimensions metrology

SUBJECT OBJECTIVES

C1. Achievement of knowledge about the essence of CMM
C2. Achievement of knowledge about types and properties of equipment used to measure in coordinate technology
C3. Achievement of basic ability to use equipment that uses technology coordinate.
C4. Gaining skills in analyzing the suitability of equipment to perform the tasks of measuring, analyzing test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. The ability to find relevant information and their critical analysis.
C6. Achievement and consolidation of social skills including emotional intelligence, involving the cooperation among students aiming to effectively solve technical problems. Responsibility, honesty and reliability in measurement procedure.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the essence of CMM distinguishes ordinate measuring equipment, know how to describe its features and metrological characteristics. He knows and is able to explain the concept of "Coordinate Metrology", "principle of measurement using CMM"
PEK_W02 - Able to characterize the concept of "error" and "uncertainty of measurement", explain the issue to eliminate potential sources of error associated with the measurements on the CMM.
PEK_W03 - He knows the specific measurement procedures used in the art of coordinate measurements for size measurements which are subject to various types of standard machine elements.

II. Relating to skills:
PEK_U01 - Can use measuring equipment which uses coordinate measuring technique. He can set the tolerance of geometric features on the basis of information contained in the technical documentation, depending on the acceptable size. He can interpret the markings of geometric features used in the measurements.
PEK_U02 - He can use a basic knowledge of the equipment using the technique to measure the quantity of coordinate geometry. He can make the selection of appropriate test equipment and set it up depending on the task measuring.
PEK_U03 - He can write a basic knowledge of the program on the machine coordinate for the calculation of basic geometric features.

III. Relating to social competences:
PEK_K01 - Search for information and their critical analysis.
PEK_K02 - Team collaboration on improving the method of selection of measurement strategies aimed at optimal solution entrusted to a group of test problems.
PEK_K03 - Objective evaluation of arguments, the rational justification of translation and his own point of view using the knowledge of metrology

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts of measurement techniques.	2
Lec2	The essence of CMM.	2
Lec3	Errors in the measurement process, selected topics in statistics.	2

Lec4	CMM components and their functions.	2
Lec5	Classification technique using CMM machines.	2
Lec6	Measurement strategy, secure fastening device.	3
Lec7	Software measurement - a review.	3
Lec8	Discussion of selected 2D measurement procedures.	2
Lec9	Some specific procedures for 3D measurements.	2
Lec10	Simulation of the measurement process and the principles of working with CAD models in some programming environments.	2
Lec11	Sources of error in the measurement of the CMM.	2
Lec12	Methods of testing the accuracy of the measuring heads.	2
Lec13	The accuracy of the measuring equipment and methods of validation.	2
Lec14	Ways to prevent errors in the measurements on CMMs.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Measure in 2D.	2
Lab2	The measurements on the CMM measuring and integrated pallet clamping device.	3
Lab3	Off-line programming CMMs.	2
Lab4	Programming on-line CMM.	2
Lab5	CMM programming - simulation of measuring linear and angular dimensions.	2
Lab6	CMM programming - simulation of the measurement process form and position	2
Lab7	CMM programming - simulation optimization of measurement tasks.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03;PEK_K01; PEK_K02; PEK_K03	test

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005[2] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.

SECONDARY LITERATURE
[1] Humienny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[2] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[3] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Coordinate measuring technique
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1AIR_PT_W05	C1; C2; C3; C4; C5; C6	Wy1 - Wy14	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1AIR_PT_U04	C1; C2; C3; C4; C5; C6	La1 - La7	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1AIR_K03, K1AIR_K05, K1AIR_PT_K01	C1; C2; C3; C4; C5; C6	Wy1 - Wy14; La1 - La7	N1; N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria i metody optymalizacji**
Name in English: **Theory and methods of optimization**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of mathematical analysis confirmed by completion of relevant course at university level
2. Has basic knowledge of linear algebra confirmed by completion of relevant course at university level
3. Has basic knowledge and skills in programming using higher-order languages

SUBJECT OBJECTIVES

C1. Acquisition of knowledge in the field: linear and nonlinear programming, discrete optimization and methods for non-deterministic optimization
C2. Acquisition of skills of implementation of optimization algorithms for continuous tasks without constraints and with constraints as well as discrete tasks, also acquisition of skills of implementation of evolutionary algorithms and the ability to use standard procedures
C3. Acquisition and consolidation of social skills such as creativity in action and thinking and the ability to determine appropriate priorities for the specific purpose

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of linear programming
PEK_W02 - has knowledge of nonlinear programming
PEK_W03 - has knowledge of discrete and non-deterministic optimization

II. Relating to skills:
PEK_U01 - is able to use linear programming algorithms to solve optimization problems
PEK_U02 - is able to use non-linear programming algorithms to solve optimization problems
PEK_U03 - is able to use discrete and non-deterministic optimization algorithms for practical problem solving

III. Relating to social competences:
PEK_K01 - has expanded competences to act and think creatively
PEK_K02 - has extended the competence in determining proper priorities to achieve a particular purpose

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic concepts related to the optimization, formulation of optimization tasks, classification of optimization methods	2
Lec2	Nongradient methods	2
Lec3	Gradient methods	2
Lec4	Conjugate - direction methods	2
Lec5	Optimality conditions for nonlinear optimization problems with constraints	2
Lec6	The Kuhn - Tucker conditions	2
Lec7	Nonlinear, multivariable constrained optimization	2
Lec8	Feasible Direction Methods	2
Lec9	Penalty function methods	2
Lec10	Multicriteria optimization	2
Lec11	Linear programming, simplex method	2
Lec12	Discrete optimization, branch and bound method	2
Lec13	Global optimization, non-deterministic algorithms for optimization	2
Lec14	Evolutionary algorithms	2
Lec15	Software for solving optimization problems	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Practicing the use of non-gradient methods for solving one-dimensional optimization problems	2
Lab2	Practicing the use of non-gradient methods for solving multidimensional optimization problems	2
Lab3	Practicing the use of conjugate methods for solving optimization problems	2

Lab4	Practicing the use of penalty function methods for solving optimization problems	2
Lab5	Practicing the use of multicriteria optimization methods	2
Lab6	Practicing the use of linear programming methods	2
Lab7	Practicing the use of branch and bound method	2
Lab8	Practicing the use of evolutionary algorithms for solving optimization problems	1
		Total hours: 15

TEACHING TOOLS USED

N1. problem exercises
N2. report preparation
N3. traditional lecture with the use of transparencies and slides
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K02	laboratory reports, short tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Seidler J., A. Badach, W. Molisz: Metody rozwiązywania zadań optymalizacji. WNT – Warszawa 1980 [2] Findeisen W. ,J. Szymanowski, A. Wierzbicki: Teoria i metody obliczeniowe optymalizacji. PWN – Warszawa 1980 [3] Kusiak J., A. Danielewska-Tułecka, P. Oprycha: Optymalizacja. Wybrane metody z przykładami zastosowań. PWN 2009[4] Garfinkel R., G. Nemhauser: Programowanie całkowitoliczbowe. PWN – 1978

SECONDARY LITERATURE

[1] Gass S.: Programowanie liniowe. PWN – 1973[2] Górecki H.: Optymalizacja systemów dynamicznych. Wydawnictwo Naukowe PWN – Warszawa 1993[3] Michalewicz Z.: Algorytmy genetyczne + struktury danych = programy ewolucyjne. WNT - Warszawa 2003[4] Ignasiak E.: Badania operacyjne. Polskie Wydawnictwo Ekonomiczne – Warszawa 2001[5] Stadnicki J.: Teoria i praktyka rozwiązywania zadań optymalizacji. WNT – Warszawa 2006[6] Stachurski A., A. P. Wierzbicki: Podstawy optymalizacji. Oficyna Wydawnicza Politechniki Warszawskiej – Warszawa 1999[7] Brzózka J., L. Dorobczyński: Matlab: środowisko obliczeń naukowo – technicznych. MIKOM – Warszawa 2005[8] Schaeffer R.: Podstawy genetycznej optymalizacji globalnej. WUJ – Kraków 2002[9] Dokumentacja oprogramowania Matlab

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory and methods of optimization
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W01	C1	Lec1, Lec11, Lec15	N3, N4
PEK_W02	K2AIR_W01	C1	Lec1÷Lec10, Lec15	N3, N4
PEK_W03	K2AIR_W01	C1	Lec12÷Lec15	N3, N4
PEK_U01	K2AIR_U02	C2	La6	N1, N2, N4
PEK_U02	K2AIR_U02	C2	La1÷La5	N1, N2, N4
PEK_U03	K2AIR_U02	C2	La7÷La8	N1, N2, N4
PEK_K01	K2AIR_K09	C3	La1÷La8	N1, N4
PEK_K02	K2AIR_K09	C3	La1÷La8	N1, N4

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika analityczna**
Name in English: **Analytical Mechanics**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15	15		
Number of hours of total student workload (CNPS)	30	30	30		
Form of crediting	Crediting with grade	Crediting with grade	Crediting with grade		
Group of courses					
Number of ECTS points	1	1	1		
including number of ECTS points for practical (P) classes		1	1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7	0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differential and integral calculus)
2. Linear algebra (matrices, determinants), geometry, trigonometry
3. Mechanics I and mechanics II in range of study stage I

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of Lagrangian mechanics in the dynamics of mechanical holonomic systems (for systems with constrains depending and not depending from time). Knowledge of vibration analysis of linear holonomic conservative systems with many degrees of freedom.
C2. Ability to independently analyze complex mechanical systems with a holonomic constrains which are not depend on time to determine : differential equations of movement, natural vibration frequency spectrum, the modal matrix.
C3. The acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in the academic community and socjety

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can define a discrete mechanical holonomic system and its possible and virtual displacements. He knows the fundamental problem of dynamics. He knows the classification of dynamical systems in respect of the constrain types. He knows the general equation of dynamics and the principle of virtual work.
PEK_W02 - He knows the notion of generalized coordinates and configuration space of a dynamical system. He knows the concept of generalized forces (active and inertia). He knows the Lagrange's equations of the second kind.
PEK_W03 - He knows the vibration theory of linear systems with many degrees of freedom in the free vibration range.
II. Relating to skills:
PEK_U01 - He is able to apply the virtual work principle and d'Alembert's principle for holonomic systems
PEK_U02 - It can derive the differential equations of motion of discrete dynamical systems by using Lagrange's equations and by using the energy conservation law for conservative holonomic systems.
PEK_U03 - He can calculate the spectrum of natural frequencies and can determine the modal matrix for discrete conservative linear systems.
III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Curriculum. Requirements. Examples of dynamic systems. Constrains and their types, classification systems for the sake of the constrain types (holonomic systems), possible velocities and possible displacements.	2
Lec2	The fundamental problem of dynamics, virtual displacement, the notion of ideal constraints, the general equation of dynamics, the virtual work principle.	2

Lec3	The dynamic general equation for the rotational and planar motion of rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples).	2
Lec5	Generalized forces. Configuration space. Lagrange’s equations (of II type).	2
Lec6	Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	1
Lec7	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes.	2
Lec8	Final test	2
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements.	2
Cl2	Solving of static problems by using a principle of virtual work	2
Cl3	Solving of dynamic problems for discrete systems by using a dynamic general equation (d'Alembert’s principle).	2
Cl4	Solving of selected dynamic problems of a rigid body in plane motion by using a dynamic general equation.	2
Cl5	Derivation of motion differential equations based on the energy conservation law and Lagrange’s equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl6	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl7	Final test	2
Cl8	Credits. Improvement of marks	2
		Total hours: 16
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Getting familiar with the software Matlab and Simulink.	2
Lab2	Computer analysis of some dynamic system in case of plane motion by using dynamics equations of analytical mechanics	2
Lab3	Design by means of Simulink a dynamical system with one degree of freedom and computer analysis of the free and forced vibration.	2
Lab4	Analysis of free and forced vibration of a linear two-mass with two degrees of freedom system using Simulink software.	2
Lab5	Simulation studies a dynamic system proposed by the student and approved by the laboratory conductor.	2
Lab6	Experimental studies of vibration of selected real systems with a finite number of degrees of freedom (1 or/and 2). Introduction to the measuring apparatus, vibration sensors, methods of excitation, vibration analyzers, etc.	2
Lab7	Experimental investigation of a continuous dynamic system (beam and/or plate). Resonant frequencies, mode shapes.	2
Lab8	Evaluating the effects of activities, reports. Credits.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. Calculative-problematic exercises N3. tutorials N4. self study - preparation for laboratory class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02,PEK_W03, PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	Calculative-problematic exercises
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Final test, oral answers
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	laboratory reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. B. Gabryszewska, A. Pszonka, "Mechanics", part II, kinematics and dynamics, Wrocław University of Technology, 1988;
2. J. Zawadzki, W. Siuta, "General Mechanics", PWN, Warsaw, 1971;
3. B. Skalmierski, "Mechanics", PWN, Warsaw, 1982;
4. M. Lunn, A First Course in Mechanics, Oxford Science Publications, 1991

SECONDARY LITERATURE
1. M. Kulisiewicz St. Piesiak, "Methodology of modeling and identification of mechanical dynamical systems", WUT. , 1994;
2 J. Leyko, "General Mechanics", WNT, Warsaw, 1980;
3 J. Giergiel, "General Mechanics", WNT, Warsaw, 1980

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analytical Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2AIR_W01, K2AIR_W02	C1	Lec 1 to Lec 8	N1, N3, N5
PEK_U01, PEK_U02, PEK_U03	K2AIR_U03	C2	Cl 1 to Cl 8, Lab 1 to Lab 8	N2, N3, N4,
PEK_K01, PEK_K02, PEK_K03	K2AIR_K01, K2AIR_K03, K2AIR_K04, K2AIR_K06	C3	Lec 1 to Lec 8, Cl 1 to Cl 8, Lab 1 to Lab 8	N1, N2, N3,N4, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy mechatroniki**
Name in English: **Basics of mechatronics**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the design of the mechanical system, drives, sensors and control systems

SUBJECT OBJECTIVES

C1. The aim of the course is to familiarize students with the principles of construction, design, modern machinery in terms of mechatronics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has detailed knowledge of the design and modeling of mechatronic systems.

II. Relating to skills:
PEK_U01 - can analyze and carry out a survey of existing technologies, in particular mechatronic systems for machinery, equipment and vehicles

III. Relating to social competences:
PEK_K01 - Is aware of the importance and understanding of non-technical aspects and impacts of mechatronics engineer, including its impact on the environment, and the related responsibility for own decisions

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechatronics - definitions, history. Examples of mechatronic systems. Place of mechatronics in contemporary technique.	2
Lec2	Design of machinery and equipment in terms of mechatronics.	2
Lec3	Basics of actuators - characteristics, applications	2
Lec4	Selected mechatronic drives in machine building - piezoelectric, step motors, servodrives	2
Lec5	Virtual Prototyping - examples of use (Hardware in the Loop, Rapid Prototyping)	2
Lec6	Analysis and image recognition - fundamentals and applications	2
Lec7	Elements of control system : programmable controllers, real-time computers, etc.	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the study of mechatronic systems, safety rules	1
Lab2	The test of distance sensors (report)	3
Lab3	Research and programming linear drive (report)	3
Lab4	Research and programming parallel manipulator (report)	3
Lab5	Design and programming of image analysis system (report)	3
Lab6	Design and programming of microcontroller or PLC (report)	2
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. self study - preparation for laboratory class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Evaluation of the report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty, metody, przykłady. Wydawnictwo PWN , Warszawa 2001.
2. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne. Wydawnictwo Politechniki Białostockiej. Rozpr. Naukowe nr 44. Białystok 1997.
3. Denny K. Miu: Mechatronics. Springer –Verlag, Nowy York 1993.
4. Craig J.: Wprowadzenie do robotyki. WNT 1993.

SECONDARY LITERATURE
1. Bolton W.: Mechatronics. Longman, Nowy York 1999
2. Roddeck W.: Einfurung in die Mechatronik. B.G. Teubner Sttutgart 1997

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of mechatronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W03	C1	Le1-Le7	N1-N4
PEK_U01	K2AIR_U04	C1	La1-La6	N1-N4
PEK_K01	K2AIR_K04	C1	le1-Le7, La1-La6	N1-N4

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Bałchanowski tel.: 71 320-27-10 email: jacek.balchanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sieci przemysłowe rozproszone**
Name in English: **Distributed industrial networks**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041007**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the basic concepts of control theory
2. The student knows the principles of resources management in information systems.

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the construction and operation of a network computer control
C2. The acquisition of knowledge in the implementation of simple control algorithms for industrial network
C3. Learn how to design web applications for typical industrial control tasks

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Being able to describe the topology, electrical standard and protocol for typical network
PEK_W02 - Can describe application data exchange between PLCs.
PEK_W03 - Can describe application data exchange between PLC and operator panel.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The physical layer in computing and industrial control networks. Conflict resolution access to the medium.	3
Lec2	Unitelway network, the role of master and slave devices, execution of client and server.	3
Lec3	Programming Languages (IEC 61131-3) as the industrial network application layer.	3
Lec4	The structure of the Master and remote input / output. An example of the control algorithm (task 1).	3
Lec5	Structure of master and slave, an embodiment of the control algorithm (task 2).	3
Lec6	Visualization of the process. Panels and operator stations. SCADA systems.	3
Lec7	XBT operator panel type. Application for sequence control (task 3).	3
Lec8	XBT operator panel type. Application for continuous control (task 4).	3
Lec9	S7-1200 controllers and operator panels on PROFINET. Making connection, device configuration, network testing.	3
Lec10	KNX bus, power and communications standards, the physical layer, addressing and network segmentation. Programming typical applications, group assignments, the typical functions for the buttons and relays (task 5).	3
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	evaluation of the tasks: task1, task2, task3, task5
F2	PEK_W01, PEK_W02, PEK_W03	written test
P = max(F1, 0.2*F1+0.8*F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Siemens SIMATIC S7-1200 in the examples. Siemens, Warsaw 2011.
[2] J. Kasprzyk, programming industrial controllers. WNT, Warsaw 2006
[3] J. Kwasniewski, programmable controller SIMATIC S7-300 in engineering practice. Publisher BTC, Arkady 2009.
[4] W. Solnik, Zayd Z., Computer, industrial networks and Uni-Telway bus module TSX. Publishing House of Wroclaw University of Technology, 2010.

SECONDARY LITERATURE

[1] W. Bolton: Programmable Logic Controllers. Elsevier 2003
[2] J. Halawa, simulation and computer aided design of dynamic control systems. Publishing House of Wroclaw University of Technology in 2007
[3] W. Solnik, Zayd Z., Profibus DP network in industrial practice. Publisher BTC, Arkadiusz 2013.
Company Studies:
[1] Websites PLC manufacturers
[2] http://wazniak.mimuw.edu.pl [3] http://plcs.pl
[4] http://controlengineering.pl
[5] http://www.automatykaonline.pl/poradnik/
[6] https://support.automation.siemens.com
Magazines:
[1] Measurement Automation and Control
[2] Measurement Automation and Robotics

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Distributed industrial networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W01	C1	Lec1, Lec2, Lec3	N1, N2, N3, N4
PEK_W02	K2AIR_W05	C2	Lec4, Lec5, Lec6	N1, N3, N4

PEK_W03	K2AIR_W06	C3	Lec7, Lec8, Lec9, Lec10	N1, N3, N4

SUBJECT SUPERVISOR
dr Antoni Izworski tel.: 71 320 2808 email: antoni.izworski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka i nadzorowanie procesów i maszyn**
Name in English: **Diagnostics and supervision of processes and machines**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041008**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a firm knowledge of the structure and operation of the basic machinery of production. Knows the basic principles of design processes typical of machine parts.
2. Has a basic knowledge of calculus and statistics for the engineering signal processing and analysis.
3. Has a a basic understanding of sensory and build measurement systems.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the diagnosis and monitoring of manufacturing equipment and processes carried out with their help.
C2. Gaining knowledge of the processing, analysis and evaluation of the diagnostic signal.
C3. Familiar with the methods of knowledge acquisition and diagnostic methods of inference based on the accumulated knowledge diagnosis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the basic purposes of diagnosis and monitoring of machines and processes implemented by it.
PEK_W02 - Has knowledge of various sources of interference with the equipment and appropriate research methods.
PEK_W03 - Has knowledge of diagnostic knowledge acquisition, analysis and evaluation of diagnostic signals and methods of applying the accumulated knowledge of the diagnostic.

II. Relating to skills:
PEK_U01 - Provides support for used measurement and control equipment.
PEK_U02 - Able to analyze and evaluate the diagnostic signals.
PEK_U03 - Can choose the right way to measure, depending on the source of the interference of the machine.

III. Relating to social competences:
PEK_K01 - Takes responsibility and integrity in the conduct of laboratory experiments and objective evaluation of arguments.
PEK_K02 - Can think creatively and determine how to implement the research task.
PEK_K03 - Has sense of responsibility for their own work and its impact on the functioning of the company.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, Assessment and literature. Basic issues.	2
Lec2	Elements of the theory of operation.	2
Lec3	The physical aspects of the diagnosis.	2
Lec4	Diagnosis in the life of the machine.	2
Lec5	Modeling of the diagnosis of machines and processes.	2
Lec6	Diagnostic signals and their parameters.	2
Lec7	Processing and analysis of diagnostic signals.	2
Lec8	Construction machinery diagnostic procedures. Diagnostic experiments.	2
Lec9	Monitoring the condition of machinery manufacturing.	2
Lec10	Supervising tools.	2
Lec11	Supervising the machining process.	2
Lec12	Supervising the accuracy of workpieces.	2
Lec13	Artificial intelligence methods for the diagnosis and supervising.	2
Lec14	Diagnosis and supervision of machines and processes in industrial use.	2
Lec15	Summary of lectures, additional explanations. Checking knowledge.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Supervising production process of cast iron.	2
Lab2	Supervising welding processes.	2

Lab3	Diagnostic equipment for plastic working.	2
Lab4	Diagnosis of CNC machine tools with the help of the tester QC10.	2
Lab5	Monitoring the machine geometry.	2
Lab6	Artificial intelligence tools in supervising of machines and processes.	2
Lab7	Processing and analysis of diagnostic signals.	3
		Total hours: 15

TEACHING TOOLS USED

N1. tutorials
N2. traditional lecture with the use of transparencies and slides
N3. self study - preparation for laboratory class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	test, report on laboratory exercises, participation in discussions of problem
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Żółtowski B., Cempel Cz.: "Engineering of machine diagnostics", Polskie Towarzystwo Diagnostyki Technicznej, Instytut Technologii Eksploatacji PIB Radom, Warszawa, Bydgoszcz, Radom, 2004
2. Cempel Cz., Tomaszewski F.: "Machine diagnostics. General. Examples of applications", Międzyresortowe Centrum Naukowe Eksploatacji Majątku Trwałego, Radom, 1992
3. Honczarenko J.: "Flexible manufacturing automation", WNT, Warszawa, 2000
4. Korbicz J., Kościelny J., Kowalczuk Z., Cholewa W.: "Diagnostic processes. Models, methods of artificial intelligence, applications." WNT, 2002

SECONDARY LITERATURE
1. Czyszpak T.: "Application of fuzzy inference system in the diagnosis of machine tools and machining process", Prace Naukowe Katedry Budowy Maszyn - Politechnika Śląska 1427-9347 nr 2/2008, Gliwice, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diagnostics and supervision of processes and machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_W01, K2AIR_W02, K2AIR_W03	C1, C2, C3	Lec1-Lec15	N1, N2, N3
PEK_U01 - PEK_U03	K2AIR_U01, K2AIR_U03, K2AIR_U04, K2AIR_U05, K2AIR_U10	C1, C2, C3	Lec1-Lec15, Lab1-Lab7	N1 - N4
PEK_K01 - PEK_K03	K2AIR_K02, K2AIR_K03, K2AIR_K05, K2AIR_K06, K2AIR_K08, K2AIR_K09	C1, C2, C3	Lec1-Lec15, Lab1-Lab7	N1 - N4

SUBJECT SUPERVISOR

dr inż. Tomasz Jankowski tel.: 41-74 email: tomasz.jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Drgania i hałas w inżynierii maszyn**
Name in English: **Vibration and noise in mechanical engineering**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041100**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of formation of vibration and noise in machines.
2. Is able to analyze measurements results.
3. Has a basic knowledge of the methods to reduce noise and vibration.

SUBJECT OBJECTIVES

C1. Gaining basic knowledge of noise and vibrations in machines.
C2. Gaining knowledge of noise and vibrations measurements.
C3. Gaining knowledge of selection methods to reduce noise and vibrations.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the physical phenomena related to the way of formation of noise and vibrations in machines.
PEK_W02 - Knows the methods of measurement of noise and vibration in machines and methods for noise source location.
PEK_W03 - Knows how to eliminate noise and vibrations in machines and materials used to eliminate noise and vibrations.

II. Relating to skills:
PEK_U01 - Can use appropriate calculation methods used for the analysis of macine vibrations.
PEK_U02 - Can measure and locate the noise source in machines and analyze the results.
PEK_U03 - Can choose the right materials for vibration and noise reduction.

III. Relating to social competences:
PEK_K01 - Effective information retrieval and critical evaluation.
PEK_K02 - Ability to work in a team aimed at appropriate division of responsibilities and effective solution of the assignments.
PEK_K03 - Ability to proper argumentation and justification of own point of view.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course, program, requirements, the definition of vibroacoustic processes in machines.	2
Lec2	Theoretical description of vibration of systems with one degree of freedom (with damping and without damping, resonance).	2
Lec3	Multi degrees of freedom systems (the main coordinates, the natural frequencies).	2
Lec4	Description of propagation of sound waves in air, conduction of sound.	2
Lec5	Vibration simulation and computing methods used in machine vibration analysis (simulation methods, FEM).	2
Lec6	Dynamic vibration eliminator (applications, design principles).	2
Lec7	Measurement methods of vibrations in machines (modal analysis, operational analysis).	2
Lec8	Vibration isolation of machines and devices, types, principles of damper selections.	2
Lec9	The main types and classification of noise sources in machines.	2
Lec10	Noise measurements of machines and devices, methods of noise reduction (active and passive).	2
Lec11	Location of noise sources using energy methods.	2
Lec12	Soundproof and sound absorbing materials used in the industry.	2
Lec13	Sound absorbing housings, acoustic barriers, personal protection.	2
Lec14	Vibroacoustic diagnostics of machines and devices.	2
Lec15	Standards and EU directives for the assessment of vibration and noise emission, noise maps.	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Free transverse vibrations of the beam	2
Lab2	Dynamic vibration eliminator	2
Lab3	Modal analysis on example of	2
Lab4	Identification of damping coefficient on example of lifting hydraulic mechanism	2
Lab5	Noise measurements of hydraulic pump in reverberation chamber	2
Lab6	Identification of noise sources on example of : energetic method, acoustic holography	2
Lab7	Noise measurements using sound level meter	2
Lab8	Final laboratory - credit and mark	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for laboratory class
N4. laboratory experiment
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_K01 - PEK_K03	written-oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	short test at the beginning of the class
F2	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	oral answers

F3	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	report from laboratory
P = 0,2F1+0,4F2+0,4F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Cempel Cz.: Wibroakustyka stosowana, PWN Warszawa, 1989
Engel Z.: Drgania w technice, Ossolineum, Kraków 1987
Łączkowski R.: Wibroakustyka maszyn i urządzeń, WNT Warszawa, 1983
Golinski J.: Wibroizolacja maszyn, PWN, 1979
Osinski Z.: Teoria drgań, PWN, 1978

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Vibration and noise in mechanical engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2AIR_AM_W10, K2AIR_AM_W12	C1-C3	Wy1 - Wy4	N1.
PEK_U01, PEK_U02, PEK_U03	K2AIR_AM_U12, K2AIR_U03	C1-C3	Wy7, Wy9-Wy11, Wy14-Wy15, La4, La6-La8	N1.- N5.
PEK_K01, PEK_K02, PEK_K03	K2AIR_K05, K2AIR_K08, K2AIR_K09	C1-C3	Wy5 - Wy6, Wy8, Wy12 - Wy13, La1 - La3, La5	N1. - N5.

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania układów kinematycznych**
Name in English: **Foundations of Kinematics Systems Design**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in mathematical analysis and classical mechanics.
2. Knowledge of fundamental the theory of mechanisms and machines.

SUBJECT OBJECTIVES

C1. Choice of the optimal kinematic scheme of a mechanism - designed to fulfill the specified requirements.
C2. Skill in geometrical synthesis ofchosen linkages and cam mechanisms.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of forms of mechanisms’ structure notation.
PEK_W02 - Knowledge of fundamental methods of type synthesis of kinematic systems.
PEK_W03 - Knowledge of fundamental methods of gepmetrical synthesis of kinematic systems, fulfilled the specified requirements

II. Relating to skills:
PEK_U01 - Student is able to create set of mechanism schemes.
PEK_U02 - Student is able to carry out geometrical synthesis of linkage mechanism.
PEK_U03 - Student is able to design cam mechanisms and planetary gears.

III. Relating to social competences:
PEK_K01 - Correctly identifies and resolves dilemmas associated with the implementation of engineering tasks.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mobility of contours. Forms of mechanisms’ structure notation.	2
Lec2	Type synthesis - making of closed link chains	2
Lec3	Methods of type synthesis, set of possible solutions creation. Criteria and selection of optimal solution.	2
Lec4	Introduction to methods of dimensional synthesis of linkages mechanisms.	2
Lec5	Methods of dimensional synthesis of linkages mechanisms.	2
Lec6	Designing of cam mechanisms.	3
Lec7	Designing of planetery gears.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Analysis of topology of kinematics systems (test and project).	2
Proj2	Methods of notation of topology (test and project).	2
Proj3	Type synthesis. Making of possible sets of the solutions (test).	2
Proj4	Type synthesis cont. Criteria and selection for optimal solution (project).	2
Proj5	Dimensional synthesis of linkages mechanisms (test and project).	3
Proj6	Project of cam mechanisms (test and project).	2
Proj7	Project of planetary gear (project).	2
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. traditional lecture with the use of transparencies and slides
N3. problem exercises
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	tests, project discussion
P = średnia ocen z kartkówek i projektów		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Miller S.: Układy kinematyczne. Podstawy projektowania. WNT 1987
2. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wyd. PWr. 2003
3. Gronowicz A., Miller S.: Mechanizmy. Oficyna Wyd. PWr. 1996
4. Gronowicz A., Miller S., Twaróg W.: Teoria maszyn i mechanizmów. Zestaw problemów analizy i projektowania. Oficyna Wyd. PWr. 1999

SECONDARY LITERATURE

1. Bałchanowski J., Twaróg W.: Metoda syntezy strukturalnej mechanizmów równoległych. TMM. Wydawnictwo ATH Bielsko-Biała 2008, str. 377-384.
2. Bałchanowski J., Twaróg W.: Synteza strukturalna przestrzennych mechanizmów równoległych. TMM. Wydawnictwo ATH Bielsko-Biała 2008, str. 385-392.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Foundations of Kinematics Systems Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_AM_W04	C1-C2	la1-la7	N1-N2
PEK_U01- PEK_U03	K2AIR_AM_U04	C1-C2	pr1-pr7	N3-N4
PEK_K01	K2AIR_K05	C1-C2	la1-la7, pr1-pr7	N1-N4

SUBJECT SUPERVISOR

dr inż. Sławomir Wudarczyk tel.: 71 320-27-10 email: Slawomir.Wudarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Urządzenia i układy automatyki**
Name in English: **Equipment and automation systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041106**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the basics of automation.

SUBJECT OBJECTIVES

C1. Understanding the issues of automation equipment.
C2. Understanding the issues of control systems.
C3. Rules for the use of systems and automation equipment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic issues of instruments for measuring mechanical quantities and flow, pressure, level, temperature.
PEK_W02 - The student has knowledge of the regulators, servo and PLC.

II. Relating to skills:
PEK_U01 - He has in-depth knowledge and expanded to devices and automation systems

III. Relating to social competences:
PEK_K01 - The student is able to think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basic elements of automation	2
Lec2	Measuring equipment for automatic control systems	2
Lec3	Instruments for measuring mechanical quantities and measurement of flow, pressure, level, temperature	8
Lec4	Setting elements and actuators. Test	3
Lec5	Basic information on regulators, controllers direct action and continuous	2
Lec6	Digital controllers	2
Lec7	Falowniki	3
Lec8	Engines used in systems and automation devices	2
Lec9	PLCs, PLC Programming	4
Lec10	SCADA systems	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Test 1

F2	PEK_W02	Test 2
P = F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. "Components, equipment and automation systems" J. Kostro, publishing WSiP Warsaw 2007.
2. "Equipment and automation systems" Z. Zajda, L. Żebrowski, publishing PWr. Wroclaw 1993

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Equipment and automation systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2AIR_AM_W01	C1,C2, C3	Lec1-Lec10	N1
PEK_K01, PEK_U01	K2AIR_K04, K2AIR_U01	C1, C2, C3	Lec1-Lec10	N1

SUBJECT SUPERVISOR

dr inż. Daniel Nowak tel.: 44-42 email: daniel.nowak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja pojazdów i maszyn roboczych**
Name in English: **Automation of vehicles and working machines**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of sensors and measuring systems confirmed by the completion of relevant course
2. Has basic knowledge of microcontrollers confirmed by the completion of relevant course
3. Has basic knowledge of automation confirmed by completion of relevant course

SUBJECT OBJECTIVES

C1. The acquisition of detailed knowledge of the issues of automation of vehicles and working machines
C2. The acquisition of skills in conducting experimental research, diagnostics and adapting to the current requirements of automation in vehicles and working machines
C3. The acquisition and consolidation of awareness of validity of professionalism and non-technical aspects of engineering

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of data buses and navigation systems used in industrial vehicles and working machines
PEK_W02 - has knowledge of automation systems used in industrial vehicles
PEK_W03 - has knowledge of automation systems used in cranes and storage systems

II. Relating to skills:
PEK_U01 - is able to carry out testing and diagnostics of the automation system in industrial vehicle
PEK_U02 - is able to examine and diagnose the crane automation system
PEK_U03 - is able to make reasonable changes in the control programs of industrial vehicles and working machines

III. Relating to social competences:
PEK_K01 - understands the need and knows the possibilities of lifelong learning in the field of automation in vehicles and working machines
PEK_K02 - is aware of and understands the non-technical aspects of mechanical engineering, such as health and safety, environmental impact
PEK_K03 - is aware of the importance of behavior in a professional manner and compliance with the rules of professional conduct

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introductione to automation systems for vehicles and working machines	2
Lec2	Typical communication standards used in control systems for industrial vehicles and cranes	2
Lec3	Navigation systems used in industrial vehicles	2
Lec4	Automation systems used in transmission systems of industrial vehicles and working machines	2
Lec5	Advanced automation systems supporting the process of positioning of manipulators of earthmoving machines	2
Lec6	Automatic systems for excavating and loading of crushed material	2
Lec7	Automatic safety and diagnostic systems in industrial vehicles	2
Lec8	Selected automation systems used in agricultural machines	2
Lec9	Autonomous industrial vehicles	2
Lec10	Hybrid propulsion systems and energy recovery in industrial vehicles	2
Lec11	Active suspensions of vehicles and working machines	2
Lec12	Selected automation systems used in mining vehicles and working machines	1
Lec13	Remote-controlled underwater working machines	1
Lec14	Automation of storage and transhipment processes	2
Lec15	Overview of automation systems used in cranes	2
Lec16	Basis of design of selected automation systems used in cranes	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Experimental studies of a robot used for ropeway's rope diagnostics	2
Lab2	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab3	The investigation of the new generation's mechatronic steering system for articulated vehicle	2
Lab4	Experimental studies of an automatic scooping system of transhipment vehicle	2
Lab5	Experimental studies of an electric power transmission system start-up controlled process - frequency converter	2
Lab6	Examination of jib crane monitoring system	2
Lab7	Experimental studies of a stability monitoring and improvement system for industrial wheeled vehicle	2
Lab8	Testing of a laser positioning system of transhipment vehicle manipulator	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03, PEK_K01	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K02÷PEK_K03	laboratory reports, short tests

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r.[2] Dudziński P.: Lenksysteme für Nutzfahrzeuge - Theorie und Praxis. Springer, 2005r.

SECONDARY LITERATURE
[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki i Magazynowania, 1998r.[2] Zimmermann W., Schmidgall R.: Magistrale danych w pojazdach. WKiŁ, 2008[3] Piątkiewicz A., Sobolski R.: Dźwignice. Tom I i II. WNT, Warszawa 1977r

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Automation of vehicles and working machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W08	C1	Lec2÷Lec3	N2, N5
PEK_W02	K2AIR_AM_W08	C1	Lec1, Lec4÷Lec13	N2, N5
PEK_W03	K2AIR_AM_W08	C1	Lec14÷Lec16	N2, N5
PEK_U01	K2AIR_AM_U08, K2AIR_AM_U10	C2	Lab1, Lab3, Lab4, Lab7, Lab8	N1, N2, N3, N4
PEK_U02	K2AIR_AM_U08, K2AIR_AM_U10	C2	Lab2, Lab5, Lab6	N1, N2, N3, N4
PEK_U03	K2AIR_AM_U05	C2	Lab1÷Lab8	N1, N2, N3, N4
PEK_K01	K2AIR_K01	C1	Lec1÷Lec16	N2, N5
PEK_K02	K2AIR_K02	C3	Lab1÷Lab8	N1, N2, N3, N4
PEK_K03	K2AIR_K03	C3	Lab1÷Lab8	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie i symulacja układów**
Name in English: **Modeling and simulation of the system**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041108**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Informatics
2. Mechanics II
3. Hydraulic and pneumatic drive system

SUBJECT OBJECTIVES

C1. The practical application of theoretical knowledge to build simulation models of real selected objects
C2. Introduction to the methodology of the construction of the simulation model
C3. Fixation of knowledge and skills in various areas of technology.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Explain the need for physical models creation of real objects.
PEK_W02 - Separate from the environment a functional model of the selected real object.
PEK_W03 - Define of simplifying assumptions for the real object.

II. Relating to skills:
PEK_U01 - Apply theoretical knowledge to build a simulation model of the selected real object.
PEK_U02 - Develop a program of simulation research.
PEK_U03 - Evaluate and compare the simulation results with the results obtained from experimental tests.

III. Relating to social competences:
PEK_K01 - Develop the ability to work in a team.
PEK_K02 - Increasing the efficiency of the design process (reducing of development time).
PEK_K03 - Organizing informations from the current level of knowledge and skills the student.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The rules for creating mathematical models based on physical models: the separation from the environment and simplifying assumptions	2
Lec2	Simplifying assumptions - working hypotheses: skipping small influences, independent of physical parameters.	3
Lec3	Analogies of systems of different physical structure: mechanical, electrical, hydraulic, pneumatic, thermal, etc.	2
Lec4	Mathematical models creation based on functional models. The use of experimental research of components and assemblies. The structure of dynamical systems.	2
Lec5	The method of bond graphs: flow and effort variable , sources of active and passive components. The structure of dynamical systems.	2
Lec6	Modeling and simulation of complex dynamical systems: e.g. -drive system of the loader	2
Lec7	Example of multi-source mechano-hydraulic drive system	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction to Matlab- Simulink	2
Proj2	Modeling and simulation of hydraulic buffer	2
Proj3	Modeling and simulation of car suspension	2
Proj4	Modeling and simulation of hydrostatic transmission	2
Proj5	Preparing of 4 topics chosen by the student from about 20 available topics.	7
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. report preparation
N3. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	pek_w01	test
F2	pek_w02	test
F3	pek_w03	test
P = F1+F2+F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	pek_u01	discussion about project
F2	pek_u02	laboratory report
F3	pek_u03	laboratory report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Autor: Cannon R.H. jr, tytuł: Dynamika układów fizycznych, wydawnictwo: WNT, rok: 1973
Autor: 3.Kacki E., Wozniakowski M, tytuł: Modelowanie analogowe, hybrydowe oraz cyfrowa symulacja maszyn analogowych, wydawnictwo: PWN, rok: 1973
Autor: Giergiel J, tytuł: Tłumienie drgan mechanicznych, wydawnictwo: PWN, rok: 1980
Autor: Kulisiewicz M., Piesiak S, tytuł: Metodologia modelowania i identyfikacji mechanicznych układów dynamicznych, wydawnictwo: Oficyna Wydawnicza Politechniki Wrocławskiej, rok: 1995
Autor: Nizioł J, tytuł: Podstawy drgan w maszynach, wydawnictwo: Skrypt Politechniki Krakowskiej, rok: 1996

SECONDARY LITERATURE
Autor: Bekey G.A., Karplus W.I., tytuł: Obliczenia hybrydowe, wydawnictwo: WNT, rok: 1976
Autor: Kacki E, tytuł: Równania ró¿niczkowe czastkowe w zagadnieniach fizyki i techniki, wydawnictwo: PWN, rok: 1992
Autor: Osinski Z, tytuł: Zbiór zadan z teorii drgan, wydawnictwo: PWN, rok: 1988
Autor: 4.Budak M., Samerski A., Tichonov V, tytuł: Badania i problemy fizyki matematycznej, wydawnictwo: PWN, rok: 1965
Autor: Arczynski S, tytuł: Mechanika ruchu samochodu, wydawnictwo: WNT, rok: 1997
Autor: Mitschke M, tytuł: Dynamika samochodu. Tom 1. Naped i hamowanie, wydawnictwo: WKiŁ, rok: 1988

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modeling and simulation of the system
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
pek_w01	K2AIR_AM_W12	c1	lec1	n1
pek_w02	K2AIR_AM_W12	c1	lec2, lec3, lec4	n1
pek_w03	K2AIR_AM_W12	c2	lec5, lec6	n1
pek_u01	K2AIR_U03	c2, c3	pr1	n1, n2
pek_u02	K2AIR_U03	c2, c3	pr2, pr3, pr4	n1, n2
pek_u03	K2AIR_U03	c2, c3	pr5	n3

SUBJECT SUPERVISOR

dr inż. Krzysztof Kędzia tel.: 71 320-26-67 email: krzysztof.kedzia@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Urządzenia i układy automatyki**
Name in English: **Equipment and automation systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041113**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the basics of automation.

SUBJECT OBJECTIVES

C1. Understanding the issues of automation equipment.
C2. Understanding the issues of control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic issues of instruments for measuring mechanical quantities and flow, pressure, level, temperature.
PEK_W02 - The student has knowledge of the regulators, servo and PLC.

II. Relating to skills:
PEK_U01 - The student is able to evaluate and choose the basic automation systems.
PEK_U02 - The student is able to evaluate and choose the basic controller.

III. Relating to social competences:
PEK_K01 - The student is able to think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction, organization, training, health and safety	1
Lab2	Instruments for measuring mechanical quantities and measurement of flow, pressure, level, temperature	2
Lab3	Relays, contactors, control elements	2
Lab4	Setting elements and actuators	2
Lab5	Regulators	4
Lab6	Frequency inverters	3
Lab7	Engines used in systems and automation devices	4
Lab8	PLC	2
Lab9	PLC Programming	6
Lab10	SCADA systems	4
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_U02	average of the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. "Components, equipment and automation systems" J. Kostro, publishing WSiP Warsaw 2007.
2. "Equipment and automation systems" Z. Zajda, L. Żebrowski, publishing PWr. Wroclaw 1993

SECONDARY LITERATURE

1. Instructions to Festo MPS positions.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Equipment and automation systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2AIR_AM_U01, K2AIR_U01	C1,C2	Lab1-Lab10	N1
PEK_K01	K2AIR_K04	C1,C2	Lab1-Lab10	N1
PEK_W01, PEK_W02	K2AIR_AM_W01	C1,C2	Lab1-Lab10	N1

SUBJECT SUPERVISOR

dr inż. Daniel Nowak tel.: 44-42 email: daniel.nowak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania układów mechanicznych i niemechanicznych**
Name in English: **Testing of Mechanical and Non-mechanical Systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041115**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge from basic subjects: physics, mechanics.
2. Student has ordered knowledge of specialized subjects: strength of materials, biomechanics engineering.
3. Student is able to support programs supporting the work of the engineer.

SUBJECT OBJECTIVES

C1. Obtaining the theoretical basis and practical knowledge needed to conduct experimental studies.
C2. Understanding the different experimental methods of research.
C3. Learn how to registration and processing of measurement results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge of the use of modern methods of measurement.

II. Relating to skills:
PEK_U01 - Student is able to merge information, obtain information from the literature, interpret then, draw conclusions.
PEK_U02 - Student potrafi zaplanować przeprowadzenie eksperymentu.

III. Relating to social competences:
PEK_K01 - The student is able to think and act creatively.
PEK_K02 - Student is able to work on tasks independently and in groups.
PEK_K03 - Student understands the necessity of lifelong learning.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	The research work of the hydrostatic drive industrial vehicle.	3
Lab2	Analysis of ultrasonic surface wave propagation.	3
Lab3	Error analysis of material thickness measurement by ultrasonic method.	3
Lab4	The project of the hydraulic system of linear simulator hydrostatic drive.	3
Lab5	Commissioning and testing of the selected objects, of the experimental mechatronics sensor characteristics.	3
Lab6	Determination of the mechanical properties of the implant materials.	3
Lab7	Studies of selected structural and mechanical properties of various tissues (eg, bone, skin, blood vessels, the core, the intervertebral disc).	3
Lab8	Measurement of resistance of materials to fracture.	3
Lab9	Investigation of the influence of stabilization on the changes of mechanical characteristics.	3
Lab10	Preparation the measuring setup to analysis of flow phenomena.	3
		Total hours: 30

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. report preparation
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02, PEK_K01, PEK_K02, PEK_K03	Report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Orłoś Z., Doświadczalna analiza odkształceń i naprężeń, PWN, Warszawa 1977 (in Polish).
Szczepiński W., Metody doświadczalne mechaniki ciała stałego, PWN, Warszawa1984.
Będziński R., Biomechanika inżynierska. Zagadnienia wybrane, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997 (in Polish).

SECONDARY LITERATURE

Beckwith T.G., Mechanical Measurements, Prentice Hall, 1995.
Journals

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Testing of Mechanical and Non-mechanical Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W02, K2AIR_AM_W06	C1, C2, C3	La1 - La10	N1, N2, N3, N4
PEK_U01, PEK_U02	K2AIR_AM_U06, K2AIR_AM_U10, K2AIR_W05	C1, C2, C3	La1 - La10	N1, N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2AIR_K01, K2AIR_K04, K2AIR_K05, K2AIR_K06, K2AIR_K08, K2AIR_K09	C1, C2, C3	La1 - La10	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Sylwia Szotek tel.: 71 320-29-83 email: Sylwia.Szotek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy hydrotroniki i pneumotroniki**
Name in English: **Hydrotronic and pneumotronic systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041116**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of machine power systems with particular reference to their requirements. The student understand the define depending the power flow in the power system and the equations describing the load impact on the physical parameters present in the power system.
2. The student has a basic knowledge of the control system of machines and equipment. The student be able to define the role and functions of the control system, and propose a preliminary concept of the control system based on the requirements.
3. The student is able to analyze and interpret the observed effects of a number of known power systems and identify their advantages and disadvantages.

SUBJECT OBJECTIVES

C1. The acquisition of basic knowledge about the pneumotronic hydrotronic systems, the analysis of the construction, principle of operation, structure, desirability of the application.
C2. Acquiring the ability to conduct its own analysis of the pneumotronic and hydrotronic systems. Acquiring skills indication of the benefits of using these systems, with particular emphasis on the comparative analysis performed with the classic solutions hydrostatic and pneumatic systems.
C3. Acquiring the ability to create a conception of the pneumotronic or hydrotronic system, based on the required motion parameters and transfered knowledge, in the form of examples of the already existing systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to describe the principle of operation, the individual elements and benefits of the hydrotronic and pneumotronic systems. Student can define differences in the operation of the pneumotronic and hydrotronic systems for classical hydrostatic and pneumatic power system.
PEK_W02 - The Student identifies the role of individual hydrotronic and pneumotronic components in the system, their impact on the operation of the system and is able to carry out preliminary selection of system components based on the operation requirements.
PEK_W03 - The student defines the role of the control system, is able to describe and explain its mode of action and identify the system desired features which, in combination with the parameters of the power transmission system formed the hydrotronic or pneumotronic system with the favorable working parameters or allows the new applications.

II. Relating to skills:
PEK_U01 - The student analyzes the principle of operation and determines the impact of sample components to the hydrotronic and pneumotronic systems. Students draw graphs of variation of components selected parameters, based on laboratory experiment.
PEK_U02 - The student analyzes and evaluates the work of the sample hydrotronic and pneumotronic systems. The student plans and carries out the system laboratory experiment, the results of which are the subject to analysis.
PEK_U03 - The Student plans the laboratory experiment, performs independently combining each elements of the system, is responsible for the proper installation and performs a series of laboratory experiments, the results of which are analyzed and reported together with its own interpretation.

III. Relating to social competences:
PEK_K01 - The student takes part in the work of the group of students, the goal of which is the joint planning and perform of a laboratory experiment.
PEK_K02 - The student acquires skills to present the results of their work in the written form report supplementing them orally during classes with the teacher.
PEK_K03 - The student independently searches for information and analyzes them based on the knowledge acquired during the course.

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Introducing students to with the scope of the course, the conditions of crediting and the course literature. The hydraulic and pneumatic modular connecting system.	2
Lec2	Comparative analysis of hydrostatic systems with the hydrotronic systems, the comparison of the example parameters.	2
Lec3	The hydraulic and pneumatic actuator speed control systems.	2
Lec4	Systems with multiple energy sources, accumulate energy of the liquid, example parameters.	2
Lec5	Stop and lock actuator movement, diagrams, method of implementation, examples of solutions.	2
Lec6	Synchronization of the actuators on the example hydrotronic systems, description and control functions.	2
Lec7	Adaptive control, overview, principle of operation, applications.	2
Lec8	Completion of the course.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	The series and parallel connection of the system actuators.	2
Lab3	The use of the hydraulic rectifier.	2
Lab4	The sequencer with the pressure switch.	2
Lab5	The tandem arrangement of the pneumatic actuators.	2
Lab6	The testing of the parameters of hydrostatic system with the Load-Sensing valve.	2
Lab7	Sequencer systems controlled by the course of time.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. traditional lecture with the use of transparencies and slides
N3. self study - preparation for laboratory class
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01÷PEK_W03 PEK_K03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	the written report, the verbal response, the preliminary presentations to the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. W. Kollek: Fundamentals of hydraulic drive. SINH Wrocław 1989. (in Polish)
2. W. Kollek: Basics of the designing hydraulic drives and controls. Oficyna Wydaw. Polit. Wroc. Wrocław 2004. (in Polish)
3. Z. Szydelski: Car vehicles. The drive and hydraulic control. WKŁ Warszawa 1999. (in Polish)
4. W. Szejnach: Pneumatic drive and control. WNT 1992. (in Polish)

SECONDARY LITERATURE

1. L. T. Wrotny: Designing machine tools. General problem and examples. WNT 1980. (in Polish)
2. W. Kollek, E. Palczak: Optimization of the hydraulic system components. Wydawnictwo Ossolineum, Wrocław 1994. (in Polish)
3. A. Pizoń: Hydraulic and electro-hydraulic control and regulation systems. WNT 1987. (in Polish)
4. Catalogues of the typical hydraulic and pneumatic components.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrotronic and pneumotronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W11	C1	Lec1÷Lec2	N2, N5
PEK_W02	K2AIR_AM_W11	C1	Lec3÷Lec5	N2, N5
PEK_W03	K2AIR_AM_W11	C1, C3	Lec6÷Lec7	N2, N5

PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2AIR_AM_U02, K2AIR_AM_U11, K2AIR_AM_W11, K2AIR_K04, K2AIR_K08	C2, C3	Lab1÷Lab7	N1, N3, N4, N5

SUBJECT SUPERVISOR
dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowalne sterowniki przemysłowe**
Name in English: **Programmable logic controllers**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PLC controllers

SUBJECT OBJECTIVES

C1. Demonstrate advanced properties of industrial controllers.
C2. Present advanced programming language of industrial controllers
C3. Present selected applications of industrial controllers.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Is able to explain advanced properties of industrial controllers.
PEK_W02 - Can characterize advanced techniques of industrial controllers designing
PEK_W03 - Is able to select suitable control system for desired application.

II. Relating to skills:
PEK_U01 - Is able to use advanced properties and functions of industrial controllers.
PEK_U02 - Is able to prepare the program for advanced application.
PEK_U03 - Is able to use suitable controller for selected application.

III. Relating to social competences:
PEK_K01 - Is able to work in a group.
PEK_K02 - Is able to use technical literature in an independent way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The ST programming language	2
Lec2	The SFC programming language	2
Lec3	Structured programming.	2
Lec4	System functions and interrupt	2
Lec5	Software realization of the PID algorithm	2
Lec6	Control system diagnosis	2
Lec7	Sample applications of control systems	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	Programowanie w języku ST	2
Lab3	Programming in SFC	2
Lab4	The use of system functions and interrupt handling	2
Lab5	Programming the PID algorithm	2
Lab6	Implementation of the discrete process control	2
Lab7	The implementation of a continuous process control system	2
Lab8	Control systems diagnosis	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U012, PEK_U03,	average grade
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Kwaśniewski J., Programowalny sterownik S7-300 w praktyce inżynierskiej, BTC 2009

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programmable logic controllers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K2AIR_W06	C1	Lec4, Lec5, Lec6,	N1
PEK_W02	K2AIR_W06	C2	Lec1, Lec2, Lec3,	N1
PEK_W03	K2AIR_W06	C3	Lec7,	N1
PEK_U01	K2AIR_U10	C1	LA4, LA5	N2, N3
PEK_U02	K2AIR_U10	C2	LA2, LA3	N2, N3
PEK_U03	K2AIR_U10	C3	LA6, LA7	N2, N3
PEK_K01, PEK_K02	K2AIR_K08	C1,C2,C3	Lec1-Lec7, LA1-LA8	N1,N2,N3

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń wytwórczych**
Name in English: **Operation maintenance of manufacturing machines and devices**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure and operation of machine components and assemblies, as well as principles of their selecting and designing.
2. Basic knowledge about operation, reliability and safety of machines.
3. Well-grounded knowledge about basic manufacturing techniques and role of manufacturing machines.

SUBJECT OBJECTIVES

C1. Getting acquainted with principles of the Total Productive Maintenance (TPM) concept.
C2. Getting acquainted with basic TPM tools and methods allowing to increase efficiency of machine stock maintenance. Getting acquainted with principles of determining indices describing progress at implementing the TPM methodology.
C3. Getting acquainted with possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of scope and principles of selecting a maintenance strategy of manufacturing machines and devices.
PEK_W02 - Knowledge of basic TPM tools and indices.
PEK_W03 - Knowledge of basic features and possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

II. Relating to skills:
PEK_U01 - Ability to use the acquired knowledge to formulate tasks aimed at improving a maintenance system of manufacturing machines and devices.
PEK_U02 - Ability to determine indices determining progress at implementing the TPM methodology.
PEK_U03 - Ability to use modern IT tools for computer-aided managing the maintenance processes.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to gain knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic problems related to maintenance of manufacturing machines and devices: service requirements, cause and effect analysis of machine failure, role and significance (benefits) of maintenance organization and planning.	2
Lec2	History and development of the TPM concept (characteristics of basic TMP pillars).	2
Lec3	Characteristics of basic TPM tools – exemplary applications.	2
Lec4	Maintenance strategies – idea of systematic and system-related attitude to maintenance problems.	2
Lec5	Measures and indices determining efficiency of implementing the TPM methodology.	2
Lec6	CMMS-class computer systems supporting maintenance management (requirements and functions of selected systems, system selection criteria).	2
Lec7	Implementing the TPM methodology to industrial practice (role and organization of Maintenance Department). Exemplary solutions of implementing a TPM program.	2
Lec8	Crediting the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides.
N2. Own work – preparation for crediting the lecture.
N3. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Credit colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Legutko S.: Basics of operation of machines and devices. Editorial Office WSiP. Warsaw, 2007 (in Polish).
Słowiński B.: Engineering of machine operation. Editorial Office of Koszalin University of Technology. Koszalin, 2011 (in Polish).
Kaźmierczak J.: Operation of technical systems. Editorial Office of Silesian University of Technology. Gliwice, 2000 (in Polish).

SECONDARY LITERATURE
Hebda M.: Elements of the theory of technical systems operation. Editorial Office MCNEMT. Radom, 1990 (in Polish).
Żółtowski B.: Basics of machine diagnostics. Editorial Office ATR Bydgoszcz, 1996(in Polish).
Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warsaw, 2000 (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of manufacturing machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_SP_W02	C1 - C3	Wy1 -Wy7	N1 - N3
PEK_U01 - PEK_U03	K2AIR_U10	C1 - C3	Wy8	N2

PEK_K01 - PEK_K03	K2AIR_K05	C1 - C3	Wy1 - Wy8	N1 - N3

SUBJECT SUPERVISOR
dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane procesy obróbki bezubytkowej**
Name in English: **Advanced processes of chipless forming**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041214**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of the basic techniques of production processing chipless forming methods, ie the welding, casting and plastic forming.
2. The student has ordered knowledge about the types of metallic and non-metallic materials and advanced engineering - their construction, properties, applications and selection rules.
3. The student has an established expertise in robotics and automation.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of advanced manufacturing chipless forming techniques.
C2. Acquiring the skills of critical analysis, from the point of view of the possibility of mechanization and automation, advanced manufacturing technology.
C3. Learn how to search for information and its critical analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the advanced methods of bonding, casting and wrought materials and advanced engineering.
PEK_W02 - He has knowledge of the basic parameters and the possibility of producing chipless forming mechanization and automation of advanced processing of chipless forming.
PEK_W03 - Has knowledge of the possible applications of advanced manufacturing chipless forming products.

II. Relating to skills:
PEK_U01 - He can choose the appropriate technology (method) combining (bonding) of certain materials and advanced engineering.
PEK_U02 - Can define the basic parameters of the process in advanced welding methods, casting and wrought materials.
PEK_U03 - Able to assess the possibility of mechanization and automation of advanced manufacturing processes chipless forming processing methods.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis.
PEK_K02 - An objective assessment of the arguments, the rational justification of translation and his own point of view, using knowledge of welding, casting and plastic forming.
PEK_K03 - Students should follow the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Welding concentrated energy: plasma, electron beam and laser beam. Automation of welding processes.	3
Lec2	Vacuum Brazing and gas shielded. February and their properties.	2
Lec3	Advanced welding processes: friction, FSW, diffusion, ultrasonic, explosive and hardening.	3
Lec4	Bonding advanced materials structural adhesives.	1
Lec5	Cutting methods focused energy. Mechanization and automation of cutting.	1
Lec6	The use of modern processes to improve the smelting and processing of metallurgical alloys casting.	2
Lec7	Advanced materials and technologies used in the process of preparation of molding and core.	3
Lec8	Modern, innovative technologies of foundry molds and cores.	3
Lec9	Application of "Rapid prototyping" in foundry.	2
Lec10	Physical modeling of plastic forming processes.	2
Lec11	Manufacture of metal powder.	2
Lec12	The use of modern building materials in plastic forming processes.	1
Lec13	Flexible systems for metal forming (shaping precision).	2
Lec14	The methods of electromagnetic metal stamping.	2
Lec15	Computational methods in the design of forming processes.	1

	Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03PEK_K01; PEK_K02; PEK_K03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced processes of chipless forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2AIR_SP_W06, K2AIR_SP_W10, K2AIR_W07	C1; C2; C3		N1; N2; N3
PEK_U01; PEK_U02; PEK_U03	K2AIR_SP_U07, K2AIR_SP_U10	C1; C2; C3		N1; N2; N3

PEK_U02	K2AIR_SP_U02	C1; C2; C3		N1; N2; N3
PEK_K01; PEK_K02; PEK_K03	K2AIR_K01, K2AIR_K06, K2AIR_K08, K2AIR_K09	C1; C2; C3		N1; N2; N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Zbigniew Mirski tel.: 21-42 email: zbigniew.mirski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria i metody optymalizacji**
Name in English: **Theory and methods of optimization**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of mathematical analysis confirmed by completion of relevant course at university level
2. Has basic knowledge of linear algebra confirmed by completion of relevant course at university level
3. Has basic knowledge and skills in programming using higher-order languages

SUBJECT OBJECTIVES

C1. Acquisition of knowledge in the field: linear and nonlinear programming, discrete optimization and methods for non-deterministic optimization
C2. Acquisition of skills of implementation of optimization algorithms for continuous tasks without constraints and with constraints as well as discrete tasks, also acquisition of skills of implementation of evolutionary algorithms and the ability to use standard procedures
C3. Acquisition and consolidation of social skills such as creativity in action and thinking and the ability to determine appropriate priorities for the specific purpose

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of linear programming
PEK_W02 - has knowledge of nonlinear programming
PEK_W03 - has knowledge of discrete and non-deterministic optimization

II. Relating to skills:
PEK_U01 - is able to use linear programming algorithms to solve optimization problems
PEK_U02 - is able to use non-linear programming algorithms to solve optimization problems
PEK_U03 - is able to use discrete and non-deterministic optimization algorithms for practical problem solving

III. Relating to social competences:
PEK_K01 - has expanded competences to act and think creatively
PEK_K02 - has extended the competence in determining proper priorities to achieve a particular purpose

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic concepts related to the optimization, formulation of optimization tasks, classification of optimization methods	2
Lec2	Linear programming, simplex method	2
Lec3	Nongradient methods	2
Lec4	Gradient methods	2
Lec5	Conjugate - direction methods	2
Lec6	Optimality conditions for nonlinear optimization problems with constraints	2
Lec7	Nonlinear, multivariable constrained optimization	2
Lec8	Feasible Direction Methods	2
Lec9	Global optimization, non-deterministic algorithms for optimization	2
Lec10	Discrete optimization, branch and bound method	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Practicing the use of linear programming methods	2
Lab2	Practicing the use of non-gradient methods for solving optimization problems	2
Lab3	Practicing the use of conjugate methods for solving optimization problems	2
Lab4	Practicing the use of penalty function methods for solving optimization problems	2
Lab5	Practicing the use of evolutionary algorithms and branch and bound method for solving optimization problems	2
		Total hours: 10

TEACHING TOOLS USED

N1. problem exercises
N2. report preparation
N3. tutorials
N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U02, PEK_K01÷PEK_K02	laboratory reports, short tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Seidler J., A. Badach, W. Molisz: Metody rozwiązywania zadań optymalizacji. WNT – Warszawa 1980[2] Findeisen W. ,J. Szymanowski, A. Wierzbicki: Teoria i metody obliczeniowe optymalizacji. PWN– Warszawa 1980 [3] Kusiak J., A. Danielewska-Tułecka, P. Oprycha: Optymalizacja. Wybrane metody z przykładamizastosowań. PWN 2009[4] Garfinkel R., G. Nemhauser: Programowanie całkowitoliczbowe. PWN – 1978

SECONDARY LITERATURE
[1] Gass S.: Programowanie liniowe. PWN – 1973[2] Górecki H.: Optymalizacja systemów dynamicznych. Wydawnictwo Naukowe PWN – Warszawa 1993[3] Michalewicz Z.: Algorytmy genetyczne + struktury danych = programy ewolucyjne. WNT - Warszawa2003[4] Ignasiak E.: Badania operacyjne. Polskie Wydawnictwo Ekonomiczne – Warszawa 2001[5] Stadnicki J.: Teoria i praktyka rozwiązywania zadań optymalizacji. WNT – Warszawa 2006[6] Stachurski A., A. P. Wierzbicki: Podstawy optymalizacji. Oficyna Wydawnicza Politechniki Warszawskiej– Warszawa 1999[7] Brzózka J., L. Dorobczyński: Matlab: środowisko obliczeń naukowo – technicznych. MIKOM –Warszawa 2005[8] Schaeffer R.: Podstawy genetycznej optymalizacji globalnej. WUJ – Kraków 2002[9] Dokumentacja oprogramowania Matlab

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory and methods of optimization
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W01	C1	Lec1÷Lec2	3, 4
PEK_W02	K2AIR_W01	C1	Lec1, Lec3÷Lec8	3, 4
PEK_W03	K2AIR_W01	C1	Lec1, Lec9÷Lec10	3, 4
PEK_U01	K2AIR_U02	C2	La1	1, 2, 3
PEK_U02	K2AIR_U02	C2	La2÷La4	1, 2, 3
PEK_U03	K2AIR_U02	C2	La5	1, 2, 3
PEK_K01	K2AIR_K09	C3	La1÷La5	1, 3
PEK_K02	K2AIR_K09	C3	La1÷La5	1, 3

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy mechatroniki**
Name in English: **Basics of mechatronics**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the design of the mechanical system, drives, sensors and control systems

SUBJECT OBJECTIVES

C1. The aim of the course is to familiarize students with the principles of construction, design, modern machinery in terms of mechatronics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has detailed knowledge of the design and modeling of mechatronic systems.

II. Relating to skills:
PEK_U01 - can analyze and carry out a survey of existing technologies, in particular mechatronic systems for machinery, equipment and vehicles

III. Relating to social competences:
PEK_K01 - Is aware of the importance and understanding of non-technical aspects and impacts of mechatronics engineer, including its impact on the environment, and the related responsibility for own decisions

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechatronics - definitions, history. Examples of mechatronic systems. Place of mechatronics in contemporary technique.	2
Lec2	Design of machinery and equipment in terms of mechatronics.	2
Lec3	Basics of actuators - characteristics, applications	2
Lec4	Analysis and image recognition - fundamentals and applications	2
Lec5	Virtual Prototyping - examples of use (Hardware in the Loop, Rapid Prototyping)	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the study of mechatronic systems, safety rules	1
Lab2	The test of distance sensors (report)	3
Lab3	Research and programming parallel manipulator (report)	3
Lab4	Design and programming of image analysis system (report)	3
		Total hours: 10

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. tutorials
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = Ocena z kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Evaluation of the report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty, metody, przykłady. Wydawnictwo PWN , Warszawa 2001.
2. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne. Wydawnictwo Politechniki Białostockiej. Rozpr. Naukowe nr 44. Białystok 1997.
3. Denny K. Miu: Mechatronics. Springer –Verlag, Nowy York 1993.
4. Craig J.: Wprowadzenie do robotyki. WNT 1993.

SECONDARY LITERATURE

1. Bolton W.: Mechatronics. Longman, Nowy York 1999
2. Roddeck W.: Einfurung in die Mechatronik. B.G. Teubner Sttutgart 1997

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of mechatronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W03	C1	Le1-Le5	N1-N4
PEK_U01	K2AIR_U04	C1	La1-La5	N1-N4

PEK_K01	K2AIR_K04	C1	Le1-Le5, La1-La5	N1-N4

SUBJECT SUPERVISOR
dr hab. inż. Krzysztof Bałchanowski tel.: 71 320-27-10 email: jacek.balchanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sieci przemysłowe rozproszone**
Name in English: **Distributed industrial networks**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042007**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the basic concepts of control theory
2. The student knows the principles of resources management in information systems.

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the construction and operation of a network computer control
C2. The acquisition of knowledge in the implementation of simple control algorithms for industrial network
C3. Learn how to design web applications for typical industrial control tasks

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Being able to describe the topology, electrical standard and protocol for typical network
PEK_W02 - Can describe application data exchange between PLCs.
PEK_W03 - Can describe application data exchange between PLC and operator panel.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Unitelway network, the role of master and slave devices, execution of client and server.	2
Lec2	Programming Languages (IEC 61131-3) as the industrial network application layer.	2
Lec3	The structure of the Master and remote input / output. An example of the control algorithm (task 1).	2
Lec4	Structure of master and slave. An example of the control algorithm (task 2).	2
Lec5	Visualization of the process. Panels and operator stations. SCADA systems.	2
Lec6	XBT operator panel type. Application for sequence control (task 3).	2
Lec7	XBT operator panel type. Application for continuous control (task 4).	2
Lec8	S7-1200 controllers and operator panels on PROFINET. Making connection, device configuration, network testing.	2
Lec9	KNX bus, power and communications standards, the physical layer, addressing and network segmentation. Programming typical applications, group assignments, the typical functions for the buttons and relays (task 5).	2
		Total hours: 18

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	evaluation of the tasks: task1, task2, task3, task5
F2	PEK_W01, PEK_W02, PEK_W03	written test
P = max(F1, 0.2*F1+0.8*F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Siemens SIMATIC S7-1200 in the examples. Siemens, Warsaw 2011.
[2] J. Kasprzyk, programming industrial controllers. WNT, Warsaw 2006
[3] J. Kwasniewski, programmable controller SIMATIC S7-300 in engineering practice. Publisher BTC, Arkady 2009
[4] W. Solnik, Zayd Z., Computer, industrial networks and Uni-Telway bus module TSX. Publishing House of Wroclaw University of Technology, 2010.

SECONDARY LITERATURE

[1] W. Bolton: Programmable Logic Controllers. Elsevier 2003
[2] J. Halawa, simulation and computer aided design of dynamic control systems. Publishing House of Wroclaw University of Technology in 2007
[3] W. Solnik, Zayd Z., Profibus DP network in industrial practice. Publisher BTC, Arkadiusz 2013.

Company Studies:
[1] Websites PLC manufacturers
[2] http://wazniak.mimuw.edu.pl [3] http://plcs.pl
[4] http://controlengineering.pl
[5] http://www.automatykaonline.pl/poradnik/
[6] https://support.automation.siemens.com

Magazines:
[1] Measurement Automation and Control
[2] Measurement Automation and Robotics

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Distributed industrial networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W01	C1	Lec1, Lec2, Lec3	N1, N2, N4

PEK_W02	K2AIR_W05	C2	Lec4, Lec5, Lec6	N1, N2, N3, N4
PEK_W03	K2AIR_W06	C3	Lec7, Lec8, Lec9, Lec10	N1, N3, N4

SUBJECT SUPERVISOR

dr Antoni Izworski tel.: 71 320 2808 email: antoni.izworski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka i nadzorowanie procesów i maszyn**
Name in English: **Diagnostics and supervision of processes and machines**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042008**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a firm knowledge of the structure and operation of the basic machinery of production. Knows the basic principles of design processes typical of machine parts.
2. Has a basic knowledge of calculus and statistics for the engineering signal processing and analysis.
3. Has a a basic understanding of sensory and build measurement systems.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the diagnosis and monitoring of manufacturing equipment and processes carried out with their help.
C2. Gaining knowledge of the processing, analysis and evaluation of the diagnostic signal.
C3. Familiar with the methods of knowledge acquisition and diagnostic methods of inference based on the accumulated knowledge diagnosis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the basic purposes of diagnosis and monitoring of machines and processes implemented by it.
PEK_W02 - Has knowledge of various sources of interference with the equipment and appropriate research methods.
PEK_W03 - Has knowledge of diagnostic knowledge acquisition, analysis and evaluation of diagnostic signals and methods of applying the accumulated knowledge of the diagnostic.

II. Relating to skills:
PEK_U01 - Provides support for used measurement and control equipment.
PEK_U02 - Able to analyze and evaluate the diagnostic signals.
PEK_U03 - Can choose the right way to measure, depending on the source of the interference of the machine.

III. Relating to social competences:
PEK_K01 - Takes responsibility and integrity in the conduct of laboratory experiments and objective evaluation of arguments.
PEK_K02 - Can think creatively and determine how to implement the research task.
PEK_K03 - Has sense of responsibility for their own work and its impact on the functioning of the company.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, Assessment and literature. Basic issues.	2
Lec2	Diagnosis in the life of the machine. The physical aspects of the diagnosis.	2
Lec3	Modeling of the diagnosis of machines and processes.	2
Lec4	Diagnostic signals, processing and analysis.	2
Lec5	Construction machinery diagnostic procedures. Diagnostic experiments.	2
Lec6	Monitoring the condition of machinery manufacturing.	2
Lec7	Supervising tools.	2
Lec8	Supervising the machining process.	2
Lec9	Supervising the accuracy of workpieces.	2
Lec10	Summary of lectures, additional explanations. Checking knowledge.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Supervising production process of cast iron.	2
Lab2	Supervising welding processes.	2
Lab3	Monitoring the machine geometry.	2
Lab4	Processing and analysis of diagnostic signals.	2
Lab5	Artificial intelligence tools in supervising of machines and processes.	2
		Total hours: 10

TEACHING TOOLS USED

N1. tutorials
N2. traditional lecture with the use of transparencies and slides
N3. self study - preparation for laboratory class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	test, report on laboratory exercises, participation in discussions of problem
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Żółtowski B., Cempel Cz.: "Engineering of machine diagnostics", Polskie Towarzystwo Diagnostyki Technicznej, Instytut Technologii Eksploatacji PIB Radom, Warszawa, Bydgoszcz, Radom, 2004
2. Cempel Cz., Tomaszewski F.: "Machine diagnostics. General. Examples of applications", Międzyresortowe Centrum Naukowe Eksploatacji Majątku Trwałego, Radom, 1992
3. Honczarenko J.: "Flexible manufacturing automation", WNT, Warszawa, 2000
4. Korbicz J., Kościelny J., Kowalczuk Z., Cholewa W.: "Diagnostic processes. Models, methods of artificial intelligence, applications." WNT, 2002

SECONDARY LITERATURE
1. Czyszpak T.: "Application of fuzzy inference system in the diagnosis of machine tools and machining process", Prace Naukowe Katedry Budowy Maszyn - Politechnika Śląska 1427-9347 nr 2/2008, Gliwice, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diagnostics and supervision of processes and machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_W01, K2AIR_W02, K2AIR_W03	C1, C2, C3	Lec1 - Lec10	N1, N2, N3
PEK_U01 - PEK_U03	K2AIR_U01, K2AIR_U03, K2AIR_U04, K2AIR_U05, K2AIR_U10	C1, C2, C3	Lec1-Lec10, Lab1-Lab5	N1 - N4
PEK_K01 - PEK_K03	K2AIR_K02, K2AIR_K03, K2AIR_K05, K2AIR_K06, K2AIR_K08, K2AIR_K09	C1, C2, C3	Lec1-Lec10, Lab1-Lab5	N1 - N4

SUBJECT SUPERVISOR

dr inż. Tomasz Jankowski tel.: 41-74 email: tomasz.jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Drgania i hałas w inżynierii maszyn**
Name in English: **Vibration and noise in mechanical engineering**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042100**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of formation of vibration and noise in machines.
2. Is able to analyze measurements results.
3. Has a basic knowledge of the methods to reduce noise and vibration.

SUBJECT OBJECTIVES

C1. Gaining basic knowledge of noise and vibrations in machines.
C2. Gaining knowledge of noise and vibrations measurements.
C3. Gaining knowledge of selection methods to reduce noise and vibrations.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the physical phenomena related to the way of formation of noise and vibrations in machines.
PEK_W02 - Knows the methods of measurement of noise and vibration in machines and methods for noise source location.
PEK_W03 - Knows how to eliminate noise and vibrations in machines and materials used to eliminate noise and vibrations.

II. Relating to skills:
PEK_U01 - Can use appropriate calculation methods used for the analysis of macine vibrations.
PEK_U02 - Can measure and locate the noise source in machines and analyze the results.
PEK_U03 - Can choose the right materials for vibration and noise reduction.

III. Relating to social competences:
PEK_K01 - Effective information retrieval and critical evaluation.
PEK_K02 - Ability to work in a team aimed at appropriate division of responsibilities and effective solution of the assignments.
PEK_K03 - Ability to proper argumentation and justification of own point of view.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course, program, requirements, the definition of vibroacoustic processes in machines.	2
Lec2	Theoretical description of vibration of systems with one degree of freedom (with damping and without damping, resonance).	2
Lec3	Description of propagation of sound waves in air, conduction of sound.	2
Lec4	Measurement methods of vibrations in machines (modal analysis, operational analysis).	2
Lec5	Vibration isolation of machines and devices, types, principles of damper selection.	2
Lec6	The main types and classification of noise sources in machines.	2
Lec7	Noise measurements of machines and devices, methods of noise reduction (active and passive).	2
Lec8	Location of noise sources using energy methods.	2
Lec9	Standards and EU directives for the assessment of vibration and noise emission, noise maps.	2
Lec10	Credit.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Organizational issues. Modal analysis on the example of a cantilever.	2
Lab2	Determination of damping coefficient on the example of a hydraulic lifting mechanism.	2

Lab3	Location of noise sources on the example of hydraulic power units: energy method, the method of acoustic holography.	2
Lab4	The noise measurement using a sound level meter.	2
Lab5	Credit.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for laboratory class
N4. laboratory experiment
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Written-oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	short test at the beginning of the class
F2	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	oral answers
F3	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	report from laboratory classes
P = 0,2F1+0,4F2+0,4F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Cempel Cz.: Wibroakustyka stosowana, PWN Warszawa, 1989
Engel Z.: Drgania w technice, Ossolineum, Kraków 1987
Łączkowski R.: Wibroakustyka maszyn i urządzeń, WNT Warszawa, 1983
Golinski J.: Wibroizolacja maszyn, PWN, 1979
Osinski Z.: Teoria drgań, PWN, 1978

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Vibration and noise in mechanical engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2AIR_AM_W10, K2AIR_AM_W12	C1-C3	Wy1 - Wy9	N1.
PEK_U01, PEK_U02, PEK_U03	K2AIR_AM_U12, K2AIR_U03	C1-C3	Wy1 - W4 La4, La6-La8	N1.- N5.
PEK_K01, PEK_K02, PEK_K03	K2AIR_K05, K2AIR_K08, K2AIR_K09	C1-C3	Wy1 - Wy4, La1- La5	N1. - N5.

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania układów kinematycznych**
Name in English: **Foundations of Kinematics Systems Design**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in mathematical analysis and classical mechanics.
2. Knowledge of fundamental the theory of mechanisms and machines.

SUBJECT OBJECTIVES

C1. Choice of the optimal kinematic scheme of a mechanism - designed to fulfill the specified requirements.
C2. Skill in geometrical synthesis ofchosen linkages and cam mechanisms.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of forms of mechanisms' structure notation.
PEK_W02 - Knowledge of fundamental methods of type synthesis of kinematic systems.
PEK_W03 - Knowledge of fundamental methods of gepmetrical synthesis of kinematic systems, fulfilled the specified requirements

II. Relating to skills:
PEK_U01 - Student is able to create set of mechanism schemes.
PEK_U02 - Student is able to carry out geometrical synthesis of linkage mechanism.
PEK_U03 - Student is able to design cam mechanisms

III. Relating to social competences:
PEK_K01 - Correctly identifies and resolves dilemmas associated with the implementation of engineering tasks.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Forms of mechanisms' structure notation.	2
Lec2	Methods of structural synthesis, set of possible solutions creation.	2
Lec3	Methods of structural synthesis,set of possible solutions creation. Criteria and selection of optimal solution.	2
Lec4	Methods of geometrical synthesis of linkages mechanisms	2
Lec5	Design of cam mechanisms.	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Forms of mechanisms' structure notation (test and project)	2
Proj2	Type synthesis. Making of possible sets of the solutions.	2
Proj3	Type synthesis cont. Criteria and selection for optimal solution. (project)	2
Proj4	Dimensional synthesis of linkages mechanisms (test and project).	2
Proj5	Project of cam mechanisms (test and project).	2
		Total hours: 10

TEACHING TOOLS USED

N1. problem lecture
N2. traditional lecture with the use of transparencies and slides
N3. problem exercises
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	tests, project discussion
P = średnia ocen z kartkówek i projektów		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Foundations of Kinematics Systems Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_AM_W04	C1-C2	L1-L5	N1-N2
PEK_U01- PEK_U03	K2AIR_AM_U04	C1-C2	Pr1-Pr5	N3-N4
PEK_K01	K2AIR_K05	C1-C2	L1-L5, Pr1-Pr5	N1-N4

SUBJECT SUPERVISOR

dr inż. Sławomir Wudarczyk tel.: 71 320-27-10 email: Slawomir.Wudarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Urządzenia i układy automatyki**
Name in English: **Equipment and automation systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042106**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the basics of automation.

SUBJECT OBJECTIVES

C1. Understanding the issues of automation equipment.
C2. Understanding the issues of control systems.
C3. Rules for the use of systems and automation equipment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic issues of instruments for measuring mechanical quantities and flow, pressure, level, temperature.
PEK_W02 - The student has knowledge of the regulators, servo and PLC.

II. Relating to skills:
PEK_U01 - The student is able to evaluate and choose the basic automation systems.
PEK_U02 - The student is able to evaluate and choose the basic controller.

III. Relating to social competences:
PEK_K01 - Students can interact and work in a group.
PEK_K02 - The student is able to think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basic elements of automation	2
Lec2	Measuring equipment for automatic control systems	2
Lec3	Instruments for measuring mechanical quantities and measurement of flow, pressure, level, temperature	4
Lec4	Setting elements and actuators.	2
Lec5	Basic information on regulators, controllers direct action and continuous	2
Lec6	Digital controllers	2
Lec7	PLCs. PLC programming.	4
Lec8	Test	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. "Components, equipment and automation systems" J. Kostro, publishing WSiP Warsaw 2007.
2. "Equipment and automation systems" Z. Zajda, L. Żebrowski, publishing PWr. Wroclaw 1993

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Equipment and automation systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2AIR_AM_W01	C1,C2,C3	Lec1-Lec8	N1
PEK_U01, PEK_U02	K2AIR_AM_U01, K2AIR_U01	C1,C2,C3	Lec1-Lec8	N1
PEK_K01, PEK_K02	K2AIR_K04, K2AIR_K09	C1,C2,C3	Lec1-Lec8	N1

SUBJECT SUPERVISOR

dr inż. Daniel Nowak tel.: 44-42 email: daniel.nowak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja pojazdów i maszyn roboczych**
Name in English: **Automation of vehicles and working machines**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of sensors and measuring systems confirmed by the completion of relevant course
2. Has basic knowledge of microcontrollers confirmed by the completion of relevant course
3. Has basic knowledge of automation confirmed by completion of relevant course

SUBJECT OBJECTIVES

C1. The acquisition of detailed knowledge of the issues of automation of vehicles and working machines
C2. The acquisition of skills in conducting experimental research, diagnostics and adapting to the current requirements of automation in vehicles and working machines
C3. The acquisition and consolidation of awareness of validity of professionalism and non-technical aspects of engineering

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of data buses and navigation systems used in industrial vehicles and working machines
PEK_W02 - has knowledge of automation systems used in industrial vehicles
PEK_W03 - has knowledge of automation systems used in cranes and storage systems

II. Relating to skills:
PEK_U01 - is able to carry out testing and diagnostics of the automation system in industrial vehicle
PEK_U02 - is able to examine and diagnose the crane automation system
PEK_U03 - is able to make reasonable changes in the control programs of industrial vehicles and working machines

III. Relating to social competences:
PEK_K01 - understands the need and knows the possibilities of lifelong learning in the field of automation in vehicles and working machines
PEK_K02 - is aware of and understands the non-technical aspects of mechanical engineering, such as health and safety, environmental impact
PEK_K03 - is aware of the importance of behavior in a professional manner and compliance with the rules of professional conduct

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introductione to automation systems for vehicles and working machines.	2
Lec2	Typical communication standards used in control systems for industrial vehicles and cranes	2
Lec3	Navigation systems used in industrial vehicles	2
Lec4	Advanced automation systems supporting the process of positioning of manipulators of earthmoving machines	2
Lec5	Automatic systems for excavating and loading of crushed material	2
Lec6	Automatic safety and diagnostic systems in industrial vehicles	2
Lec7	Selected automation systems used in agricultural machines	2
Lec8	Hybrid propulsion systems and energy recovery in industrial vehicles	2
Lec9	Automation of storage and transhipment processes	2
Lec10	Overview of automation systems used in cranes	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Experimental studies of a robot used for ropeway's rope diagnostics	2
Lab2	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab3	The investigation of the new generation's mechatronic steering system for articulated vehicle	2

Lab4	Experimental studies of an automatic scooping system of transhipment vehicle	2
Lab5	Experimental studies of an electric power transmission system start-up controlled process - frequency converter	2
		Total hours: 10

TEACHING TOOLS USED
N1. laboratory experiment N2. tutorials N3. self study - preparation for laboratory class N4. report preparation N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03, PEK_K01	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03,PEK_K02÷PEK_K03	laboratory reports, short tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r.[2] Dudziński P.: Lenksysteme für Nutzfahrzeuge - Theorie und Praxis. Springer, 2005r.

SECONDARY LITERATURE

[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki iMagazynowania, 1998r.[2] Zimmermann W., Schmidgall R.: Magistrale danych w pojazdach. WKiŁ, 2008[3] Piątkiewicz A., Sobolski R.: Dźwignice. Tom I i II. WNT, Warszawa 1977r

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Automation of vehicles and working machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W08	C1	Lec2÷Lec3	2, 5
PEK_W02	K2AIR_AM_W08	C1	Lec1, Lec4÷Lec8	2, 5
PEK_W03	K2AIR_AM_W08	C1	Lec9÷Lec10	2, 5
PEK_U01	K2AIR_AM_U08, K2AIR_AM_U10	C2	La1, La3, La4	1, 2, 3, 4
PEK_U02	K2AIR_AM_U08, K2AIR_AM_U10	C2	La2, La5	1, 2, 3, 4
PEK_U03	K2AIR_AM_U05	C2	La1÷La5	1, 2, 3, 4
PEK_K01	K2AIR_K01	C3	Lec1÷Lec10	2, 5
PEK_K02	K2AIR_K02	C3	La1÷La5	1, 2, 3, 4
PEK_K03	K2AIR_K03	C3	La1÷La5	1, 2, 3, 4

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie i symulacja układów**
Name in English: **Modeling and simulation of the systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042108**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Informatics
2. Mechanics II
3. Hydraulic and pneumatic drive system

SUBJECT OBJECTIVES

C1. Introduction to the methodology of the construction of the simulation model
C2. The practical application of theoretical knowledge to build simulation models of real selected objects

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Explain the need for physical models creation of real objects.
PEK_W02 - Separate from the environment a functional model of the selected real object.

II. Relating to skills:
PEK_U01 - Apply theoretical knowledge to build a simulation model of the selected real object.
PEK_U02 - Develop a program of simulation research.
PEK_U03 - Evaluate and compare the simulation results with the results obtained from experimental tests.

III. Relating to social competences:
PEK_K01 - Develop the ability to work in a group.
PEK_K02 - Organizing information from the current level of knowledge and skills the student.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The rules for creating mathematical models based on physical models: the separation from the environment and simplifying assumptions	2
Lec2	Simplifying assumptions - working hypotheses: skipping small influences, independent of physical parameters.	2
Lec3	Analogies of systems of different physical structure: mechanical, electrical, hydraulic, pneumatic, thermal, etc.	2
Lec4	Mathematical models creation based on functional models. The use of experimental research of components and assemblies. The structure of dynamical systems.	2
Lec5	Modeling and simulation of complex dynamical systems: e.g. -drive system of the loader	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Introduction to Matlab- Simulink	2
Proj2	Modeling and simulation of hydraulic buffer	2
Proj3	Modeling and simulation of car suspension	2
Proj4	Modeling and simulation of hydrostatic transmission	2
Proj5	The development of any topic chosen by the student	2
		Total hours: 10

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. report preparation
N3. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	pek_w01	written tests
F2	pek_w02	written tests
P = egzamin pisemno- ustny		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	pek_u01	discussion about project
F2	pek_u02	laboratory report
F3	pek_u03	laboratory report
P = obrona projektu		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Autor: Cannon R.H, tytuł: Dynamika układów fizycznych, wydawnictwo: WNT, rok: 1973Autor: Kacki E., Wozniakowski M, tytuł: Modelowanie analogowe, hybrydowe orazcyfrowa symulacja maszyn analogowych, wydawnictwo: PWN, rok: 1973Autor: Giergiel J, tytuł: Tłumienie drgan mechanicznych, wydawnictwo: PWN, rok: 1980Autor: Kulisiewicz M., Piesiak S, tytuł: Metodologia modelowania i identyfikacjimechanicznych układów dynamicznych, wydawnictwo: Oficyna Wydawnicza PolitechnikiWrocławskiej, rok: 1995Autor: Nizioł J, tytuł: Podstawy drgan w maszynach., wydawnictwo: Skrypt PolitechnikiKrakowskiej, rok: 1996Autor: 7.Szczepaniak C, tytuł: Podstawy modelowania systemu: człowiek – pojazd –otoczenie, wydawnictwo: PWN , rok: 1999

SECONDARY LITERATURE

Autor: Bekey G.A., Karplus W.I., tytuł: Obliczenia hybrydowe, wydawnictwo: WNT, rok:1976Autor: Kacki E, tytuł: Równania ró¿niczkowe czastkowe w zagadnieniach fizyki i techniki,wydawnictwo: PWN, rok: 1992Autor: Osinski Z, tytuł: Zbiór zadan z teorii drgan, wydawnictwo: PWN, rok: 1988Autor: 4.Budak M., Samerski A., Tichonov V, tytuł: Badania i problemy fizykimatematycznej, wydawnictwo: PWN, rok: 1965Autor: Arczynski S, tytuł: Mechanika ruchu samochodu, wydawnictwo: WNT, rok: 1997Autor: Mitschke M, tytuł: Dynamika samochodu. Tom 1. Naped i hamowanie,wydawnictwo: WKiŁ, rok: 1988

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modeling and simulation of the systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
pek_w01	K2AIR_AM_W12	c1	lec1	n1
pek_w02	K2AIR_AM_W12	c1	lec2, lec3, lec4, lec5	n1
pek_u01	K2AIR_U03	c2, c3	pr1	n1, n2
pek_u02	K2AIR_U03	c2, c3	pr2, pr3, pr4	n1, n2
pek_u03	K2AIR_U03	c2, c3	pr5	n3

SUBJECT SUPERVISOR

dr inż. Krzysztof Kędzia tel.: 71 320-26-67 email: krzysztof.kedzia@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Urządzenia i układy automatyki**
Name in English: **Equipment and automation systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042113**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			20		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the basics of automation.

SUBJECT OBJECTIVES

C1. Understanding the issues of automation equipment.
C2. Understanding the issues of control systems.
C3. Rules for the use of systems and automation equipment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic issues of instruments for measuring mechanical quantities and flow, pressure, level, temperature.
PEK_W02 - The student has knowledge of the regulators, servo and PLC.

II. Relating to skills:
PEK_U01 - The student is able to evaluate and choose the basic automation systems.
PEK_U02 - The student is able to evaluate and choose the basic controller.

III. Relating to social competences:
PEK_K01 - Students can interact and work in a group.
PEK_K02 - The student is able to think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction, organization, training, health and safety	1
Lab2	Instruments for measuring mechanical quantities and measurement of flow, pressure, level, temperature	2
Lab3	Setting elements and actuators	2
Lab4	Regulators	2
Lab5	Frequency inverters	2
Lab6	PLC	4
Lab7	PLC Programming	4
Lab8	SCADA systems	3
		Total hours: 20

TEACHING TOOLS USED

N1. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	average of the laboratory

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. "Components, equipment and automation systems" J. Kostro, publishing WSiP Warsaw 2007.
2. "Equipment and automation systems" Z. Zajda, L. Żebrowski, publishing PWr. Wroclaw 1993

SECONDARY LITERATURE
1. Instructions to Festo MPS positions.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Equipment and automation systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2AIR_AM_U01, K2AIR_U01	C1,C2,C3	Lab1-Lab8	N1
PEK_W01, PEK_W02	K2AIR_AM_W01	C1,C2,C3	Lab1-Lab8	N1
PEK_K01, PEK_K02	K2AIR_K04, K2AIR_K09	C1,C2,C3	Lab1-Lab8	N1

SUBJECT SUPERVISOR

dr inż. Daniel Nowak tel.: 44-42 email: daniel.nowak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania układów mechanicznych i niemechanicznych**
Name in English: **Testing of Mechanical and Non-mechanical Systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042115**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			20		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge from basic subjects: physics, mechanics.
2. Student has ordered knowledge of specialized subjects: strength of materials, biomechanics engineering.
3. Student is able to support programs supporting the work of the engineer.

SUBJECT OBJECTIVES

C1. Obtaining the theoretical basis and practical knowledge needed to conduct experimental studies.
C2. Understanding the different experimental methods of research.
C3. Learn how to registration and processing of measurement results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge of the use of modern methods of measurement.

II. Relating to skills:
PEK_U01 - Student is able to merge information, obtain information from the literature, interpret then, draw conclusions.
PEK_U02 - Student potrafi zaplanować przeprowadzenie eksperymentu.

III. Relating to social competences:
PEK_K01 - The student is able to think and act creatively.
PEK_K02 - Student is able to work on tasks independently and in groups.
PEK_K03 - Student understands the necessity of lifelong learning.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	The research work of the hydrostatic drive industrial vehicle.	2
Lab2	Analysis of ultrasonic surface wave propagation.	2
Lab3	Error analysis of material thickness measurement by ultrasonic method.	2
Lab4	The project of the hydraulic system of linear simulator hydrostatic drive.	2
Lab5	Commissioning and testing of the selected objects, of the experimental mechatronics sensor characteristics.	2
Lab6	Determination of the mechanical properties of the implant materials.	2
Lab7	Studies of selected structural and mechanical properties of various tissues (eg, bone, skin, blood vessels, the core, the intervertebral disc).	2
Lab8	Measurement of resistance of materials to fracture.	2
Lab9	Investigation of the influence of stabilization on the changes of mechanical characteristics.	2
Lab10	Preparation the measuring setup to analysis of flow phenomena.	2
		Total hours: 20

TEACHING TOOLS USED

N1. tutorials
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02, PEK_K01, PEK_K02, PEK_K03	Report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Orłoś Z., Doświadczalna analiza odkształceń i naprężeń, PWN, Warszawa 1977 (in Polish).
Szczepiński W., Metody doświadczalne mechaniki ciała stałego, PWN, Warszawa1984.
Będziński R., Biomechanika inżynierska. Zagadnienia wybrane, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997 (in Polish).

SECONDARY LITERATURE

Beckwith T.G., Mechanical Measurements, Prentice Hall, 1995.
Journals

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Testing of Mechanical and Non-mechanical Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W02, K2AIR_AM_W06	C1, C2, C3	La1 - La10	N1, N2, N3, N4
PEK_U01, PEK_U02	K2AIR_U06, K2AIR_U10	C1, C2, C3	La1 - La10	N1, N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2AIR_K01, K2AIR_K04, K2AIR_K05, K2AIR_K06, K2AIR_K08, K2AIR_K09	C1, C2, C3	La1 - La10	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Sylwia Szotek tel.: 71 320-29-83 email: Sylwia.Szotek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy hydrotroniki i pneumotroniki**
Name in English: **Hydrotronic and pneumotronic systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042116**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of machine power systems with particular reference to their requirements. The student understand the define depending the power flow in the power system and the equations describing the load impact on the physical parameters present in the power system.
2. The student has a basic knowledge of the control system of machines and equipment. The student be able to define the role and functions of the control system, and propose a preliminary concept of the control system based on the requirements.
3. The student is able to analyze and interpret the observed effects of a number of known power systems and identify their advantages and disadvantages.

SUBJECT OBJECTIVES

C1. The acquisition of basic knowledge about the pneumotronic hydrotronic systems, the analysis of the construction, principle of operation, structure, desirability of the application.
C2. Acquiring the ability to conduct its own analysis of the pneumotronic and hydrotronic systems. Acquiring skills indication of the benefits of using these systems, with particular emphasis on the comparative analysis performed with the classic solutions hydrostatic and pneumatic systems.
C3. Acquiring the ability to create a conception of the pneumotronic or hydrotronic system, based on the required motion parameters and transfered knowledge, in the form of examples of the already existing systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to describe the principle of operation, the individual elements and benefits of the hydrotronic and pneumotronic systems. Student can define differences in the operation of the pneumotronic and hydrotronic systems for classical hydrostatic and pneumatic power system.
PEK_W02 - The Student identifies the role of individual hydrotronic and pneumotronic components in the system, their impact on the operation of the system and is able to carry out preliminary selection of system components based on the operation requirements.
PEK_W03 - The student defines the role of the control system, is able to describe and explain its mode of action and identify the system desired features which, in combination with the parameters of the power transmission system formed the hydrotronic or pneumotronic system with the favorable working parameters or allows the new applications.

II. Relating to skills:
PEK_U01 - The student analyzes the principle of operation and determines the impact of sample components to the hydrotronic and pneumotronic systems. Students draw graphs of variation of components selected parameters, based on laboratory experiment.
PEK_U02 - The student analyzes and evaluates the work of the sample hydrotronic and pneumotronic systems. The student plans and carries out the system laboratory experiment, the results of which are the subject to analysis.
PEK_U03 - The Student plans the laboratory experiment, performs independently combining each elements of the system, is responsible for the proper installation and performs a series of laboratory experiments, the results of which are analyzed and reported together with its own interpretation.

III. Relating to social competences:
PEK_K01 - The student takes part in the work of the group of students, the goal of which is the joint planning and perform of a laboratory experiment.
PEK_K02 - The student acquires skills to present the results of their work in the written form report supplementing them orally during classes with the teacher.
PEK_K03 - The student independently searches for information and analyzes them based on the knowledge acquired during the course.

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Introducing students to with the scope of the course, the conditions of ratings and the course literature. The hydraulic and pneumatic modular connecting system.	2
Lec2	The hydraulic and pneumatic actuator speed control systems.	2
Lec3	Systems with multiple energy sources, accumulate energy of the liquid, example parameters.	2
Lec4	Synchronization of the actuators on the example hydrotronic systems, description and control functions.	2
Lec5	Comparative analysis of hydrostatic systems with the hydrotronic systems, the comparison of the example parameters. Completion of the course.	2
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of ratings.	2
Lab2	The series and parallel connection of the system actuators.	2
Lab3	The sequencer with the pressure switch.	2
Lab4	The tandem arrangement of the pneumatic actuators.	2
Lab5	The testing of the parameters of hydrostatic system with the Load-Sensing valve.	2
		Total hours: 10

TEACHING TOOLS USED

N1. laboratory experiment
N2. traditional lecture with the use of transparencies and slides
N3. self study - preparation for laboratory class
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03, PEK_K03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	the written report, the verbal response, the preliminary presentations to the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. W. Kollek: Fundamentals of hydraulic drive. SINH Wrocław 1989. (in Polish)
2. W. Kollek: Basics of the designing hydraulic drives and controls. Oficyna Wydaw. Polit. Wroc. Wrocław 2004. (in Polish)
3. Z. Szydelski: Car vehicles. The drive and hydraulic control. WKŁ Warszawa 1999. (in Polish)
4. W. Szejnach: Pneumatic drive and control. WNT 1992. (in Polish)

SECONDARY LITERATURE
1. L. T. Wrotny: Designing machine tools. General problem and examples. WNT 1980. (in Polish)
2. W. Kollek, E. Palczak: Optimization of the hydraulic system components. Wydawnictwo Ossolineum, Wrocław 1994. (in Polish)
3. A. Pizoń: Hydraulic and electro-hydraulic control and regulation systems. WNT 1987. (in Polish)
4. Catalogues of the typical hydraulic and pneumatic components.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrotronic and pneumotronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W11	C1	Lec1, Lec5	N2, N5
PEK_W02, PEK_W03	K2AIR_AM_W11	C1	Lec2÷Lec4	N2, N5
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2AIR_AM_W11, K2AIR_K04, K2AIR_K08	C2, C3	Lab1÷Lab5	N1, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowalne sterowniki przemysłowe**
Name in English: **PROGRAMMABLE LOGIC CONTROLLERS**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PLC controllers

SUBJECT OBJECTIVES

C1. Demonstrate advanced properties of industrial controllers.
C2. Present advanced programming language of industrial controllers
C3. Present selected applications of industrial controllers.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Is able to explain advanced properties of industrial controllers.
PEK_W02 - Can characterize advanced techniques of industrial controllers designing
PEK_W03 - Is able to select suitable control system for desired application.

II. Relating to skills:
PEK_U01 - Is able to use advanced properties and functions of industrial controllers.
PEK_U02 - Is able to prepare the program for advanced application.
PEK_U03 - Is able to use suitable controller for selected application.

III. Relating to social competences:
PEK_K01 - Is able to work in a group.
PEK_K02 - Is able to use technical literature in an independent way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The ST programming language	1
Lec2	The SFC programming language	2
Lec3	Structured programming.	1
Lec4	System functions and interrupt	1
Lec5	Software realization of the PID algorithm	1
Lec6	Control system diagnosis	1
Lec7	Sample applications of control systems	2
Lec8	Test	1
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	Programming in ST	1
Lab3	Programming in SFC	1
Lab4	The use of system functions and interrupt handling	1
Lab5	Programming the PID algorithm	1
Lab6	Implementation of the discrete process control	2
Lab7	The implementation of a continuous process control system	2
Lab8	Control systems diagnosis	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	average grade
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
PROGRAMMABLE LOGIC CONTROLLERS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_SP_W08	C1	Lec4, Lec5, Lec6,	N1

PEK_W02	K2AIR_SP_W08	C2	Lec1, Lec2, Lec3,	N1
PEK_W03	K2AIR_SP_W08	C3	Lec7,	N1
PEK_U01	K2AIR_SP_U08	C1	LA4, LA5, LA8	N2,N3
PEK_U02	K2AIR_SP_U08	C2	LA2, LA3	N2,N3
PEK_U03	K2AIR_SP_U08	C3	LA6, LA7,	N2,N3
PEK_K01, PEK_K02	K2AIR_K01, K2AIR_K04	C1, C2, C3	Lec1 - Lec7, LA1-LA8	N1,N2,N3

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń wytwórczych**
Name in English: **Operation maintenance of manufacturing machines and devices**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure and operation of machine components and assemblies, as well as principles of their selecting and designing.
2. Basic knowledge about operation, reliability and safety of machines.
3. Well-grounded knowledge about basic manufacturing techniques and role of manufacturing machines.

SUBJECT OBJECTIVES

C1. Getting acquainted with principles of the Total Productive Maintenance (TPM) concept.
C2. Getting acquainted with basic TPM tools and methods allowing to increase efficiency of machine stock maintenance. Getting acquainted with principles of determining indices describing progress at implementing the TPM methodology.
C3. Getting acquainted with possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of scope and principles of selecting a maintenance strategy of manufacturing machines and devices.
PEK_W02 - Knowledge of basic TPM tools and indices.
PEK_W03 - Knowledge of basic features and possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic problems related to maintenance of manufacturing machines and devices: service requirements, cause and effect analysis of machine failure, role and significance (benefits) of maintenance organization and planning.	2
Lec2	History and development of the TPM concept (characteristics of basic TMP pillars). Characteristics of basic TPM tools – exemplary applications.	2
Lec3	Maintenance strategies – idea of systematic and system-related attitude to maintenance problems. Measures and indices determining efficiency of implementing the TPM methodology.	2
Lec4	CMMS-class computer systems supporting maintenance management (requirements and functions of selected systems, system selection criteria).	2
Lec5	Implementing the TPM methodology to industrial practice (exemplary solutions of implementing). Crediting the course.	2
		Total hours: 10

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides.
N2. Own work – preparation for crediting the lecture.
N3. Consultancies

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Credit colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Basics of operation of machines and devices. Editorial Office WSiP. Warsaw, 2007 (in Polish).
Słowiński B.: Engineering of machine operation. Editorial Office of Koszalin University of Technology. Koszalin, 2011 (in Polish).
Kaźmierczak J.: Operation of technical systems. Editorial Office of Silesian University of Technology. Gliwice, 2000 (in Polish).

SECONDARY LITERATURE

Hebda M.: Elements of the theory of technical systems operation. Editorial Office MCNEMT. Radom, 1990 (in Polish)
Żółtowski B.: Basics of machine diagnostics. Editorial Office ATR Bydgoszcz, 1996(in Polish)
Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warsaw, 2000 (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of manufacturing machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_SP_W03	C1 - C3		N1 - N3

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane modelowanie i projektowanie procesów wytwarzania w systemach CAD /CAM**
Name in English: **Advanced modeling and design of manufacturing processes in CAD/CAM systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042210**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in the course "Engineering Graphics", "Descriptive geometry", "Engineering Graphics - Engineering Drawing" or similar
2. Knowledge and skills in the course "Engineering Graphics 3D", "Modeling CAD" or similar
3. Basic knowledge of design processes

SUBJECT OBJECTIVES

C1. Provide students knowledge of the methods and tools for the design and verification of products
C2. Presentation of modern tools supporting manufacturing
C3. The acquisition of knowledge in the field of design technology for CNC machines using CAD/CAM systems
C4. Discussion of issues of selection, implementation and integration of CAD/CAM systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the stages in the development of products and processes for their preparation and their use in computer technology
PEK_W02 - Student has a basic knowledge of the creation and processing of 3D models of products
PEK_W03 - Student has ordered knowledge of technological design in CAM systems

II. Relating to skills:
PEK_U01 - Students apply selected methods and computer technology in the development of products and processes for their preparation
PEK_U02 - Students can use the chosen method of creating and processing of 3D models of products
PEK_U03 - The student knows how to prepare a technological process for CNC machine tools using selected CAD / CAM system

III. Relating to social competences:
PEK_K01 - The student has the ability to work in a project team

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Wireframe 2D/3D CAD models, surface and solid and methods of representation	2
Lec2	Additional functionality CAD systems. Geometric data exchange.	2
Lec3	Visualization of 3D CAD models. Virtual reality.	2
Lec4	Advanced modeling and analysis tools in CAD	2
Lec5	Introduction to Reverse Engineering	2
Lec6	Introduction to generative technology prototyping and manufacturing	2
Lec7	Technological design CAM systems. The steps and tasks performed. Functions of CAM.	2
Lec8	Verification processes through computer simulation. NC program generation for numerically controlled machines. General Information on CNC machines.	2
Lec9	The issue of selection and implementation of CAD / CAM systems.	2
Lec10	Final test	2
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Organizational meeting: Principles of modeling for the CAD and CAM, the rules evaluator	2
Proj2	Product modeling in a CAD system using advanced tools - introduction and individual work	2
Proj3	Product modeling in a CAD system using advanced tools - own work and project presentation	2
Proj4	Generating toolpaths for machining CAM system selected. Machining simulation. Management of the project. Introduction and individual work.	2

Proj5	Generate technical documentation. NC code generation. Introduction and individual work.	2
		Total hours: 10

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. self study - preparation for project class
N4. project presentation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Score for the project.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. E. Chlebus, ""Techniki komputerowe CAx w inżynierii produkcji"", WNT, Warszawa 2000
2. K. Augustyn, ""NX CAM : programowanie ścieżek dla obrabiarek CNC"", Helion, Gliwice 2010
3. Z. Kacprzyk, ""Komputerowe wspomaganie projektowania: podstawy i przykłady"", Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2012

SECONDARY LITERATURE

1. H. B. Kief, ""FFS-Handbuch. Einfuhrung in flexible Fertigungssysteme und deren Komponenten: CNC, DNC, CAD, CAM, FFS, FMS, CAQ, CIM"", 1998
2. H. B. Kief, ""NC/CNC handbuch 2007/08: CNC, DNC, CAD, CAM, CIM, FFS, SPS, RPD, LAN, NC-Maschinen, NC-Roboter, Antriebe, Simulation, Fach- und Stichwortverzeichnis"", 2007
3. D. K. Singh, ""Fundamentals of manufacturing engineering"", 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced modeling and design of manufacturing processes in CAD/CAM systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2AIR_SP_W05, K2AIR_W05	C1, C2, C3, C4	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9	N1, N2, N5
PEK_U01, PEK_U02, PEK_U03, PEK_K01	K2AIR_K04, K2AIR_SP_U05	C1, C3	Pr1, Pr2, Pr3, Pr4, Pr5	N3, N5

SUBJECT SUPERVISOR

dr inż. Jacek Czajka tel.: 31-37 email: jacek.czajka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane procesy obróbki bezubytkowej**
Name in English: **Advanced processes of chipless forming**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ARM042214**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of the basic techniques of production processing methods chipless forming, ie the welding, casting and plastic forming.
2. The student has ordered knowledge about the types of metallic and non-metallic materials and advanced engineering - their construction, properties, applications and selection rules
3. The student has an established expertise in robotics and automation

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of advanced manufacturing chipless forming techniques.
C2. Acquiring the skills of critical analysis, from the point of view of the possibility of mechanization and automation, high tech manufacturing.
C3. Learn how to search for information and its critical analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the advanced methods of bonding, casting and wrought materials and advanced engineering.
PEK_W02 - He has knowledge of the basic parameters and the possibility of producing chipless forming mechanization and automation of advanced processing methods of chipless forming.
PEK_W03 - Has knowledge of the possible applications of advanced manufacturing chipless forming products.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Welding concentrated energy: plasma, electron beam and laser beam. Process Automation spawania.Spawanie concentrated energy: plasma, electron beam.	2
Lec2	Vacuum Brazing and gas shielded. February and their properties	1
Lec3	Advanced welding processes: friction, FSW, diffusion, ultrasonic, explosive and hardening	2
Lec4	Bonding advanced materials structural adhesives.	1
Lec5	Cutting methods focused energy. Mechanization and automation of cutting.	1
Lec6	The use of modern processes to improve the smelting and processing of alloys.	2
Lec7	Advanced materials and technologies used in the process of preparation of molding and core.	2
Lec8	Modern, innovative technologies of foundry molds and cores.	2
Lec9	Application of "Rapid prototyping" in foundry.	1
Lec10	Physical modeling of plastic forming processes.	1
Lec11	Production of powder metallurgy.	1
Lec12	The use of modern building materials in plastic forming processes.	1
Lec13	Flexible systems for metal forming (shaping precision)	1
Lec14	The methods of electromagnetic metal stamping.	1
Lec15	Computational methods in the design of forming processes.	1
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03PEK_K01; PEK_K02; PEK_K03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced processes of chipless forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2AIR_SP_W06, K2AIR_SP_W10, K2AIR_W07	C1; C2; C3		N1; N2; N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Zbigniew Mirski tel.: 21-42 email: zbigniew.mirski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria i technika sterowania**
Name in English: **Theory and control systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ARR031201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basics of algebra, mathematical and formulating and solving simple design tasks related to control systems. Knowledge of basics of continuous control systems. Basic knowledge of MATLAB / Simulink software.
2. Practical skills of using MATLAB software. Is capable of implementing digital algorithms based on difference equations.
3. Is able to cooperate with a team during realization of a complex engineering task. Is able to think and act in a creative way

SUBJECT OBJECTIVES

C1. Acquaintance of knowledge related to: description of discrete signals and systems, appropriate sampling time selection, analysis of the discrete system stability, equivalent transfer function determination (block-diagram algebra), the role of the hold elements (extrapolators), types of digital filters, types and structures of control system.
C2. Practical skills to analyze and design of both finite and infinite impulse response filters.
C3. Practical skills to: PID digital controller tuning, design of series corrector to particular object.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possesses knowledge related to solve linear difference equations and linear systems with discrete data (transfer function and frequency transfer function of discrete systems), analysis of the discrete system stability.
PEK_W02 - Has knowledge concerning types of digital filters, processing of analogue signals, Shannon sampling theorem.
PEK_W03 - Possesses knowledge related to types and structures of control system, components of control systems, structures of PID controller, effect of pole location on system response, state observer.

II. Relating to skills:
PEK_U01 - Is able to represent continuous control system (transfer function of continuous object) with use of discrete transfer function and discrete state space model and develop closed-loop and open-loop control systems.
PEK_U02 - Is able to select appropriate sampling time and model and perform analysis and synthesis of digital recursive filters (using bi-linear transformation method). Is able to model and perform analysis and synthesis of digital non-recursive filters (using the Fourier transformation).
PEK_U03 - Is able to tune digital PID controller using various methods.Is able to design dead-beat digital controller and robust digital controller of a given output transient performance indices. Is able to design state variable feedback controller and digital controller with a state observer.

III. Relating to social competences:
PEK_K01 - Is able to carry out a complex engineering project in a competent way, unaided as well as to cooperate with a team if required

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Discrete signal and Z transform.	3
Lec2	Discrete system representation in steady-state model.	1
Lec3	Block-diagram algebra.	2
Lec4	Extrapolators and steady state errors in discrete systems.	2
Lec5	Stability of discrete control systems.	4
Lec6	Shannon sampling theorem	2
Lec7	Digital filters	4
Lec8	Discrete modeling of continuous systems.	2
Lec9	Correction of discrete systems.	4
Lec10	Robust digital regulators.	2
Lec11	Design methods of state variable feedback controller and controller with a state observer.	4
		Total hours: 30
Form of classes – Laboratory		Number of hours

Lab1	Introduction. Setting rules of course crediting. Acquaintance with lab stands, safety rules and available software.	2
Lab2	Methods of describing the control systems - discrete control of continuous object, digital model of the continuous object.	2
Lab3	Closed-loop and open-loop control systems.	4
Lab4	Analog and digital signal processing: Shannon sampling theorem, A/D transducers.	2
Lab5	Design and analysis of recursive digital filters based on analog lowpass filters transformation.	4
Lab6	Design of nonrecursive digital filters using the inverse DFT.	4
Lab7	Tuning of the digital PID regulator.	4
Lab8	Design of dedicated and robust digital regulators.	4
Lab9	Design of state variable feedback controller. State variable feedback controller with a state observer.	4
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. informative lecture
N3. report preparation
N4. MATLAB/Simulink software.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Pass test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Activity during the classes
F2	PEK_U01, PEK_U02, PEK_U03	Presentation of the reports done
P = 0.3*F1+0.7*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory and control systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W09	C1	Lec1, Lec2, Lec3, Lec4, Lec5	N1, N2
PEK_W02	K1AIR_W09	C1	Lec6, Lec7	N1, N2
PEK_W03	K1AIR_W09	C1	Lec8, Lec9, Lec10, Lec11	N1, N2
PEK_U01	K1AIR_U14, K1AIR_U16	C1	Lab1, Lab2, Lab3	N3, N4
PEK_U02	K1AIR_U14, K1AIR_U16	C2	Lab4, Lab5, Lab6	N3, N4
PEK_U03	K1AIR_U14, K1AIR_U16	C3	Lab7, Lab8, Lab9	N3, N4
PEK_K01	K1AIR_K05	C2, C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9	N3, N4

SUBJECT SUPERVISOR

dr inż. Krzysztof Solak email: krzysztof.solak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy elektrotechniki**
Name in English: **Principles of Circuit Theory**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARR031301**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1. The student should have basic knowledge of calculus for number valued functions of one variable.
2. The students should have basic knowledge about the properties of trigonometric functions, polynomials, exponential and logarithmic functions.
3. The student should have basic knowledge of physics (electrostatics, electrical current, electromagnetic induction).
2. 1.The student should be capable of implementing correctly and effectively both the algebra and calculus to problems related to the studied engineering discipline.
2.The student should be capable of implementing correctly and effectively the laws of physics to the qualitative analysis to problems related to the studied engineering discipline.
3. 1.The student should understand the need for studying the selected discipline of study.
2.The student should understand the need for improvements of professional, personal and social skills.

SUBJECT OBJECTIVES

C1. be able to learn basic phenomena associated with the electromagnetic field.
C2. know the possibilities of using the methods, techniques and tools utilized in electrical engineering.
C3. develop skills in implementation of calculation techniques for linear electrical circuits.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - know the fundamental, electrical quantities and their units.
PEK_W02 - know and understand the methods used in analysis of electric and magnetic field.
PEK_W03 - know the methods used in linear analysis of electrical circuits.

II. Relating to skills:
PEK_U01 - be able to calculate the intensity of the electrostatic field, the intensity of current and the intensity of magnetic field for selected distributions of charge and electrical circuits.
PEK_U02 - be able to write equations describing the voltage, current and power for the elements of electrical circuit. Be able to arrange and solve linear equations describing the electric circuit elements.
PEK_U03 - be able to implement the learned theory to both qualitative and quantitative evaluation of physical quantities (voltage, current and power) relevant to electrical engineering .

III. Relating to social competences:
PEK_K01 - ability to think and act creatively and resourcefully.
PEK_K02 - ability of showing concern for the execution of his duties.
PEK_K03 - understand the need for continuous training in the field of knowledge.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction of the subject, requirements and grading policy. Fundamental values and concepts of mathematical and physical.	2
Lec2	The properties of the electric field. The electric charge. Types of electric charge. Electrification of bodies. Conservation of electric charge. Field of electrostatics. Coulomb force. The intensity and induction of the electric field and induction. Gauss' law. Capacitance. Potential and voltage. Electromotive force.	2
Lec3	The current field. The intensity of electric current. The current density. Ohm’s law. Resistance. Joule-Lenz law. Kirchhoff voltage and current law. Classification of materials due to the interaction with the electric field.	2
Lec4	The properties of the magnetic field. The intensity and induction of magnetic field. The magnetic flux. Biot - Savart law. Amper’s law. The Lorentz and Ampere force. Faraday's law. Self inductance and mutual inductance. Classification of materials due to the interaction with the magnetic field.	2

Lec5	Signals. Classification of signals. Signal parameters - the average value and Root Mean Square value (rms). Linear and non-linear elements of electrical circuit. Active and passive elements. Linear and nonlinear components. Quality factor. Models and symbols of the elements. Connection of electrical elements. Relationship between current and voltage for electrical elements.	2
Lec6	Methods for the analysis of electrical circuits in a steady state. Description methods the circuit configuration. Graphs and matrices of incidence. The method of superposition. The method of Kirchhoff's equations. Nodal method. Maxwell method. Method of alternative sources - Thevenin and Norton.	2
Lec7	Methods for the analysis of electrical circuits in transient state. Transient and steady state in linear circuits. Component of transient and steady state for constant and sinusoidal signals. Commutation law in electrical circuits. Conservation of flux in mesh. The principle of charge conservation in the node. Circuit with a single passive element. Current in RL and RC circuit for step and sinusoidal voltage. Applications of the Laplace transform to determine the transient state of SLS circuits by operators method. Synthesis of electric circuits. Two-port network.	2
Lec8	Final tests.	1
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Familiarization with the subject, the requirements and the way of crediting. Coulomb force. Calculation of the electric field and potential for point charges and linear, surface and volume charge distributions.	2
Cl2	Capacitance. The intensity and the current density. Resistance.	2
Cl3	Calculation of the magnetic field from simple electrical circuits. The Lorentz force. Faraday's Law. Self-inductance and mutual-inductance.	2
Cl4	Midterm test	1
Cl5	The mean value and Root Mean Square value of signals. Analysis of simple electrical circuits in steady state in time domain.	2
Cl6	Analysis of simple electrical circuits in steady state using the symbolic method.	2
Cl7	Analysis of simple electrical circuits in a transit state. Initial conditions in electrical circuits. Determination of transient state in electrical circuits with one and two passive elements for constant signals.	2
Cl8	Final tests.	2
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lectures supplemented by audio-visual demonstrations. Multi-media presentation.
N2. Traditional recitation sessions.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02 i PEK_W03	Final written test
P = P		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Midterm test
F2	PEK_U02, PEK_U03	Final tests
P = 0,3F1+0,7F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] T. Łobos, M. Łukaniszyn, B. Jaszczyk, Teoria pola dla elektryków, Oficyna Wydawnicza Politechniki Wrocławskiej, 2004,[2] S. Osowski, K. Siwek, M.Śmiałek, Teoria Obwodów, Oficyna Wydawnicza Politechniki Warszawskiej, 2006.[3] S. Bolkowski, Teoria Obwodów Elektrycznych , WNT 1995,

SECONDARY LITERATURE
[1] Z. Piątek , P.Jabłoński, Podstawy teorii pola elektromagnetycznego. WNT 2010,[2] S.Bolkowski, W. Brociek., H. Rawa, Teoria obwodów elektrycznych. Zadania. WNT 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Principles of Circuit Theory
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W02	C1.,C2.		N1.
PEK_W02	K1AIR_W02, K1AIR_W11	C2.		N1.
PEK_W03	K1AIR_W11	C2.		N1.
PEK_U01	K1AIR_U09	C1.,C3,		N2.

PEK_U02	K1AIR_U09	C2,.C3.		N2.
PEK_U03	K1AIR_U09	C2.,C3.		N2.
PEK_K01	K1AIR_K06	C1.,C2., C3.		N1.,N2.
PEK_K02	K1AIR_K03	C1.,C2., C3.		N1.,N2.
PEK_K03	K1AIR_K01	C1.,C2., C3.		N1.,N2.

SUBJECT SUPERVISOR

dr inż. Adam Gubański tel.: 71 320 20 26 email: adam.gubanski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy elektryczne**
Name in English: **Electrical drives**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ARR033201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the field physics, especially electrodynamics and electromagnetizm.
2. Has basic knowledge in the field of electrotechnics, including basics of DC and AC circuits theory.
3. Can properly and effectively apply the knowledge on the differential and integral calculus of single variable function for qualitative and quantitative analysis of mathematical problems connected with studying field of engineering.

SUBJECT OBJECTIVES

C1. Familiarizing students with the basic steady-state and dynamical performances of electrical drives.
C2. Familiarizing students with the basic converter-fed DC and AC motor drives, with speed control methods of mechatronic drives.
C3. Perfecting skills for measuring, data acquisition and elaboration of test results, their interpretation and analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge on basic elements of converter-fed drive, its operation regimes, can define and describe them. Can explain the principles of the operation and steady-state characteristics of the basic electrical and loading machines.
PEK_W02 - Can characterize and describe the basic methods used for speed control of the DC and AC motor drives.
PEK_W03 - Can characterize and describe the basic control structures of the DC and AC motor drives in open and closed-loop structures.

II. Relating to skills:
PEK_U01 - Can calculate basic values characterizing operation of the DC and AC motors.
PEK_U02 - Can choose the basic measurements equipment for electrical motors applied in choosen drive systems.
PEK_U03 - Can realize the experimental tests of chosen controlled electrical drives in laboratory set-up including their static and dynamical characteristics and analyse obtained results.

III. Relating to social competences:
PEK_K01 - Can cooperate and work in teams.
PEK_K02 - Can think and act in creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Electrical drive system - basic definition, components. Steady state characteristics of different types of motors and loading machines, regions of operation.	2
Lec2	Motion equation of electrical drive system, static and dynamic states, stable steady-state operation conditions. Influence of different types of mechanical connections to equation of motion.	2
Lec3	DC motor drive systems: construction and operation principle of DC motor with separate excitation, its mathematical model, steady-state characteristics, speed control and breaking methods.	2
Lec4	Cascade structure of the speed and torque control of the DC motor. Controller adjustment dynamical performances.	2
Lec5	Induction motor (IM) drive systems: principle of IM operation, its steady-state characteristics, speed control and breaking methods.	2
Lec6	Basics of frequency speed and torque control method (scalar control, principles of vector control).	2
Lec7	Brushless DC and AC permanent magnet motors; construction, principle ofoperation, basic methods for torque and speed control.	2
Lec8	Development trends in electrical drive systems. Crediting with grade.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours

Lab1	Introduction - general description of laboratory set-ups, measurement equipment and measuring methods.	2
Lab2	Forming of characteristics of the DC motor with separate excitation iin different operation modes.	2
Lab3	Testing of the DC motor drive system supplied from the bidirectional controlled rectifier.	2
Lab4	Starting systems for squirrel-cage and slip-ring induction motors.	2
Lab5	Testing of the induction motor drive supplied form the voltage inverter -scalar control.	2
Lab6	Testing of the induction motor drive supplied form the voltage inverter - vector control.	2
Lab7	Testing of the PMSM (or BLDC) drive system.	2
Lab8	Crediting with grade.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for laboratory class
N4. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_WO2, PEK_W03	colloqium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Evaluation of short tests before laboratory exercises.
F2	PEK_UO2, PEK_U03	Activity in the exercises and discussion.
F3	PEK_U01, PEK_UO2, PEK_U03	Evaluation of the written works and laboratory reports.
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
W. Leonhard, Control of Electrical Drives, Springer Verlag, 1990
Krishnan R., Electric Motor Drives – modeling, analysis and control, Prentice Hall, 2001

SECONDARY LITERATURE
Tunia H., Kaźmierkowski M.P, Automatic Control of Converter-fed Drives, Elsevier, 1994

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical drives
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W11	C1		N1, N2
PEK_W02	K1AIR_W11	C1, C2		N1, N2
PEK_W03	K1AIR_W11	C1, C2		N1, N2
PEK_U01	K1AIR_U07	C2, C3		N3, N4
PEK_U02	K1AIR_U08, K1AIR_U09, K1AIR_U11	C2, C3		N3, N4
PEK_U03	K1AIR_U09, K1AIR_U11	C2, C3		N3, N4
PEK_K01	K1AIR_K03	C1, C2, C3		N3, N4
PEK_K02	K1AIR_K06	C1, C2, C3		N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Teresa Orłowska-Kowalska email: Teresa.Orlowska-Kowalska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Biosensory**
Name in English: **Biosensors**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **ETP006367**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in basic biology, biochemistry, chemical physics and physics.
2. In capable to analyze simple electrical circuits, determination of thermodynamical parameters of biological and chemical systems.

SUBJECT OBJECTIVES

C1. Presentation of methodological principles of measurements in biological systems with the emphasis on molecular specificity.
C2. Presentation of consistent description of measuring scheme based on biosensor.
C3. Presentation of selected examples of applications of biosensors in medical diagnostics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course student should be able to understand specifications of marketed biosensors.
PEK_W02 - Student should be able to differentiate biosensors form the point of view of working principle and necessary requirements for the sample.
PEK_W03 - Student should posses knowledge on technical aspects of functioning for all main groups of biosensors.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction - information coding in biological systems	2
Lec2	The relevance of weak interactions in biology and medicine.	4
Lec3	Parametrization of biological systems and molecular basis of specificity.	2
Lec4	Classification and specification of biosensors.	2
Lec5	Basic principle of electrochemical biosensors.	2
Lec6	Redox potential and voltaperometry	2
Lec7	Amperometric measurements illustrated by glucometer and other enzymatic biosensors	4
Lec8	Selected examples of optical transducers and their applications in medical diagnostics.	6
Lec9	The structure and applications of gene- and protein- chips.	4
Lec10	Molecular imaging - selected examples.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01, PEK_W02, PEK_W03	written essay
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Material provided by the lecturer

SECONDARY LITERATURE
Textbooks in physicochemistry, biochemistry, electrochemistry and physiology.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Biosensors
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2IB_W17	C1, C2, C3	Lec1-Lec10	N1

SUBJECT SUPERVISOR

Prof. dr hab. inż. Marek Langner email: marek.langner@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Koszty jakości**
Name in English: **Quality Costs**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **FBZ001189**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basics of quality management.

SUBJECT OBJECTIVES

C1. Acquiring by the student the basic knowledge ensuring the ability to understand the economic issues related to quality management in business organisations.
C2. Becoming acquainted with the issues concerning the importance of quality costs in business, the process approach to error flows (deviations from quality requirements) and their association with the risk of hazard to people and environment, the quality cost accounting, including the one based on activities.
C3. Ability to evaluate the component parts of the costs related to quality and the way of analysing and monitoring them.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - systematised knowledge of the costs related to quality and their structure and of the ways of collecting information, analysing and monitoring

II. Relating to skills:
PEK_U01 - ability to distinguish between causes and effects of economic events concerning quality costs, both within the enterprise and in its environment, and to employ the appropriate research tools in the analysis
PEK_U02 - ability to recognize in the activities concerning the product life cycle the necessity of calculating the quality costs in the costs-benefits-risk relation

III. Relating to social competences:
PEK_K01 - awareness of the significance of quality costs in business practice and in everyday life

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the economic issues related to quality management.	2
Lec2	Quality and quality costs.	2
Lec3	Evolution of the knowledge of quality costs.	2
Lec4	Quality management concepts taking account of quality costs.	2
Lec5	Structural and economic models of quality costs.	2
Lec6	Quality cost accounting.	2
Lec7	Quality costs related to product safety.	2
Lec8	Test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
PRIMARY LITERATURE:
[1] Zymonik Z., Koszty jakości w zarządzaniu przedsiębiorstwem, wydanie drugie poszerzone, Oficyna Wydawnicza Politechniki wrocławskiej, Wrocław 2003.
[2] Zymonik Z., Hamrol A., Grudowski P., Zarządzanie jakością i bezpieczeństwem, PWE, Warszawa 2012.

SECONDARY LITERATURE
SECONDARY LITERATURE:
[1] Bank, Zarządzanie przez jakość, Gebethner i Ska, Warszawa 1996.
[2] Dahlgaard J.J., Kristensen K., Kanji G.K., Podstawy zarządzania jakością, PWN, Warszawa 2001.
[3] Szczepańska K., Koszty jakości dla inżynierów, Wydawnictwo Placet, Warszawa 2009.
Czasopisma; „Problemy Jakości”, Zarządzanie Jakością”.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Quality Costs
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2ZIP_ZJ_W01, K2ZIP_ZJ_W04	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7	N1, N2, N3
PEK_U01	K2ZIP_ZJ_U01	C2, C3	Lec5, Lec7	N1, N2, N3
PEK_U02	K2ZIP_ZJ_U06	C2, C3	Lec4, Lec5, Lec6	N1, N2, N3
PEK_K01	K2ZIP_ZJ_K01, K2ZIP_ZJ_K02	C1, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7	N1, N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Zofia Zymonik email: zofia.zymonik@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Koszty jakości**
Name in English: **Quality Costs**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **FBZ001191**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basics of quality management.

SUBJECT OBJECTIVES

C1. Acquiring by the student the basic knowledge ensuring the ability to understand the economic issues related to quality management in business organisations.
C2. Becoming acquainted with the issues concerning the importance of quality costs in business, the process approach to error flows (deviations from quality requirements) and their association with the risk of hazard to people and environment, the quality cost accounting, including the one based on activities.
C3. Ability to evaluate the component parts of the costs related to quality and the way of analysing and monitoring them

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - systematised knowledge of the costs related to quality and their structure and of the ways of collecting information, analysing and monitoring

II. Relating to skills:
PEK_U01 - ability to distinguish between causes and effects of economic events concerning quality costs, both within the enterprise and in its environment, and to employ the appropriate research tools in the analysis
PEK_U02 - ability to recognize in the activities concerning the product life cycle the necessity of calculating the quality costs in the costs-benefits-risk relation

III. Relating to social competences:
PEK_K01 - awareness of the significance of quality costs in business practice and in everyday life

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the economic issues related to quality management. Quality and quality costs.	2
Lec2	Evolution of the knowledge of quality costs. Quality management concepts taking account of quality costs.	2
Lec3	Structural models of quality costs. Quality cost accounting.	2
Lec4	Quality costs related to product safety.	2
Lec5	Quality costs related to product safety, contd. Test	2
		Total hours: 10

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = 1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

PRIMARY LITERATURE:
[1] Zymonik Z., Koszty jakości w zarządzaniu przedsiębiorstwem, wydanie drugie poszerzone, Oficyna Wydawnicza Politechniki wrocławskiej, Wrocław 2003.
[2] Zymonik Z., Hamrol A., Grudowski P., Zarządzanie jakością i bezpieczeństwem, PWE, Warszawa 2012.

SECONDARY LITERATURE

[1] Bank, Zarządzanie przez jakość, Gebethner i Ska, Warszawa 1996.
[2] Dahlgaard J.J., Kristensen K., Kanji G.K., Podstawy zarządzania jakością, PWN, Warszawa 2001.
[3] Szczepańska K., Koszty jakości dla inżynierów, Wydawnictwo Placet, Warszawa 2009.
Czasopisma; „Problemy Jakości", Zarządzanie Jakością".

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Quality Costs
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2ZIP_ZJ_W01, K2ZIP_ZJ_W04	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5	N1, N2, N3
PEK_U01	K2ZIP_ZJ_U01	C2, C3	Lec3, Lec4, Lec5	N1, N2, N3
PEK_U02	K2ZIP_ZJ_U06	C2, C3	Lec2, Lec3	N1, N2, N3
PEK_K01	K2ZIP_ZJ_K01, K2ZIP_ZJ_K02	C1, C3	Lec1, Lec2, Lec3, Lec4, Lec5	N1, N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Zofia Zymonik email: zofia.zymonik@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Biospektroskopia**
Name in English: **Biospectroscopy**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **FTP007331**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. credited physics and chemistry courses

SUBJECT OBJECTIVES

C1. Getting basic knowledge: spectroscopic techniques, use of chemical imaging in biology and medicine, ability to read spectra and quantitative determination of parameters.
C2. Ability to design experiments using spectroscopic methods.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know and understand the basic laws which are based on spectroscopic techniques.
PEK_W02 - Has a basic knowledge of the structure and operation of various spectrophotometers.

II. Relating to skills:
PEK_U01 - can analyze the spectrum of used materials
PEK_U02 - Can use spectroscopic methods to identify materials
PEK_U03 - Being able to plan an experiment using spectrophotometric methods

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The introduction of credit conditions, the basic laws of chemistry, which is based on molecular spectroscopy.	2
Lec2	Basic laws and concepts used in molecular spectroscopy.	2
Lec3	kinds of spectroscopy and the information it provides about the molecules in different spectral ranges.	2
Lec4	Analysis of the spectra at different ranges, determination of the spectral parameters and interpretation of spectra.	4
Lec5	Applicationsof spectroscopy in various areas with particular emphasis on biological and medical sciences.	4
Lec6	Construction of spectrophotometers, radiation sources, permeable materials, recording techniques.	2
Lec7	Principles of chemical imaging.	2
Lec8	Construction of microscopes: fluorescent, Raman, FT-IR, NIR.	2
Lec9	Biomedical application of chemical imaging.	2
Lec10	Pharmaceutical application of chemical imaging.	2
Lec11	Application of chemical imaging in the polymer technology.	2
Lec12	Poster session for a class: Each student prepares a poster presentation of their choice spectroscopy applications in medicine.	4
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02,PEK_U01, PEK_U02, PEK_U03	Presentation of the poster
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Biospectroscopy
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02,U01, PEK_U02, PEK_U03	K2IB_W13	C1, C2	Lec1-Lect12	N1, N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Małgorzata Komorowska tel.: 71 320 3168 email: malgorzata.komorowska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy informatyczne w medycynie**
Name in English: **Medical Information Systems**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBE001001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No prerequisites are required.

SUBJECT OBJECTIVES

C1. Presentation of the basic issues concerning the use of information systems in medical applications
C2. To acquaint students with the methods of information processing in medical information systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Studen knows the methods of information processing in medical imaging.
PEK_W02 - Studen knows the basic structure of health systems, their advantages and disadvantages.
PEK_W03 - Student has knowledge about algorithms decision support systems in medicine.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts of medical informatics (medical information, models, systems).	2
Lec2	Information systems in medicine (objectives, requirements, tasks, examples).	2
Lec3	Specialised databases in medicine.	2
Lec4	Medical records	2
Lec5	Classification systems, methods of coding of medical information.	3
Lec6	The acquisition of medical data.	2
Lec7		4
Lec8	Algorithms for analysis and interpretation of bio-signals.	3
Lec9	Computer systems for medical decision support.	3
Lec10	Intelligence sysyems in medicine	3
Lec11	Structures of medical information systems.	2
Lec12	The selected modules of information systems in medicine.	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 – W03	test, oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Coiera Enrico, Guide to Medical Informatics, the Internet and Telemedicine, Arnold Edi., 1997.
Kompendium Informatyki Medycznej, [red] P. Szczepaniak, M. Kurzyński, R. Zajdel, Alfa Medica Press, 2002.
Nałęcz M.[red], Problemy Biocybernetyki i Inżynierii Biomedycznej, tom V Informatyka Medyczna, WKiŁ, Warszawa 2000.

SECONDARY LITERATURE

Wymagania Funkcjonalno-Użytkowe Oprogramowania Aplikacyjnego dla ZOZ. (Ruch Chorych, Apteka, Rachunek Kosztów Leczenia), wyd. MZiOS, Biuro Przekształceń Systemowych w Ochronie Zdrowia, Warszawa 1996.
Zasoby sieci Internet.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Medical Information Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2IB_W03, K2IB_W04	C1, C2	Lec1-Lec12	N1, N2

SUBJECT SUPERVISOR

dr inż. Edward Puchała email: edward.puchala@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza obrazów medycznych**
Name in English: **Medical image processing**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student knows the basics of structured programming in C / C++

SUBJECT OBJECTIVES

C1. Familiarizing with medical imaging methods and computer image analysis algorithms for filtering, segmentation and spatial modeling
C2. Introduction to the implementation of digital medical image analysis algorithms
C3. The introduction to the latest trends in the field of digital medical image analysis, decision support, virtual and augmented reality

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has structured knowledge of medical imaging methods, physical phenomena, the applicability of specific methods of imaging in terms of imaging possibilities and their invasiveness, and medical image file formats
PEK_W02 - Student has a basic knowledge of the methods of medical image filtering and segmentation of objects on medical images
PEK_W03 - Student has an elementary knowledge of new trends in the analysis of medical images, virtual and augmented reality.

II. Relating to skills:
PEK_U01 - Student can implement selected algorithms of filtering and image analysis (including quantitative analysis) and can solve the problems in the area of filtration and analysis stand-alone
PEK_U02 - Student can analyze medical data in DICOM format using packaged applications
PEK_U03 - Student can prepare a dossier with a discussion of the results of image analysis

III. Relating to social competences:
PEK_K01 - Student can work on tasks stand-alone and in a group
PEK_K02 - Student can think and act creatively

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Medical imaging methods (summary of information about the methods of CT, MRI, ultrasonography, endoscopy, PET, SPECT).	1
Lec2	Medical imaging methods (summary of information about the methods of CT, MRI, ultrasonography, endoscopy, PET, SPECT). Format of medical images.	2
Lec3	Computer analysis of digital images. Algorithms of image interpretation. Artifacts origin in medical images. Methods of noise filtration.	2
Lec4	Algorithm of object recognition on static medical images	2
Lec5	Algorithms for tissue structures recognition in images recorded in real time (video sequences)	2
Lec6	Spatial modelling of tissue structures	2
Lec7	Virtual and augmented reality. New trends in the analysis of medical images.	2
Lec8	New trends in the analysis of medical images. Examples of systems for medical decision support.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Familiarizing with the basics of programming environment.	1
Lab2	Methods to load digital images in the following formats: BMP and DICOM.	2
Lab3	Methods of filtering of medical images	2
Lab4	Tissue structures recognition (e.g. bone tissue, tumor) on medical images	2

Lab5	Quantitative analysis of medical images	2
Lab6	Segmentation and spatial modelling of bone tissue using customized software	2
Lab7	Evaluation project / Visit to the laboratory of laparoscopic simulation	2
Lab8	Evaluation project	2
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. report preparation
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	report of the exercises laboratory
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	report
P = 0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Ryszard Tadeusiewicz, Mariusz Flasiński, Image recognition, National Scientific Publisher, Warsaw, 1991 (in Polish).
[2] Ryszard Tadeusiewicz, Przemysław Korohoda: Computer Analysis and image processing, Telecommunications Advancement Foundation Publisher, Kraków 1997 (in Polish).

SECONDARY LITERATURE

[1] Jasjit S. Suri, David L. Wilson, Swamy Laxminarayan: Handbook of Biomedical Image Analysis. Kluwer Academic / Plenum Publishers, New York, Boston, Dordrecht, London, Moscow, 2005.
[2] Isaac Bankman: Handbook of Medical Imaging: Processing and Analysis Management (Biomedical Engineering), Academic Press; 1 edition (October 13, 2000)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Medical image processing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W04, K2IB_W23	C1	Lec1, Lec2, Lec3	N1, N2
PEK_W02	K2IB_W03, K2IB_W04, K2IB_W22, K2IB_W24	C1, C2	Lec3, Lec4, Lec5, Lec6	N1, N2
PEK_W03	K2IB_W22	C3	Lec7, Lec8	N1, N2
PEK_U01	K2IB_U01, K2IB_U02, K2IB_U14, K2IB_U20, K2IB_U21, K2IB_U22	C1, C2	Lab1, Lab2, Lab3, Lab4, Lab5, Lab7, Lab8	N3, N4
PEK_U02	K2IB_U06, K2IB_U14	C2, C3	Lab6	N3, N4
PEK_U03	K2IB_U03, K2IB_U14	C1, C2, C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8	N3, N4
PEK_K01	K2IB_K02, K2IB_K04	C1, C2, C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8	N3, N4
PEK_K02	K2IB_K05, K2IB_K07, K2IB_K08	C1,C2, C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8	N3, N4

SUBJECT SUPERVISOR

dr inż. Ewelina Świątek-Najwer tel.: 71 320-21-93 email: ewelina.swiatek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Biomateriały**
Name in English: **Biomaterials**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Examination				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of general chemistry and physical chemistry. He knows the basics of chemistry related to the structure and properties of chemical compounds.
2. Student has a well-established knowledge of basic phenomena and the laws of physics and the physical properties of matter.
3. Student knows the basics of material science and technology of materials.

SUBJECT OBJECTIVES

C1. Student get knowledge different groups of modern engineering materials used in medicine.
C2. Getting understand the importance of the role of biomaterial in the body's response.
C3. Acquiring knowledge of the selection of biomaterials that meet certain requirements in terms of medical and technical.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge of the classification requirements of biomaterials and biomaterials. Characterized by the biological, structural and mechanical properties of biomaterials used for specific clinical applications. Has knowledge of the various stages of the integration of biomaterial - tissue.
PEK_W02 - Student has knowledge of the methods of manufacture of individual groups of biomaterials that determine their properties. He knows the concept of biocompatibility. He has knowledge about how to modify the surface of the implant.
PEK_W03 - Student has knowledge of the methods of sterilization of implant materials. He knows the legal conditions for the placing on the market of a new biomaterial.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to biomaterials, the definition and classification of biomaterials. Requirements for biomaterials.	2
Lec2	Interfacial phenomena: the biomaterial-biological environment (adsorption of proteins, cell adhesion, inflammation, regeneration).	3
Lec3	Corrosion. Metals and alloys used in medicine, Co-Cr-Mo alloys, Ti alloys. Shape memory materials.	3
Lec4	Biopolymers: biostable, resorbable and natural polymers.	2
Lec5	Bioceramics. The bioactivity of ceramic materials.	2
Lec6	Composites as biomimetic materials, graded materials. Carbon materials in medicine.	2
Lec7	Nanocomposites. Biocompatibility of nanoparticles and their application in medicine.	2
Lec8	Selected issues concerning the design of biomaterials, surface functionalization.	2
Lec9	Surface modification of biomaterials, surface layers.	2
Lec10	Infections and medical sterilization. Biomaterials used for surgical instruments.	2
Lec11	European standards and regulations on animal research. The organization and monitoring of clinical trials.	2
Lec12	Osteosynthesis. Biomaterials for orthopedic and cardiac surgery.	2
Lec13	The polymeric drug carrier polymers in the process of the controlled release of drugs.	2
Lec14	Prospects for the development of biomaterials, tissue engineering.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Exam
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Błażewicz S., Stoch L. „Biomateriały, t.4; Biocybernetyka i inżynieria Biomedyczna 2000” pod red. Macieja Nałęcza,
[2] Marciniak J. „Biomateriały” Gliwice 2002,
[3] Łaskawiec J., Michalik R. „Zagadnienia teoretyczne i aplikacyjne w implantach”, Gliwice 2002
[4] Jaegermann Z., Ślósarczyk A., „Gęsta i porowata bioceramika korundowa w zastosowaniach medycznych „ AGH Uczelniane Wydawnictwa Naukowo-Dydaktyczne 2007.

SECONDARY LITERATURE
[5] Dąbrowski J.R., „Spiekane biomateriały na bazie stopu Co-Cr-Mo” Oficyna Wydawnicza Politechniki Warszawskiej 2004,
[6] Kurzydłowski K., Lewandowska S., Nanomateriały inżynierskie konstrukcyjne i funkcjonalne, Wydawnictwo Naukowe PWN,
[7] Dee K.C., „Tissue-Biomaterial Interaction”, Wiley – Liss 2003
[8] Inżynieria Biomateriałów

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Biomaterials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K2IB_W01, K2IB_W06	C1	Lec1-Lec7, Lec14	N1, N2, N3
PEK_W02	K2IB_W01, K2IB_W02	C1, C2	Lec3-Lec9	N1, N2, N3
PEK_W03	K2IB_W01	C3	Lec10-Lec13	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Anna Nikodem tel.: 71 320-29-83 email: Anna.Nikodem@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie układów wspomagających lokomocję człowieka**
Name in English: **Design of the human locomotion supporting system**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				150	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				5	
including number of ECTS points for practical (P) classes				5	
including number of ECTS points for direct teacher-student contact (BK) classes				3.5	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the basics of the mechanical structures designing, the construction of control systems of machines and devices, as well as the biomechanics of human motion system.
2. Student has mastered the ability to represent machine components and assemblies by freehand drawing and AutoCad system.
3. Student has ability to work systematically, gradually realizing work tasks.

SUBJECT OBJECTIVES

C1. Learning to the complex devices designing of the human locomotion supporting systems.
C2. Preparation for work in a team.
C3. Increase knowledge of devices design basics particularly for biomedical engineering devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can design a complex device for supporting of physically disabled person locomotion, designing the necessary parts and assemblies, as well as expertly selecting finished systems and assemblies.
PEK_U02 - Student can interact with other participants in the process of design and construction, serving a variety of roles in a team.
PEK_U03 - Student can prepare technical documentation and evaluate innovativeness of designed solutions based on the analysis of existing machines and devices.

III. Relating to social competences:
PEK_K01 - Student can identify and take into account in its action priorities for implementation tasks undertaken.
PEK_K02 - Student can identify and take into account in its action priorities for implementation of the taken task.
PEK_K03 - Student is able to present results of his work using modern techniques of presentation.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction - general formulation of the problem to be solved (in the field of physically disabled person locomotion supportingt - such as providing an autonomy upright for paraplegic persons, enabling participation in marathons, etc.), information on the principles of the realisation and evaluation of the project; homework # 1: Prepare a short description of the selected method (techniques) exploring the concept of solving the problem design and analysis of existing solutions.	3
Proj2	A brief discussion of the various techniques of the solution concepts searching, selection one of them for application bythe project team, formulation of the brief foredesignst and criteria for solutions evaluation; conduct a session to generate ideas solve the problem, the choice of conception to realization; homework 2: Structuring of the design process - proposition of the algorithm describing the design process developing.	3
Proj3	Analysis of the prepared algorithms, establishing checkpoints of the design process. Extract the teams performing various tasks (eg, biomechanical analysis, the design powertrain, etc.) homework 3: Detailed analysis of the task - to develop proposals of designing and evaluation criteria for solving a given task.	3
Proj4	Generating the solution concepts of the individual tasks (eg brainstorming sessions) and select conception to realization; homework 4: develop proposals schedule of individual tasks and a list of the informations necessary for the task, which should be provided by the other teams.	3
Proj5	Set a schedule of the project, selection of the tasks coordinator, presentation of the solutions concepts for particular tasks. Homework 5: working in teams.	3
Proj6	Working in teams, exchange of informations, consultations, presentation of the biomechanical analysis results and diagrams depicting the proposed specific solutions.	3
Proj7	Continued work in teams, a presentation of the proposed solutions and basic calculations (including FEM).	3

Proj8	Continued work in teams, a presentation of the proposed solutions and basic calculations (including FEM).	3
Proj9	Presentation of the stage of completion in teams - evaluation of the teams.	3
Proj10	Continuation of works in teams, verification of the solutions in terms of their integration possibility.	3
Proj11	Continued work in teams, analyze the choice of materials and manufacturing technology of the components and assemblies (designed within the project).	3
Proj12	Continued work in teams, analysis of designed devic production costse, presentation of the results of the teams.	3
Proj13	Continuation of the results presentation of the teams,set up a team responsible for the final report preparation. Verification of the each task documentation.	3
Proj14	Continued verification of the tasks documentation. Discussion on development opportunities of the designed device, the scope of prototype examination, another solutions choose.	3
Proj15	Presentation of the project, the evaluation of the innovativeness, project evaluation.	3
		Total hours: 45

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. problem discussion
N3. project presentation
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01	participation in problem discussions; evaluation of the homeworks (Z); F1=(Z1 +....+Z4)/4
F2	PEK_U01, PEK_U03, PEK_K02	evaluation of preparation and computational part of the project, good rating is needed (min. 3.0).
F3	PEK_U02, PEK_K03	project presentation, good rating is needed (min. 3.0).
P = 1/10*F1+3/5*F2+3/10*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Dietrych M. (red.), Podstawy konstrukcji maszyn, PWN, Warszawa, 1989.
[2] Prochowski L., Mechanika ruchu, WKiŁ, Warszawa, 2005.
[3] Pawlicki G., Podstawy inżynierii medycznej, Wyd. PW, Warszawa, 1997.
[4] Będziński R., i in., Biomechanika i inżynieria rehabilitacyjna, Tom 5, Biocybernetyka i Inżynieria Biomedyczna, pod red. Nałęcza M., Polska Akademia Nauk, Warszawa, 2004.

SECONDARY LITERATURE
[1] Pahl G., Beitz W., Nauka konstruowania, WNT, Warszawa, 1984
[2] Mazanek E.(red.), Przykłady obliczeń z podstaw konstrukcji maszyn, WNT, Warszawa, 2008.
[3] Bober T., Zawadzki J., Biomechanika układu ruchu człowieka, Wyd. BK, Wrocław, 2001.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of the human locomotion supporting system
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K2IB_U03, K2IB_U07, K2IB_U08	C1, C2, C3	Proj1 - Proj14	N1 - N5
PEK_K01 - PEK_K03	K2IB_K07	C2	Proj1 - Proj14	N1 - N5

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Roboty i manipulatory medyczne I**
Name in English: **Manipulators and Medical Robots**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mechanics and strength of materials
2. Knowledge of the basics of mechanical structures
3. knowledge of the biomaterials

SUBJECT OBJECTIVES

C1. Discussion of robots and manipulators used in medical practice, characterize their structure, used powertrain and sensory systems
C2. Presentation of the development prospects of medical robots and manipulators.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - have a basic knowledge about medical robots and manipulators, the scope of their applications, types of used construction solutions.
PEK_W02 - has knowledge of the requirements that must be satisfied a technical device dedicated to surgery on a living organism.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Application possibilieties of robots and manipulators in modern medicine.	2
Lec2	The basic concepts of the mechanisms and machines theory.	2
Lec3	Laboratory manipulators, medication dispensers; structure, systems drive used.	2
Lec4	Surgical robots, applications, review of existing design solutions.	3
Lec5	Kinematic structure of surgical manipulators, drive systems, control and sensor technology.	2
Lec6	Robots for technical servicing the hospital, informational robots, auxiliary robots and manipulators.	2
Lec7	Development trends of robots in modern medicine, medical microrobots and nanorobots.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Będziński R. (ed.), Engineering Technology, Vol. XII Biomechanics. Institute of Fundamental Technological Research, Warsaw 2011 (in Polish)

Nałęcz M. (ed.), Biocybernetics and Biomedical Engineering, Vol. 3: Artificial organs, Exit Academic Publishing House, Warsaw 2004

Morecki A., Knapczyk J.: Introduction to robotics, theory and components of manipulators and robots, ed. III, WNT, Warsaw, 1999

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manipulators and Medical Robots
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W03, K2IB_W04, K2IB_W11, K2IB_W16, K2IB_W22	C1, C2	Lec2-Lec6	N1
PEK_W02	K2IB_W05, K2IB_W07	C1, C2	Lec1, Lec7	N1

SUBJECT SUPERVISOR

dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wybrane działy matematyki**
Name in English: **Selected issues of mathematics**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041005**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has basic knowledge of mathematical statistics, probability theory, error analysis and experiment planning necessary to describe and analyze the data obtained in the study
2. Student has skills in interpretation, presentation and documentation of experiments, analysis and monitoring of processes and tasks of a project
3. Student able to use computer tools, including specialized applications, graphics programs, PC systems

SUBJECT OBJECTIVES

C1. Introduction to the methods of statistical analysis in practical applications, with particular emphasis on biomedical engineering
C2. Acquainting with computer algorithms using statistical analysis software such as Statistica
C3. Presentation of the needs and specific requirements of industry and science in the field of statistical data analysis and experiment planning, including clinical studies

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered, broader and deeper knowledge of the techniques of statistical inference, including the parametric and non-parametric tests, regression analysis (simple, multiple, stepwise, non-linear and logistic), variance (univariate and multivariate), canonical analysis, discriminant, and factorial analysis clustering, and survival analysis.
PEK_W02 - Student has ordered knowledge of the theoretical assumptions of statistical data analysis implementation to PC software like Statistica
PEK_W03 - Student has a basic knowledge of experimental design including statistical data analysis

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts Introduction to data processing	2
Lec2	Descriptive Statistics Measures of location, variability, asymmetry and concentration	2
Lec3	Statistical distributions Random variables and their distributions	2
Lec4	Statistical Inference - Hypothesis Testing Parametric statistical tests 1	2
Lec5	Statistical Inference - Hypothesis Testing Parametric statistical tests 2	2
Lec6	Statistical Inference - Hypothesis Testing Non-parametric statistical tests 1	2
Lec7	Statistical Inference - Hypothesis Testing Non-parametric statistical tests 2	2
Lec8	Statistical Inference - Hypothesis Testing Contingency tables and the sensitivity and specificity, and ROC curve - diagnostic tools	2
Lec9	Statistical Inference - Hypothesis Testing Testing multiple comparisons post-hoc	2
Lec10	The study relationships between variables - correlation	2
Lec11	The study relationships between variables - regression	2
Lec12	Methods for exact nonparametric inference in the case of abnormal distribution of the experimental data	2
Lec13	Analysis of canonical discriminant and cluster analysis	2
Lec14	Analysis of survival	2
Lec15	Elements of experimental design	2
		Total hours: 30

TEACHING TOOLS USED
N1. informative lecture N2. multimedia presentation N3. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] A. Stanisz, Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny. Tom 1. Statystyki podstawowe. Kraków, 2006.
[2] A. Stanisz, Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny. Tom 2. Kraków, 2006.
[3] A. Stanisz, Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny. Tom 3. Kraków, 2006.
[4] J. Koronacki J., J. Mielniczuk, Statystyka dla studentów kierunków technicznych i przyrodniczych. WNT, Warszawa, 2001.
[5] J. Greń, Statystyka matematyczna – modele i zadania. PWN Warszawa , 1978.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Selected issues of mathematics** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Biomedical Engineering**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K2IB_W20	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14	N1, N2, N3
PEK_W02	K2IB_W21	C2	Lec5, Lec7	N1, N2, N3
PEK_W03	K2IB_W21	C1, C3	Lec15	N1, N2 N3

SUBJECT SUPERVISOR

dr inż. Magdalena Kobielarz tel.: 71 320-22-50 email: Magdalena.Kobielarz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanobiologia**
Name in English: **Mechanobiology**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041009**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of biomedical engineering
2. Mechanics and strength of materials

SUBJECT OBJECTIVES

C1. Describe the role of mechanical stimuli as a factor in regulating biological processes in a living organism.
C2. Discussion of selected biomechanical models of biological processes in the living organism.
C3. The acquisition of the practical use of mechnobiological models for the analysis of processes formation, differentiation and tissue remodeling.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge about the effects of the mechanical stimuli impact on the tissue in the living organism.
PEK_W02 - has knowledge of currently used biomechanical models of biological processes in the living organism

II. Relating to skills:
PEK_U01 - able to apply the mathematical model of the biomechanical process to analysis of issues related to the tissues remodeling as a function of the load application.
PEK_U02 - can individually analyze the results of numerical simulations (FEM) of biological processes in tissues.

III. Relating to social competences:
PEK_K01 - is aware of the role of the engineer in their efforts to improve the quality of life of contemporary society.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechanobiologia, historical overview. Discussion of the mechanical parameters are treated as stimuli affecting the biological responses of cells and tissues.	2
Lec2	Tissue mechanical characteristics, their comparison depending on the load type (static or dynamic).	2
Lec3	Mesenchymal stem cells (MSC) and their role in tissue adaptation processes.	2
Lec4	Effect of mechanical factors on the biological processes that occur in the tissues, tissue sensitivity to mechanical stimuli.	2
Lec5	The formation and development of bone tissue.	2
Lec6	Bone tissue modeling and remodeling, the interaction between tissues and implants.	2
Lec7	Bone remodeling model by Carter	2
Lec8	Bone remodeling model by Huiskes and Prendergrast.	2
Lec9	Models of tissues proliferation and differentiation in the fracture gap.	2
Lec10	Mechanobiology of leg elongation process, part 1.	2
Lec11	Mechanobiology of leg elongation process, part 2.	2
Lec12	Blood vessel wall mechanobiology, healthy and pathological lesions (aneurysm, atherosclerosis).	2
Lec13	Biomechanical aspects of cooperation between the stent and a blood vessel.	2
Lec14	Bioreactors in tissue engineering, the role of tissue bioreactors, design of bioreactors, bioreactors for clinical applications	2
Lec15	Scafolds design and manufacture, scafolds biocompatibility.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	The impact of external concentrated forces on bone remodeling by the Carter algorithm.	6

Proj2	Remodeling of the trabecular and cancellous bone structure - Tsubota algorithm.	6
Proj3	Tissue remodeling around the implant as a result of interaction between the implant and tissue.	6
Proj4	Modeling and analysis of the pressure wave as a effect on the state of strain and the stress in the blood vessel wall.	6
Proj5	Effect of bone fragments displacement on differentiation and tissue remodeling processes on the bone fractures gap.	6
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem exercises
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01	mark of the project Proj1
F2	PEK_U01, PEK_U02, PEK_K01	mark of the project Proj2
F3	PEK_U01, PEK_U02, PEK_K01	mark of the project Proj3
F4	PEK_U01, PEK_U02, PEK_K01	mark of the project Proj4
F5	PEK_U01, PEK_U02, PEK_K01	mark of the project Proj5
P = (F1+F2+F3+F4+F5)/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Będziński R. (ed.), Engineering Technology, Vol. XII Biomechanics. Institute of Fundamental Technological Research, Warsaw 2011 (in Polish)

Van C. Mow, Huiskes R.: Basic Orthopaedic Biomechanics and Mechano-Biology. Lippincott Williams & Wilkins, Philadelphia, 2005

SECONDARY LITERATURE

journals: Journal of Biomechanics, Clinical Biomechanics, Acta of Bioengineering and Biomechanics

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanobiology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W09, K2IB_W14	C1	Le1-Le6, Le12, Le13, Le15	N1, N2
PEK_W02	K2IB_W06, K2IB_W09	C2	Le7-Le11, Le14	N1, N2
PEK_U01	K2IB_U01, K2IB_U02	C3	Proj1- Proj5	N2, N3
PEK_U02	K2IB_U03, K2IB_U04, K2IB_U06	C3	Proj1- Proj5	N2, N3
PEK_K01	K2IB_K01, K2IB_K02, K2IB_K08	C1, C2, C3	Proj1- Proj5	N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody badań biomateriałów**
Name in English: **Methods of Biomaterials Testing**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041011**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the basics of material science and technology of materials.
2. Student has knowledge about classification of biomaterials, he is able to characterize the biological properties, structural and mechanical properties of biomaterials used for specific clinical applications.
3. Student has a basic knowledge of mechanics and strength of materials.

SUBJECT OBJECTIVES

C1. Get to know the trends in the development of modern methods of measurement of biomaterials, conducted at different scales: macro / micro / nano.
C2. Student get knowledge and skills in conducting experimental studies aimed at determining the physical and mechanical properties of biomaterials.
C3. Acquisition of knowledge and skills in the field of research of chemical and structural properties of biomaterials, especially in terms of their functions and the required traits.
C4. Acquisition of basic knowledge about testing the biological activity of medical devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge of investigations of physical, mechanical, chemical and biological properties of biomaterials.
PEK_W02 - Student has a basic knowledge of experimental studies of degradation of implant materials.
PEK_W03 - Student has a basic knowledge of the possibilities to use cell lines in toxicity studies of biomaterials.

II. Relating to skills:
PEK_U01 - Student is able to analyze the relationship between the physical, chemical and structural properties of biomaterials and their functions.
PEK_U02 - Student is able to perform simple measurement apparatus designed to study the chemical, physical and structural properties of biomaterials.
PEK_U03 - Student can choose the appropriate techniques and measurement procedures, depending on the type of test and the type of biomaterial.

III. Relating to social competences:
PEK_K01 - Student is able to interpret the results of the experiments.
PEK_K02 - Student is aware of the need for interdisciplinary research in medical devices placed on the market.
PEK_K03 - Student can work on tasks independently and in groups.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Methods of experimental studies: introduction, classification, testing standards.	2
Lec2	Experimental studies on different organization levels at the micro, macro, meso and nano scales.	2
Lec3	Test methods for physical and structural properties of tissues and biomaterials.	3
Lec4	Test methods for mechanical properties: destructive test methods, static and dynamic mechanical tests.	2
Lec5	Test methods for mechanical properties: hardness and impact resistance measurements.	2
Lec6	Test methods for mechanical properties: methods of non-destructive testing, ultrasonic methods.	2
Lec7	Methods of test surfaces of biomaterials: methods of medical imaging.	2
Lec8	Test methods for biomaterial surfaces: X-ray, optical microscopy, TEM, SEM and AFM.	2
Lec9	Test methods for biomaterial surfaces: roughness and contact angle measurement.	2
Lec10	Test methods for biomaterial surfaces: test for resistance to wear.	3
Lec11	Methods for determining the chemical composition of biomaterials: elemental analysis, FT-IR spectroscopy, Raman spectroscopy, NMR spectroscopy. Liquid and gas chromatography.	2
Lec12	Histological and histochemical measurement methods.	2
Lec13	Studies in vivo and in vitro biomaterials: cytotoxicity and thrombocompatibility	2
Lec14	Qualitative assessment of the final products.	1

Lec15	Final test	1
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to laboratory safety training. Determination of mechanical properties of biological tissues.	2
Lab2	Determination of mechanical characteristics of tissues and biomaterials, in dynamic measurements.	2
Lab3	Test methods for biomaterial surfaces: microscopic methods.	2
Lab4	Test methods for biomaterial surfaces: profiler, contact angle, surface roughness.	2
Lab5	Corrosion testing of metallic biomaterials.	2
Lab6	Hardness test of biomaterials: the measurement of microhardness and scratchtests.	2
Lab7	Biotribological tests:: Measurement of wear resistance of metals and plastics.	2
Lab8	Degradation of biomaterials in simulated biological environment.	2
Lab9	Measurement of the mechanical properties using ultrasonic methods.	2
Lab10	Techniques for producing coatings: sol-gel method.	2
Lab11	Test methods for structural properties: microcomputed tomography	2
Lab12	Cytotoxicity biomaterials measurements I.	2
Lab13	Cytotoxicity biomaterials measurements II.	2
Lab14	Thrombocompatibility of biomaterials measurements.	2
Lab15	Characteristics of bacteria and biofilm on the surface of biomaterials.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - self studies and preparation for examination
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	Evaluation of preparation and implementation of laboratory tasks, verbal response, optional - a written report of the laboratory tasks.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Błażewicz S., Stoch L. (2003); Biocybernetyka i Inżynieria Biomedyczna 2000. Tom 4. Biomateriały, pod red. Macieja Nałęcza, Exit, Warszawa
[2] Jaźwiński S. (1988); Instrumentalne metody badań materiałów, Wydawnictwa Politechniki Warszawskiej, Warszawa
[3] Szczepaniak, W. (2008); Metody instrumentalne w analizie chemicznej, PWN, Warszawa
[4] Michler, G.H. (2008); Electron microscopy of polymers, Springer
[5] Bala, H. (2003) Wstęp do chemii materiałów, WNT, Warszawa

SECONDARY LITERATURE

[6] Cygański, A. (2009); Metody spektroskopowe w chemii analitycznej, WNT, Warszawa
[7] Łaskawiec J., Michalik R. (2002); Zagadnienia teoretyczne i aplikacyjne w implantach, Gliwice
[8] Rabek, J.F. (2009); Współczesna wiedza o polimerach, PWN, Warszawa
[9] Niezgodziński, M.E., Niezgodziński, T. (2010); Wytrzymałość materiałów, PWN, Warszawa
[10] Kurzydłowski, K., Lewandowska, M. (2010); Nanomateriały inżynierskie konstrukcyjne i funkcjonalne, PWN, Warszawa

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods of Biomaterials Testing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W01, K2IB_W06	C1-C4	Lec1-Lec14	N1, N3, N5

PEK_W02	K2IB_W01, K2IB_W07	C1-C3	Lec1, Lec2, Lec10	N1, N3, N5
PEK_W03	K2IB_W01, K2IB_W09	C1, C4	Lec1, Lec2, Lec13	N1, N3, N5
PEK_U01	K2IB_U09, K2IB_U11	C2, C3	Lab1-Lab15	N2, N4, N5
PEK_U02	K2IB_U11, K2IB_U13, K2IB_U14	C2, C3	Lab1-Lab15	N2, N4, N5
PEK_U03	K2IB_U10, K2IB_U14	C1-C4	Lab1-Lab15	N2, N4, N5
PEK_K01	K2IB_K08	C1-C4	Lab1-Lab15	N2, N4, N5
PEK_K02	K2IB_K01, K2IB_K02	C1, C4	Lab1-Lab15	N2, N4, N5
PEK_K03	K2IB_K04, K2IB_K07	C2, C3	Lab1-Lab15	N2, N4, N5

SUBJECT SUPERVISOR

dr inż. Anna Nikodem tel.: 71 320-29-83 email: Anna.Nikodem@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Proseminarium dyplomowe**
Name in English: **Thesis proseminar**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041012**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					15
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Background & general knowledge about realised Master’s thesis area.

SUBJECT OBJECTIVES

C1. Knowledge of proper technical and scientific Master Thesis preparation.
C2. Review of current knowledge, aim and scope for diploma thesis preparation.
C3. Selection the individual own diploma thesis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can prepare & present the research problem using text, charts & tables.

II. Relating to skills:
PEK_U01 - Rules of proper technical and scientific paper preparation.

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review it.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Information about diploma work and diploma exam - requirements. Selection the individual own diploma thesis. Review of current knowledge, aim and scope of individual diploma thesis – students presentations. Reports from progress in realization of students work – students presentation.	15
		Total hours: 15

TEACHING TOOLS USED

N1. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_K01	Evaluation of project preparation.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.Publications from the scope of the thesis carried out
2.Baranowski B.; Metody twórczego rozwiązywania problemów inżynierskich. Wielkopolska Korporacja Techniczna NOT, Poznań 1999
3. Regulations Governing Higher Education Studies at Wroclaw University of Technology
4. G. Gambarelli, Z. Łucki: Jak przygotować pracę dyplomową lub doktorską. Wyd. Universitas, Kraków 1996, wyd. II.
5. R. Zanderowski: Praca magisterska, licencjat: krótki przewodnik po metodologii pisania i obrony pracy dyplomowej. Wyd. Fachowe CeDeWu PL, Warszawa 2009.

SECONDARY LITERATURE
1.Wiszniewski A.; Sztuka pisania. Videograf II, Katowice 2003
2. B. Kurzępa, E. Kurzępa: Ochrona własności intelektualnej: zarys problematyki. Wyd. Towarzystwo Naukowe Organizacji i Kierownictwa "Dom Organizatora", Toruń 2010.
3. A. Lenar: Profesjonalna prezentacja multimedialna. Wyd. Helion, Gliwice 2010.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Thesis proseminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W22	C1	Se1	N1
PEK_U01	K2IB_U01	C2	Se1	N1
PEK_K01	K2IB_K02	C3	Se1	N1

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Roboty i manipulatory medyczne II**
Name in English: **Medical robots and manipulators II**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is assumed that prior to learning of this course the student has to be prepare for: the fundamentals of design and engineering, basic electronics and control systems.

SUBJECT OBJECTIVES

C1. Familiarize students with the construction and operation of medical robots and manipulators.
C2. Familiarize students with the applied control systems.
C3. Familiarize students with the applied drives and sensors in building robots.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has an extended knowledge of the construction of medical robots and manipulators.
PEK_W02 - Has an extended knowledge of building control systems, the use of sensors in the construction of medical robots and manipulators.

II. Relating to skills:
PEK_U01 - Can design a structure, analyze the structure, select the appropriate drive and how to use transmission systemfor robot or medical manipulator .
PEK_U02 - Can perform strength calculations, make drawings.

III. Relating to social competences:
PEK_K01 - Can work on tasks independently and in groups.
PEK_K02 - Can think and act creatively.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to robots and manipulators.	2
Lec2	Manipulators and rehabilitation robots.	2
Lec3	Mechanical construction of upper limb prostheses.	2
Lec4	The structure and control systems of upper limb prostheses.	2
Lec5	Mechanical construction of lower limb prostheses.	2
Lec6	The structure and control systems of lower limb prostheses.	2
Lec7	Medical robots for surgery on soft tissues.	2
Lec8	Medical robots for surgery on hard tissue.	2
Lec9	Robots for support operations in the area of the knee, spine and hips - mechanical construction	2
Lec10	Robots for support operations in the area of the knee, spine and hips - control systems, sensors.	2
Lec11	Robots in neurosurgery.	2
Lec12	Exoskeleton as a support structure for medical staff.	2
Lec13	Used drives, control systems, vision systems in the construction of medical robots.	3
Lec14	The use of sensors in medical robots and manipulators.	3
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction to project to the robot or manipulator for special tasks in medicine.	2
Proj2	Definition of the functions that robot or manipulator should do.	2
Proj3	Propose three solutions of kinematic structure of the robot or manipulator.	2
Proj4	Defining the method of transmission.	2

Proj5	Choosing the right motors.	2
Proj6	Developing a sketch solutions of kinematics, transmission and motors.	2
Proj7	Developing a sketch solutions adopted kinematics, transmission and drive themselves.	2
Proj8	Perform strength calculations.	2
Proj9	Perform strength calculations.	2
Proj10	Perform strength calculations.	2
Proj11	Development of the mechanical design of the selected robot or manipulator. 3D computer model in ACAD or SolidWorks.	2
Proj12	Development of the mechanical design of the selected robot or manipulator. 3D computer model in ACAD or SolidWorks.	2
Proj13	Development of engineering drawings and assembly drawing	2
Proj14	Development of engineering drawings and assembly drawing	2
Proj15	Development of engineering drawings and assembly drawing	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01, PEK_K02	raport
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.‘Mechanical automation devicesi’ - B. Chorowski, M. Wereszko.
2.‘Fundamentals of robotics. The theory and components of manipulators and robots’ – collective work.
3.‘Theory of mechanisms and manipulators. Fundamentals and Application Examples in practice’ A. Morecki, J. Knapczyk, K. Kędzior.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Medical robots and manipulators II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W03, K2IB_W04, K2IB_W18	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12	N1, N2
PEK_W02	K2IB_W03, K2IB_W04	C2, C3	Lec13, Lec14	N1, N2
PEK_U01	K2IB_U01, K2IB_U02	C1	Pr1-Pr17	N3
PEK_U02	K2IB_U01, K2IB_U02	C2, C3	Pr1-Pr17	N3
PEK_K01	K2IB_K04	C1, C2, C3	Pr1-Pr17	N3
PEK_K02	K2IB_K05, K2IB_K07, K2IB_K08	C1, C2, C3	Pr1-Pr17	N3

SUBJECT SUPERVISOR

dr inż. Krzysztof Krysztoforski tel.: 71 320-21-93 email: k.krysztoforski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie podzespołami robotów i manipulatorów**
Name in English: **Control components of robots and manipulators**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM041017**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		45		
Number of hours of total student workload (CNPS)	30		90		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is assumed that prior to learning of this course the student has to prepare in the following areas: writing basics algorithms, programming in C / C + + and basic of electronics.

SUBJECT OBJECTIVES

C1. Familiarizing students with the control systems of robots and manipulators. Presentation of the implementation of control systems.
C2. Familiarizing students with the control of component of the robot, such as electric motors, temperature sensors, acceleration and gyroscopes.
C3. Familiarizing students with the architecture of the microcontroller core ARM SAM7 necessary during the implementation of control algorithms.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a basic understanding of the basics of the implementation of control systems.
PEK_W02 - Has a basic knowledge of motor drive.
PEK_W03 - Has basic knowledge of programming of digital and analog sensors.

II. Relating to skills:
PEK_U01 - Can implement control algorithms for microprocessor systems.
PEK_U02 - Can control a DC motor, unipolar and bipolar stepper motor.
PEK_U03 - Can program the digital temperature sensors, acceleration and gyroscope.

III. Relating to social competences:
PEK_K01 - Can work on tasks independently and in groups.
PEK_K02 - Can think and act creatively.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to robots and manipulators.	2
Lec2	Control algorithms, control systems of robots and manipulators.	2
Lec3	Control systems with open and closed-loop.	2
Lec4	Digital implementation of PID algorithm for fixed and floating value.	2
Lec5	Unipolar stepper motor control.	2
Lec6	Bipolar stepper motors control .	2
Lec7	Servomotor control.	2
Lec8	Control of DC motors.	2
Lec9	The accelerometers sensor.	2
Lec10	Gyro sensor.	2
Lec11	Overview of I2C and 1-Wire interface	2
Lec12	Implementation of digital temperature sensors on the interface I2C and 1-Wire.	2
Lec13	Introduction to microcontroller architecture (selected family ofARM microcontroller).	2
Lec14	Description of selected modulus in microcontroller: I / O ports, Real Timer, Timer / Counter.	2
Lec15	Description of ADC converter of the microcontroller. Programming method of alphanumeric LCD display.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the programming environment C/C++.	3
Lab2	Introduction to the laboratory set of SAM7.	3
Lab3	Starting the selected modules of microcontroller necessary to control the robot component: I/O port.	3

Lab4	Starting the selected modules of microcontroller necessary to control the robot component: Real Timer.	3
Lab5	Starting the selected modules of microcontroller necessary to control the robot component: Timer/Counter.	3
Lab6	Starting the selected modules of microcontroller necessary to control the robot component: ADC converter.	3
Lab7	Starting the selected modules of microcontroller necessary to control the robot component: interface RS232.	3
Lab8	Starting the selected modules of microcontroller necessary to control the robot component: LCD display.	3
Lab9	Programming analog and digital sensors: acceleration sensor ADXL311.	3
Lab10	Programming analog and digital sensors: temperature sensor 1-wire DS18S20.	3
Lab11	Programming analog and digital sensors: temperature sensor I2C TMP100.	3
Lab12	Control of unipolarstepper motor in open-loop.	3
Lab13	Control of bipolar stepper motor in open-loop.	3
Lab14	Brush DC motor control.	3
Lab15	Servomotor control.	3
		Total hours: 45

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	evaluation of laboratory topic
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

J. Augustyn, Designing of embedded systems on the family microcontrolers SAM7S with core ARM7TDMI , IGSMiE PAN, 2007, ISBN: 978-83-60195-55-0

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Control components of robots and manipulators
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W03, K2IB_W04	C1	Lec1, Lec2, Lec3, Lec4	N1, N2
PEK_W02	K2IB_W03, K2IB_W04	C2	Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12	N1, N2
PEK_W03	K2IB_W03, K2IB_W04	C2, C3	Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15	N1, N2
PEK_U01	K2IB_U01, K2IB_U02, K2IB_U12	C2, C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9, Lab10, Lab11, Lab12, Lab13, Lab14, Lab15	N3
PEK_U02	K2IB_U01, K2IB_U02	C2, C3		N3
PEK_U03	K2IB_U01, K2IB_U02	C1, C2, C3	Lab12, Lab13, Lab14, Lab15	N3
PEK_K01	K2IB_K04	C1, C2, C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9, Lab10, Lab11, Lab12, Lab13, Lab14, Lab15	N3
PEK_K02	K2IB_K05, K2IB_K07, K2IB_K08	C1, C2, C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9, Lab10, Lab11, Lab12, Lab13, Lab14, Lab15	N3

SUBJECT SUPERVISOR

dr inż. Krzysztof Krysztoforski tel.: 71 320-21-93 email: k.krysztoforski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Języki programowania**
Name in English: **Programming languages**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041022**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is assumed that prior to learning of this course the student has to prepare in the following areas: systems of counting, simple algorithms, the basic elements of programming in C language and basic knowledge of the design and operation of computers.

SUBJECT OBJECTIVES

C1. Familiarize students with the basic techniques of structured programming.
C2. Familiarize students with the methods of computer data representation.
C3. Prepared for independent software development and implementation of simple algorithms.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course the student has a basic knowledge of structural programming and object-oriented.
PEK_W02 - As a result of the course the student has a basic knowledge of the type of variables, defining functions, classes, and transfer them to your selection, overloading operators.
PEK_W03 - As a result of the course the student has a basic knowledge of the creation of conditional statements, loops programming, operations on indicators and creating objects.

II. Relating to skills:
PEK_U01 - Can write any program in C / C++.
PEK_U02 - Can create dynamic data structures.
PEK_U03 - Can implement the developed algorithm.

III. Relating to social competences:
PEK_K01 - Can work on tasks independently and in groups.
PEK_K02 - Can think and act creatively.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The introduction of the basic concepts of: algorithm and methods of its presentation, examples of algorithms.	2
Lec2	Introduction to the C language. Data types. Working on data types.	2
Lec3	Operators: arguments, priority. Control statements and loops.	2
Lec4	Working whit indicators, tables and functions. Definitions of functions, a function prototype, a function call.	2
Lec5	The value returned by the function. Recursion.	2
Lec6	The standard input and output operations for C (stdio.h).	2
Lec7	Structure, union and bit fields: the declarations and implementation. The parameters of the main function.	2
Lec8	Introduction to object-oriented programming: C++ language.	2
Lec9	The concept of class. Action on objects, member functions: declaring and defining. This indicator. The static component class.	2
Lec10	Encapsulation , the difference between the structure and class in C++.	2
Lec11	Overriding the names of variables and functions. Overloading function names. Default arguments in function. Introduction to the constructor.	2
Lec12	The constructor. The destructor. Dynamic memory allocation.	2
Lec13	Constructor initialization list. Copy constructor.	2
Lec14	Friend Functions. Friending classes.	2
Lec15	Overloading operators: number of arguments, the operator as a standard feature, as a function of the component.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1		1
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Initiation classes. Getting familiar with the programming work environment.	1
Proj2	Creation and implementation of a simple algorithm. The use of control statements and loops.	2
Proj3	Declaring and defining a function.	2
Proj4	Creating arrays, structures and unions. Dynamic Allocation.	2
Proj5	Working on indicators and tables.	2
Proj6	Logical and arithmetic (bit) operations .	2
Proj7	The project your own	2
Proj8	The project your own	2
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Grębosz Jerzy,Phymfony C++, Oficyna Kallimach, Kraków 1993,
[2] Stroustrup Bjarne, C++ language, WNT, Warszawa 1994.

SECONDARY LITERATURE

[1] Grębosz J.: C++ passion. Oficyna Kallimach, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming languages
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W03, K2IB_W04, K2IB_W25, K2IB_W26	C1	Lec1, Lec2, Lec8, Lec10	N1, N2
PEK_W02	K2IB_W03, K2IB_W04, K2IB_W25, K2IB_W26	C2	Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec9, Lec11, Lec12, Lec13, Lec14, Lec15	N1, N2
PEK_W03	K2IB_W03, K2IB_W04, K2IB_W22, K2IB_W25, K2IB_W26	C2	Lec3, Lec4, Lec12	N1, N2
PEK_U01	K2IB_U01, K2IB_U02, K2IB_U22	C3	Pr1, Pr2, Pr3, Pr4, Pr5 Pr6, Pr7, Pr8	N3
PEK_U02	K2IB_U02, K2IB_U22	C2	Pr4	N3
PEK_U03	K2IB_U01, K2IB_U22	C3	Pr7, Pr8	N3
PEK_K01	K2IB_K04	C2 ,C3	Pr1, Pr2, Pr3, Pr4, Pr5 Pr6, Pr7, Pr8	N3

PEK_K02	K2IB_K05, K2IB_K07, K2IB_K08	C1, C2, C3	Pr1, Pr2, Pr3, Pr4, Pr5 Pr6, Pr7, Pr8	N3

SUBJECT SUPERVISOR

dr inż. Krzysztof Krysztoforski tel.: 71 320-21-93 email: k.krysztoforski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie logistyczne w medycynie**
Name in English: **Medical Logistics Management**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041023**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should have a basic knowledge of basic economics and marketing.
2. Student should have a base in the field of mathematical analysis.

SUBJECT OBJECTIVES

C1. Introduction to basics of logistics management in various areas of medicine: hospital wards, emergency medical services, pharmacy, blood banks.
C2. Get knowledge of the basics of warehouse management, inventory management and the organization of the flow of materials on the example of the hospital and pharmacy.
C3. Presentation of the documents and laws regulating the conduct in specific areas of medicine.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student get a basic knowledge of logistics and logistics management in the hospital. Has knowledge of the functioning of health care providers.
PEK_W02 - Student has a knowledge of the organization and management of the supply chain of medical products. He knows the regulations on medical devices.
PEK_W03 - Get knowledge of the organization and management of the various operators involved with the hospital: pharmacy, emergency medical services, blood banks.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to logistics and logistics management in the enterprise: the scope of the enterprise, logistics processes, engineering, logistics (packaging, storage technologies, techniques, internal and external transport).	2
Lec2	Logistics processes in medicine. Hospital Logistics: the scope of the operation, the organization of a network of hospitals in a large city, the management of emergency medical services, distribution of food, medicine and other supplies needed in hospital wards	2
Lec3	Distribution and logistics in the pharmaceutical industry. Medical device - definition, functions, classification, standardization and regulatory framework for medical devices. Logistics distribution of medicines, logistic labels in the labeling of drugs, labeling unit.	2
Lec4	Logistics in emergency care, ambulance, emergency road fast. Medical management of mass casualty events.	2
Lec5	Logistics in transplantation: the coordination of organ transplants. The management and logistics of blood banking.	2
Lec6	Financial aspects of inventory management, reimbursement, maintenance, and emergency medical service. Types of inventory, objectives and tasks of inventory management. Hospital Formulary.	2
Lec7	Management of medical waste, waste classification. Legislation governing the handling of medical waste.	2
Lec8	Final test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Abt S., Zarządzanie logistyczne w przedsiębiorstwie, PWE, Warszawa 1998.
[2] Nowakowski T. (red): Systemy logistyczne.Tom II. Wyd. Difin. Warszawa 2011
[3] Balter J.F., Zbroja T., Zarządzanie logistyczne w przedsiębiorstwie, Oficyna Wydawnicza CL Consulting i Logistyka, Wrocław 2003.

SECONDARY LITERATURE

[4] Coyle J.J., Bardi E.J., Langley Jr C.J., Zarządzanie logistyczne, PWE, Warszawa 2002.
[5] Zając P: Elektroniczna wymiana danych w systemach logistycznych. Seria Navigator nr 19, Of. Wyd. Pol. Wr. Wrocław 2010
[6] Czasopismo LOGISTYKA

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Medical Logistics Management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W03, K2IB_W08	C1	Lec1, Lec2, Lec8	N1, N2, N3
PEK_W02	K2IB_W08, K2IB_W21	C2, C3	Lec3, Lec6, Lec8	N1, N2, N3
PEK_W03	K2IB_W08	C1, C3	Lec4-Lec6, Lec7, Lec8	N1, N2, N3

SUBJECT SUPERVISOR
dr inż. Anna Nikodem tel.: 71 320-29-83 email: Anna.Nikodem@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Planowanie eksperymentu**
Name in English: **Experiment planning**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041024**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis and linear algebra
2. Knowledge of statistics, including: descriptive statistics, statistical inference, correlation and regression methods, and time series analysis

SUBJECT OBJECTIVES

C1. Introducing students to the different methods and techniques of planning experiments
C2. Collect and organize results of experiments and analyze this information to reach a conclusion
C3. Application of experiments, inter alia, to optimize the performance and quality of products and services in the field of biomedical engineering
C4. Presentation of principles, objectives, milestones and basic concepts related to the planning of experiments
C5. Importance indication of experiments planning to improve quality in biomedical engineering

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student indicates the principles, objectives and planning stages of experiments
PEK_W02 - Student defines the basic concepts of experiment design
PEK_W03 - Student explains the basic statistical model, which is used in planning of experiments, known as the general linear model

II. Relating to skills:
PEK_U01 - Student is able to design an experiment
PEK_U02 - Student is able to choose the tools for data analysis
PEK_U03 - Student is able to carry out data mining, interpret the results and draw conclusions

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	General principles of experiment planning. Historical overview	2
Lec2	Definition and basic assumptions of general linear model	2
Lec3	Models of analysis of variance (ANOVA) and regression analysis	2
Lec4	Classic plans of experiments: completely randomized experimental plan, two-factor experimental design	2
Lec5	Classic plans of experiments: plans of randomized and incomplete blocks	2
Lec6	Classic plans of experiments: Latin and Graeco-Latin square, Youden square	2
Lec7	Factorial experiments plans: full and fractional factorial experiments	4
Lec8	Factorial experiments plans: centrally formulated plans for factorial experiments	2
Lec9	Factorial experiments plans: plans for saturated experiments on three levels	2
Lec10	Factorial experiments plans: factorial experiments plans with different numbers of levels of factors, Taguchi orthogonal arrays	2
Lec11	Search of optimization conditions: Box-Wilson method, the method EVOP, examples of applications	2
Lec12	Search of optimization conditions: examples of Taguchi methods applications in biomedical engineering	2
Lec13	Optimal design of experiments: real and discrete experiment plans, optimality criteria and optimal plans	2
Lec14	Carry out a test to check the knowledge and skills of students for this course	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-W03	Final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Experiment planning
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2IB_W04, K2IB_W20	C1, C2, C3, C4, C5	Lec1-Lec14	N1, N2
PEK_U01	K2IB_U01, K2IB_U02, K2IB_U11	C1, C3-C5	Lec1, Lec2, Lec4-Lec13	N1, N2
PEK_U02	K2IB_U06, K2IB_U11	C2	Lec2, Lec3	N1, N2
PEK_U03	K2IB_U01, K2IB_U04, K2IB_U06, K2IB_U11	C4, C5	Lec2, Lec3, Lec11-Lec13	N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Detyna tel.: 320-38-45 email: jerzy.detyna@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy biomechaniki sportu**
Name in English: **Problems of the sports biomechanics**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041025**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of mechanics (statics, kinematics, dynamics).
2. Student has elementary knowledge of the human anatomy.
3. Student has the ability to define the structure of complex systems.

SUBJECT OBJECTIVES

C1. Mastering knowledge of the basic laws of mechanics applications for the biomechanical analysis of human movement during a variety of sport's activity.
C2. Developing of the ability to apply student's knowledge to the analysis and description of the observed phenomena.
C3. Improving of the knowledge of biomechanics.
C4. Mastering of the ability to analyze motion and forces acting on the man who makes sport exercises with selected methods and measurement techniques.
C5. Mastering of the ability of numerical modeling and simulation of human musculoskeletal system.
C6. Developing the ability to work in a team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge of the biomechanics of sport and can to propose a biomechanical model of the man who makes the established motion profile, taking into account external influences.
PEK_W02 - Student can indicate the method of the basic geometric and mass parametrs calculation of the human body.
PEK_W03 - Student can explain the relationship between sports results and biomechanical parameters of man.

II. Relating to skills:
PEK_U01 - Student can experimentally determine the biomechanical parameters of human movement (in particular related to its sports activities), planning and implementing experiment and handling the obtained measurement data.
PEK_U02 - Student can to interpret human movement performing sports exercises in terms of biomechanics (mechanics + anatomy and physiology elements).
PEK_U03 - Student can formulate the numerical models of the human motion, and then use them to determine the parameters that characterize the physical activity of man.

III. Relating to social competences:
PEK_K01 - Student can think and act in a creative way, using his knowledge and understands the need for the continuous replenishment.
PEK_K02 - Student has ability to communicative presentation the results of their work using the relevant tools (report, drawing, diagram, multimedia presentation).
PEK_K03 - Student is able to work in a team.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction; human biomechanical model - basic definitions, geometric and mass parameters characterizing the human body, methods of their determination. Measurement methods in biomechanics of sport.	2
Lec2	Forces and torques (generated by the muscles and from the external loads). The static and kinetic balance. Motion coordination as a result of the control and regulation of human movement; its importance in sports.	2
Lec3	Biomechanical description of the walk, run, jump and athletic throw.	2
Lec4	Biomechanics of ball games (ball throw, kick, volleyball serve, serve court).	2
Lec5	Biomechanics of rowing (indoor and water).The influence of the medium resistance (in which the player and/or equipment is moving) on the achieved results.	2
Lec6	Biomechanics of water sports: swimming and diving, water as a medium in which the motiont is realised; buoyancy, resistance, propulsion and support forces. Bodies floatation and stability.	2
Lec7	Biomechanics of ski sports: cross-country skiing and downhill skiing, ski jumping. Forces: aerodynamic drag, gravity and friction; analysis of aerodynamic properties of silhouette skier.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Measurement of the body segment lengths and weight. Determination of the moment of inertia of the human body using torsion method.	2
Lab2	Measurement of joint mobility - the use of the elektrogoniometer and photographic technique.	2
Lab3	Introduction to numerical simulation program (Adams) - the multibody method (UW).	2
Lab4	Presentation of the user's graphical interface for simulation using the UW.	2
Lab5	Principles of rigid model application, introduction of the kinematic pairs, input signal, noise, forces, torques, contacts and friction modelling.	2
Lab6	Collecting and preparing the parameters obtained during the experiment for the numerical model description.	2
Lab7	Construction of the numerical mode examplel (eg. numerical model of arm, leg).	2
Lab8	Description of the postprocessor, graphs and animations preparing on the basis of a simulation (analysis reports generation).	2
Lab9	The rower rowing on ergometer kinematics analysis using cinematographic method.	2
Lab10	The rower rowing on ergometer kinematics analysis using Optotrak system.	2
Lab11	Completion task (group 2 - 3 students) - development of a numerical model of the rower rowing on ergometer (motion simulation of a ride at the given parameters) and comparing simulation results with the results of experimental measurements, discuss the parameters of the model geometry and boundary conditions.	2
Lab12	Construction of the numerical model, the definition of kinematic pairs and excitations acting on the rower.	2
Lab13	Optimization of the numerical model, comparing of the numerical calculations results and the experimental data (Lab9 and Lab10).	2
Lab14	Report generation from the Adams postprocessor, the results of simulation calculations with the results of experimental measurements comparison.	2
Lab15	Presentation of the report. Examination.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. laboratory experiment
N3. calculation exercises
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Final test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	positive laboratory reports evaluation (S) from Lab1, Lab2, Lab9 and Lab10; F1 = (S1 + S4 + ...) / 4
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	positive mark of the completion task report
P = 1/5*F1+4/5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bober T., Zawadzki J., Biomechanika układu ruchu człowieka, Wyd. BK, Wrocław, 2001. [2] Ernst K., Fizyka sportu, PWN, Warszawa, 2012. [3] Grimshaw P., Lees A.,, Fowler N., Burden A., Krótkie wykłady - Biomechanika sportu, PWN, 2010.

SECONDARY LITERATURE

[1] Urbanik Cz., Zagadnienia biomechaniki sportu, Wyd. AWF Warszawa, 2003. [2] Żołądź J., Power output, mechanical efficiency and fatigue in human skeletal muscles, Wyd. AWF Kraków, 1999. [3] Czabański B., Elementy teorii pływania, Wyd. AWF Wrocław, Wrocław, 2003.
[4] Puleo J., Milroy P., Anatomia w bieganiu, Wyd. Muza S.A., Warszawa, 2012.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Problems of the sports biomechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02, PEK_W03	K2IB_W06	C1, C3	Lec1 - Lec7	N1, N5
PEK_U01, PEK_U02, PEK_U03	K2IB_U14	C2, C4, C5	Lab1 - Lab15	N2, N3, N4, N5
PEK_K01, PEK_K02, PEK_K03	K2IB_K04, K2IB_K08	C2, C6	Lab1 - Lab15	N1 - N5

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika pękania**
Name in English: **Fracture Mechanics**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041026**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mechanics, Strength of Materials.

SUBJECT OBJECTIVES

C1. Knowledge of linear models of fracture mechanics.
C2. Stress intensity factor K & J integer as fundamental parameters of fracture mechanics.
C3. Energy methods in description of fatigue crack propagation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of linear models of fracture mechanics.
PEK_W02 - Knowledge of methods dealing with application of stress intensity factor K & J integer as fundamental parameters of fracture mechanics.

II. Relating to skills:
PEK_U01 - He can calculate fundamental parameters of fracture mechanics.
PEK_U02 - He can use stress intensity factor K & J integer to evaluation of crack propagation.

III. Relating to social competences:
PEK_K01 - He can search information and is able to review it critically.
PEK_K02 - He can objectively evaluate the arguments as well as rationally explain and justify the own point of view.
PEK_K03 - He can observe customs and rules of academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Theoretical Strength of Materials.	1
Lec2	Griffith's theory.	1
Lec3	Irwin's theory.	1
Lec4	Panasiuk-Dugdale’s model.	1
Lec5	Linear models of fracture mechanics.	1
Lec6	Brittle & ductile fracture.	1
Lec7	Parameters of fracture toughness.	1
Lec8	The J - integer.	1
Lec9	Treshold stress intensity factor K.	1
Lec10	Energy description of fatigue fracture.	2
Lec11	Analysis of kinetic fatigue failure diagrams (KFFD).	2
Lec12	Diimensional Analysis models in Fracture Mechanics.	1
Lec13	Final test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Final test.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Neimitz A., Mechanika pękania, PWN Warszawa 1998,
2. Kocańda St., Zmęczeniowe pękanie metali, WNT Warszawa, wyd. 3, 1985,
3. Boroński D., Metody badań odkształceń i naprężeń w zmęczeniu materiałów i konstrukcji, Wyd. Inst. Tech. Ekspl. - PIB , Radom 2007,
4. Szata M., Opis rozwoju zmęczeniowego pękania w ujęciu energetycznym, OW PWr, Wrocław 2002.

SECONDARY LITERATURE
1. Bochenek A., Elementy mechaniki pękania, Wyd. Politechniki Częstochowskiej, Częstochowa 1998,
2. Gasiak G., Trwałość materiałów konstrukcyjnych przy obciążeniach cyklicznych z udziałem wartości średniej obciążenia, OW PO Opole 2002.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fracture Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W22	C1, C3	Lec1 to Lec13	N1, N2
PEK_W02	K2IB_W22	C2	Lec1 to Lec13	N1, N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Biomechanika stomatologiczna**
Name in English: **Dental Biomechanics**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041028**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of biomaterials. He is able to characterize biological, structural and mechanical properties, of various biomaterials used in medicine.
2. Student has established knowledge of the biomechanical engineering issues.
3. Student has a basic knowledge of human organs from the point of view of physiology, mechanics and pathomechanics of human load-bearing structures.

SUBJECT OBJECTIVES

C1. Student get a knowledge of basic dental biomechanics issues: including the construction, function and biomechanics of the masticatory system.
C2. Student get a basic knowledge of the biomechanical analysis of dental treatment (including orthodontics), biomechanical aspects of cooperation with dental filling, bite correction, biomechanical principles for the construction of dentures and dental implants biomechanics.
C3. Mastering the practical principles of experimental research in the field of dental biomechanics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student get a knowledge of the construction, operation and biomechanics of the masticatory system.
PEK_W02 - Get a basic knowlegde of dental treatments and technical resources used in this treatment.
PEK_W03 - Student has ordered knowledge of the applications of biomechanics in the analysis techniques and the effects of treatment of the human masticatory system.

II. Relating to skills:
PEK_U01 - Student is able to analyze the mechanical properties of selected tissues of masticatory system.
PEK_U02 - Student is able to analyze the characteristics of the implants, dentures and plates for fixation for fractures of the mandible.
PEK_U03 - Student is able to carry out the measurements using different methods to analyze orthodontic systems and the impact of fill material shrinkage strain on the state of the tooth.

III. Relating to social competences:
PEK_K01 - Student is able to interpret the results of the experiments.
PEK_K02 - Student can work on tasks independently and in groups.
PEK_K03 - Student is aware of the need for continuous training and learning.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Structure and function of masticatory system. Basic concepts and terminology in the field of dental biomechanics. Basic biomechanics of the masticatory apparatus. The most significant developments in dental biomechanics.	2
Lec2	Biomechanical characteristics of enamel, dentin, periodontal and spongy tissue of the jaw bone. The loads acting on individual teeth and jaw bones. Biomaterials used in dentistry.	2
Lec3	The basic procedure for treatment in orthodontics. The basic procedure for treatment with dentures and dental implants.	2
Lec4	Basic and advanced input methods of dental fillings. Biomechanics of treatment with the contribution of root.	2
Lec5	Basic and advanced design methods of dentures. Experimental and numerical methods for the analysis of the effects of dental treatment.	2
Lec6	Basic and advanced design methods of dental implants. Evaluation of strength and functionality of prostheses and implants.	2
Lec7	Visualization of computer aided diagnostic and treatment planning. Some aspects of jaw surgery. Basics of construction of stabilizers of mandibular fractures.	2
Lec8	Final test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction to laboratory, safety training.	1
Lab2	Investigation of mechanical properties of selected tissues of masticatory system.	2

Lab3	Investigation of mechanical properties of stabilizers of mandibular fractures.	2
Lab4	Investigation of mechanical properties of dental implants.	2
Lab5	Experimental study of the mechanical properties of dental prostheses.	2
Lab6	Methods of analysis of orthodontic systems cooperated with the teeth.	2
Lab7	Analysis of strain state correlated with the impact of shrinkage of the material filling the tooth.	2
Lab8	Analysis of mechanical properties using the finite element method.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. laboratory experiment
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Evaluation of preparation and implementation of laboratory tasks, verbal response, optional - a written report of the laboratory tasks.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. A.N. Natali, Dental biomechanics, Taylor and Francis, 2003
2. R. Nanda, Biomechanika i estetyka w ortodoncji, Czelej, 2009
3. T. Rakosi, T.M. Graber, G. Śmiech-Słomkowska, Leczenie ortodontyczne i ortopedyczne wad zębowo-twarzowych, Czelej, Łódź, 2011

SECONDARY LITERATURE
1. A. Komorowska, Materiały i techniki ortodontyczne, Warszawa 2009
2. Materiały ortodontyczne w ujęciu naukowym i klinicznym, Czelej, Lublin 2003
3. Journal of Dental Biomechanics

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dental Biomechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W15	C1	Lec1, Lec2, Lec8	N1, N2
PEK_W02	K2IB_W01, K2IB_W15	C2	Lec3-Lec5, Lec8	N1-N4
PEK_W03	K2IB_W15, K2IB_W22	C1, C2	Lec5-Lec8	N1-N4
PEK_U01	K2IB_U13, K2IB_U14	C1, C3	Lab1, Lab2, Lab8	N3-N5
PEK_U02	K2IB_U03, K2IB_U14	C2, C3	Lab3-Lab6	N3-N5
PEK_U03	K2IB_U14	C2, C3	Lab7	N3-N5
PEK_K01	K2IB_K05	C3	Lab1-Lab8	N2-N5
PEK_K02	K2IB_K04, K2IB_K07	C3	Lab1-Lab8	N3, N4
PEK_K03	K2IB_K01, K2IB_K02	C1-C3	Lab1-Lab8	N2

SUBJECT SUPERVISOR

dr inż. Anna Nikodem tel.: 71 320-29-83 email: Anna.Nikodem@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sprzęt i metody rehabilitacji**
Name in English: **Medical Equipment and Methods for Rehabilitation**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041029**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has an ordered knowledge of the anatomy and physiology of the human locomotor system.
2. Student has an ordered knowledge of biomechanical engineering.
3. Student has a basic knowledge of rehabilitation engineering.

SUBJECT OBJECTIVES

C1. Getting knowledge of existing devices used in rehabilitation.
C2. Arrange knowledge of the existing methods of physical medicine.
C3. Arrange knowledge of applied rehabilitation for various disease.
C4. Learning basic first aid.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student can define rules for medical rehabilitation in patients with various disabilities.
PEK_W02 - Student can characterize and describe the physical medicine therapies.
PEK_W03 - Student has a basic knowledge of first aid.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Methods for evaluation of physical capacity in healthy subjects and patients.	2
Lec2	Medical devices used in rehabilitation.	2
Lec3	New therapeutic methods of physical medicine.	4
Lec4	Kinesitherapy in oncology and internal diseases.	2
Lec5	Diagnostics and Treatment of Postural Disorders.	2
Lec6	Basic medical emergency.	2
Lec7	Test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Dega W., Milanowski K., Rehabilitacja medyczna. PZWL, Warszawa 2001 (in Polish).
Nałęcz M. (Red.), Biocybernetyka i inżynieria biomedyczna 2000, t.5 Biomechanika i inżynieria rehabilitacyjna. Akademicka Oficyna Wydawnicza EXIT, Warszawa 2003 (in Polish).
Kiwerski J., Rehabilitacja medyczna, Wydawnictwo PZWL, Warszawa 2005 (in Polish).
Ronikier A., Diagnostyka funkcjonalna w fizjoterapii, Wydawnictwo Lekarskie PZWL, Warszawa 2012 (in Polish).

SECONDARY LITERATURE

Kasperczyk T., Wady postawy ciała diagnostyka i leczenie, KASPER, Kraków 2004 (in Polish).
Brotzman S.B., Wilk K.E., Rehabilitacja ortopedyczna, Elsevier Urban & Partner, Wrocław 2009.
Lennon S., Stokes M., red. Kwolek A., Fizjoterapia w rehabilitacji neurologicznej, Elsevier Urban&Partner, Wrocław 2009 (in Polish) .
Woźniewski M., Kornafel J., Rehabilitacja w onkologii, Elsevier Urban&Partner, Wrocław 2010 (in Polish).
Donatelli R., red. Gnat R., Rehabilitacja w sporcie, Elsevier Urban&Partner, Wrocław 2011 (in Polish).
Czasopisma: Ortopedia Traumatologia Rehabilitacja, Rehabilitacja Medyczna, Praktyczna fizjoterapia i rehabilitacja .

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Medical Equipment and Methods for Rehabilitation
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03,	K2IB_W10	C1, C2, C3, C4		N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Sylwia Szotek tel.: 71 320-29-83 email: Sylwia.Szotek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie podzespołami robotów i manipulatorów medycznych**
Name in English: **Control components of medical robots and manipulators**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				30	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes				0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is assumed that prior to learning of this course the student has to be prepared for: ARM microcontroller programming in C/C++, basic knowledge of electronics, has an established knowledge in motor control, sensors programming.

SUBJECT OBJECTIVES

C1. Familiarize students with the basic principles of the development of control systems.
C2. Familiarize students with the basics of creating electronic circuits.
C3. Mastery of how to create printed circuit boards.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Can develop a logic diagram of the control system.
PEK_U02 - Can develop and make printed circuit board in the EAGLE software.

III. Relating to social competences:
PEK_K01 - Can work on tasks independently and in group.
PEK_K02 - Can think and act creatively.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to the project of the control system of a mobile or walking robot.	2
Proj2	Choose your robot and determining the amount of controlled motors.	2
Proj3	Determine the type of the motor.	2
Proj4	Develop a logical diagram of the control system.	2
Proj5	Develop a logical diagram of the control system.	2
Proj6	Introduction and using the EAGLE software to create an electronic circuit diagram and PCB.	2
Proj7	Introduction and using the EAGLE software to create an electronic circuit diagram and PCB.	2
Proj8	Development of the circuit diagram in the EAGLE	2
Proj9	Development of the circuit diagram in the EAGLE	2
Proj10	Development of the circuit board in the EAGLE	2
Proj11	Development of the circuit board in the EAGLE	2
Proj12	Implementation of the circuit board.	2
Proj13	Installation and testing of electronic components of the control system.	2
Proj14	Development and implementation of a simple control algorithm for a robot.	2
Proj15	Development and implementation of a simple control algorithm for a robot.	2
		Total hours: 30

TEACHING TOOLS USED

N1. project presentation
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01, PEK_K02	raport
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. ‘Mechanical automation devices’ - B. Chorowski, M. Wereszko.
2. 'Fundamentals of robotics. The theory and components of manipulators and robots’ – collective work.
3. ‘Theory of mechanisms and manipulators. Fundamentals and Application Examples in practice’ A. Morecki, J. Knapczyk, K. Kędzior

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Control components of medical robots and manipulators
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2IB_U01, K2IB_U02	C1, C2	Prj1, Prj2, Prj3, Prj4, Prj5, Prj14, Prj15	N2
PEK_U02	K2IB_U01, K2IB_U02	C3	Prj6, Prj7, Prj8, Prj9, Prj10, Prj11, Prj12,Prj13	N1, N2
PEK_K01	K2IB_K04	C1, C2, C3	Prj1, Prj2, Prj3, Prj4, Prj5, Prj6, Prj7, Prj8, Prj9, Prj10, Prj11, Prj12, Prj13, Prj14, Prj15	N1, N2
PEK_K02	K2IB_K05, K2IB_K07, K2IB_K08	C3, C3	Prj3, Prj4, Prj5, Prj6, Prj7, Prj8, Prj9, Prj10, Prj11, Prj12, Prj13, Prj14, Prj15	N1, N2

SUBJECT SUPERVISOR
dr inż. Krzysztof Krysztoforski tel.: 71 320-21-93 email: k.krysztoforski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrobiologia**
Name in English: **Microbiology**
Main field of study (if applicable): **Biomedical Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **IBM041032**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of materials measurement methods carried out at different scales: macro / micro / nano.
2. Student has a basic knowledge of the biological activity of medical devices
3. Student has a basic knowledge of cell biology.

SUBJECT OBJECTIVES

C1. Getting a basic knowledge about the micro-environment, with particular emphasis on human physiological microflora
C2. Getting a knowledge about the microbiological techniques used in studies of microorganisms.
C3. Student get knowledge of the disinfection and sterilization techniques, necessary for experimental studies of biological material

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student get a basic knowledge of the biodiversity of microorganisms and their biochemical and physiological properties and functions in nature. He getting know the physiological flora of the human body.
PEK_W02 - Student get know how to deal aseptic and antiseptic limiting nosocomial infections.
PEK_W03 - Student has a basic knowledge of methods and techniques for the study of microorganisms.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Systematics of environment al pathogens.	2
Lec2	Characteristics of pathogens in natural environments, the impact of environmental factors on microorganisms.	2
Lec3	Pathogenicity and virulence of microorganisms. Characteristics of micro-organisms that cause disease in humans.	3
Lec4	Immunoprophylaxis of infectious diseases.	2
Lec5	Features and functions of the human physiological microflora.	2
Lec6	Description of the mechanisms of infectious diseases.	2
Lec7	Microbial drug sensitivity and drug resistance. Determination of susceptibility of microorganisms, susceptibility testing, mykogram.	2
Lec8	Targeted and empiric therapies of diseases.	2
Lec9	Growth, reproduction and basic genetics of microorganisms. Mutations and mutagens.	2
Lec10	Chemotherapeutic agents.	2
Lec11	Bacterial drug resistance mechanisms	2
Lec12	The risks of disease in Poland and abroad.	2
Lec13	Download and upload materials for microbiological examination.	2
Lec14	Hospital-acquired infections. Sterilization of medical and disinfectants.	2
Lec15	Final test	1
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Virella G: Mikrobiologia i choroby zakaźne, Wydawnictwo Medyczne Urban&Partner, Wrocław, 2000
[2] Zaręba. M, Borowski. J: Mikrobiologia Lekarska, PZWL. W-wa 1999

SECONDARY LITERATURE
[3] Janowiec M.: Mikrobiologia i serologia, PZWL, W-wa, 1988
[4] Singleton P. Bakterie w biologii, biotechnologii i medycynie. Wydawnictwo Naukowe PWN, W-wa 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microbiology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2IB_W14	C1, C2	Lec1-Lec12, Lec15	N1-N3
PEK_W02	K2IB_W01, K2IB_W14	C3	Lec6, Lec12, Lec14, Lec15	N1-N3
PEK_W03	K2IB_W14	C2	Lec8, Lec13, Lec15	N1-N3

SUBJECT SUPERVISOR

dr inż. Anna Nikodem tel.: 71 320-29-83 email: Anna.Nikodem@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Funkcje zespolone**
Name in English: **Complex Functions**
Main field of study (if applicable): **Control Engineering and Robotics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MAP001092**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows differential calculus of function of one and many variables. Understands basic notions concerning numerical series and power series and can investigate their convergence.
2. Knows integral calculus of function of one variable.
3. Can do calculations using complex numbers.

SUBJECT OBJECTIVES

C1. Study of the basic concepts of complex analysis, review of elementary complex functions.
C2. Study of the basic properties of curvilinear complex integral and methods to evaluate it, including the residues method.
C3. Study of the basic properties of the Laplace transform and getting skill in applying it.
C4. Getting the basic knowledge of complex numerical and power series and Laurent series.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows basic complex functions and their properties, knows the notion of holomorphic function. Has a basic knowledge of complex numerical and power series and Laurent series.
PEK_W02 - Knows properties of curvilinear complex integral and methods to evaluate it. Knows the types of singularities and knows methods of evaluating residues. Knows applications of residues.
PEK_W03 - Knows basic properties of the Laplace transform and understands the idea of operational calculus

II. Relating to skills:
PEK_U01 - Can do calculations using complex functions, can find power series for a complex function and can apply it in evaluations
PEK_U02 - Can evaluate complex integrals, can calculate residues and apply them.
PEK_U03 - Can evaluate Laplace transforms and inverse transforms and apply operational calculus.

III. Relating to social competences:
PEK_K01 - Can, without assistance, search for necessary information in the literature
PEK_K02 - Understands the need for systematic and independent work on mastery of course material

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Functions of complex argument: domain, real and imaginary parts. Elementary functions: polynomials, rational functions, trigonometric functions, exponential and logarithmic functions. Properties of such funtions. Closed complex plane.	2
Lec2	Derivative of a complex function. Cauchy-Riemann equations. Necessary and sufficient conditions for the existence of a derivative. Derivatives of elementary functions. Holomorphic function.	2
Lec3	Curves in the complex plane, simple curves, Jordan curves, smooth arcs. Equations of standard curves. Integral of a complex funcion with real argument. Curvilinear integrals of complex functions. The antiderivative theorem.	2
Lec4	Cauchy's integral theorem. Cauchy's integral formula and its generalisations. Application in calculating integrals.	2
Lec5	Laplace transform and inverse transform: definitions, convergence region of a Laplace integral, properties. Holomorphicity of transforms. Operator calculus. Evaluation of inverse transforms using partial fractions. Applications of the Laplace transform. Transmittance. Convolution of functions. Borel's theorem.	3
Lec6	Series of complex numbers. Power series. Taylor series. Expansions of holomorphic functions in power series. Roots of a holomorphic function.	2
Lec7	Singularities of a complex function. Laurent series: preliminary notions. Residues of a function and examples of their applications.	2
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Learning of basic properties of elementary functions of complex argument. Using such functions in calculations.	2

Cl2	Finding real and imaginary parts of a complex function. Applying of the Cauchy-Riemann equations.	2
Cl3	Evaluating curvilinear integrals of complex functions by changing them into real variable integrals and by finding antiderivative.	2
Cl4	Applying Cauchy's theorem and Cauchy's integral formula to find complex integrals.	2
Cl5	Evaluating of Laplace transforms and inverse transforms. Finding convolution of functions and applying Borel's theorem. Evaluating of transmittances. Applying operator calculus to solve linear differential equations with constant coefficients and systems of such equations.	2
Cl6	Investigating convergence of complex series. Finding radius and disc of convergence of power series. Finding expansions of holomorphic functions in Taylor series. Finding roots of a holomorphic function and investigating their multiplicity.	1
Cl7	Evaluating residues of functions. Application of residues to evaluating complex contour integrals and some improper real integrals.	2
Cl8	Test.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03,PEK_K01,PEK_K02	Oral presentations, quizzes. Exam.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03,PEK_K01,PEK_K02	Oral presentations, quizzes. Test.

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] J. Długosz, Funkcje zespolone, Teoria, przykłady, zadania, wyd. piąte, Oficyna Wydawnicza GiS, Wrocław, 2005.[2] E. Kącki, L. Siewierski, Wybrane działy matematyki wyższej z ćwiczeniami, PWN, Warszawa 1975
[2] R. V. Churchill, Complex Variables and Applications, McGrow-Hill, New York 1960

SECONDARY LITERATURE
[1] W. Żakowski, W. Leksiński, Matematyka, cz.IV, Wydawnictwa Naukowo-Techniczne, Warszawa 1994.[2] F. Bierski, Funkcje zespolone, wyd. piąte poprawione, Wydawnictwa AGH, Kraków 1999.
[2] John M. Howie, Complex Analysis, Springer-Verlag, London 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Complex Functions
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AIR_W01	C1,C4	Lec1, Lec2, Lec6, Lec7	N1, N3, N4
PEK_W02	K1AIR_W01	C2	Lec3, Lec4, Lec7	N1, N3, N4
PEK_W03	K1AIR_W01	C3	Lec5	N1, N3, N4
PEK_U01	K1AIR_U06	C1,C4	Cl1,Cl2,Cl6	N2, N3, N4
PEK_U02	K1AIR_U06	C2	Cl3,Cl4,Cl7	N2, N3, N4
PEK_U03	K1AIR_U06, K1AIR_U07	C3	Cl5	N2, N3, N4
PEK_K01, PEK_K02	K1AIR_K04, K1AIR_K05	C1-C4	Lec1-Lec7, Cl1-Cl7	N1-N4

SUBJECT SUPERVISOR

dr Jolanta Długosz email: jolanta.dlugosz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zastosowanie optoelektroniki**
Name in English: **Applications of optoelectronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD035002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Znajomość podstaw fizyki (w tym optyki geometrycznej) oraz podstaw fizyki ciała stałego
2. Completion of Fundamentals of electrical engineering course
3. Completion of Electronics Elements and Devices course

SUBJECT OBJECTIVES

C1. To familiarize students with the basic optical phenomena in semiconductors, including the transmission of light in semiconductors and optical fiber
C2. Students become acquainted with the structure, parameters and conditions of optoelectronic components

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered in terms of theoretical knowledge of photonics, including the knowledge necessary to understand the physical basis of optical components telecommunications track and knows areas of photonic systems application in particular in the automotive, energy and microsystems.

II. Relating to skills:
PEK_U01 - Student can use optical fiber systems and simple elements known in engineering practice

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction do optoelectronics	1
Lec2	The basics of optical phenomena in semiconductors	2
Lec3	Optical fiber technique	3
Lec4	Ligth sources	2
Lec5	Photodetectors	2
Lec6	Basics of the solar cells	1
Lec7	Areas of application of optoelectronic devices	3
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Attenuation of a multisegment optical fiber transmission system measurement	2
Lab2	Study of the attenuation of optical fibers	2
Lab3	Testing of optical polarizer	2
Lab4	Investigation of spectrum characteristics of light sources	2
Lab5	Investigation of matching efficiency of optical connectors in different transmission optical windows	2
Lab6	Machine Vision for manufacturing quality assurance	2
Lab7	Optical microscope and interferometry measurements for 2D/3D	2
Lab8	Measurement of surface scattering and photometric light characteristics \	2
Lab9	Industrial laser technologies	2
Lab10	Metods of laser beam measurement and process monitoring	2
Lab11	Panels and solar cells	2
Lab12	Optical fiber sensors	2
Lab13	Optotelecommunication track	2
Lab14	Optical fiber connection technology (welding of fiber optics, measurement of the geometry of the optical fiber)	2

Lab15	Semiconductor ligthing systems	2
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with presentations and discussion
N2. Self work - independent studies and preparing for the test
N3. tutorials
N4. self study - preparation for laboratory class
N5. A brief test at the beginning of the laboratory activities

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test, discussion
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	brief tests, discussion, reports after exercise
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B. Mroziewicz, M. Bugajski, Wł. Nakwaski, Lasery półprzewodnikowe, WNT 1985,
[2] J. E. Midwinder, Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ 1995,
[3] J. I. Pankove, Zjawiska optyczne w półprzewodnikach, WNT 1984,
[4] J. Piotrowski, A. Rogalski, Półprzewodnikowe detektory podczerwieni, WNT 1985,
[5] B. Ziętek Optoelektronika, Wyd. UMK, 2004,
[6] Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT 2001

SECONDARY LITERATURE
[1] A. Smoliński, Optoelektronika światłowodowa, WKŁ 1985,
[2] J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT 1986,
[3] J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN 1997,
[4] J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ 1997,
[5] M. Marciniak, Łączność światłowodowa. WKŁ 1998,
[6] G. Einarsson, Podstawy telekomunikacji światłowodowej, WKŁ 1998,

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Applications of optoelectronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W30	C1, C2	Lec1-Lec7	N1-N3
PEK_U01	K1MTR_U35	C2	Lab1-Lab15	N1-N5

SUBJECT SUPERVISOR

dr hab. inż. Ryszard Korbutowicz email: ryszard.korbutowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory i aktuatory**
Name in English: **Sensors and actuators**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD035101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None.

SUBJECT OBJECTIVES

C1. Various methods of actuation and detection in microscale will be presented.
C2. To familiarize oneself with basic properties of micromechanic sensors
C3. Review of chosen micromachines which integrate sensors and actuators will be shown.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Organization of knowledge in the fields of micromechanic sensors and actuators.

II. Relating to skills:
PEK_U01 - Is able to use selected methods and instruments to measure basic parameters of micromechanic sensors (acceleration, pressure and optical) and actuators (electrostatic and pneumatic) to be applied in mechatronic systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Review of chosen methods of actuation and sensing utilized with MEMS	3
Lec2	Introduction to fundamental mechanics of microstructures, bending, tensing in various micromechanic structures.	2
Lec3	Piezoresitive pressure sensor – principle of operation, construction.	2
Lec4	Piezoresitive pressure sensor – parameters, conditioning of electric signal, examples of realisations	2
Lec5	Acceleration sensors, gyroscopes – principles of operation, construction, parameters and examples of realisations.	2
Lec6	Micromachines as devices with various sensors and actuators.	2
Lec7	Final colloquium	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Piezoresitsive pressure sensor	3
Lab2	Barometric altitude meter.	3
Lab3	XYZ MEMS accelerometer.	3
Lab4	E-compas.	3
Lab5	Pneumatic actuation in microsclae.	3
Lab6	Capacticane MEMS pressure sensors	3
Lab7	Thermoconductive flow meter.	3
Lab8	Fluid flow in microscale.	3
Lab9	Micromechanic valves.	3
Lab10	Reserve term.	3
		Total hours: 30

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class
N3. report preparation
N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Final colloquium.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Reports.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Lecture materials.

SECONDARY LITERATURE
1.M. Bao, Analysis and Design Principles of MEMS Devices, Elsevier 2005
2. Data sheets of discised sensors and actuators.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors and actuators
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6	N4
PEK_U01	K1MTR_U15	C1, C2	Lec1-Lec6, Lab1-Lab9	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Rafał Walczak email: rafal.walczak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie numeryczne konstrukcji mikroelektronicznych**
Name in English: **Numerical prototyping of microelectronic structures**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on mathematics and physics
2. Basic knowledge on numerical methods
3. Basic computer skills

SUBJECT OBJECTIVES

C1. Familiarize students with the basics of numerical prototyping of microelectronic structures
C2. Gaining skills for computer software usage concerning numerical modelling based on finite element method as FlexPDE, Ansys
C3. Getting familiarize with typical problems connected with numerical prototyping including simulation, optimization and deisgn of experiments, etc.
C4. Consolidation of skills for self and team work based on supplied instruction materials

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is capable of selecting appropriate engineering tools for computer aided engineering and use such software as FlexPDE, Ansys, SolidWorks in order to solve typical problems of numerical prototyping in micro-engineering
PEK_U02 - Is able to analyze and interpret the achieved results using appropriate experiment design methods, optimization, numerical modelling and simulation as well as analysis and data interpretation mehods
PEK_U03 - Can properly identify and prioritize the dilemmas connected with the interdisciplinary problems.

III. Relating to social competences:
PEK_K01 - Can properly prioritize tasks in order to finalize a specified work.
PEK_K02 - Can properly identify and solve the dilemmas associated with a profession practice.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to numerical modelling and software tools as FlexPDE and Ansys	2
Lab2	Introduction to numerical modelling of micromechanical structures	2
Lab3	Analysis and optimization methods of micromechanical structures in FEM software tools as FlexPDE and Ansys	2
Lab4	Analysis of strain and stress distribution	2
Lab5	Analysis of heat dissipation and temperature distribution	2
Lab6	Analysis of electrostatic field distribution	2
Lab7	Extraction of basic electrical parameters as resistance.	2
Lab8	Analysis of laminar and turbulent flows	2
Lab9	Analysis of stress and strain distribution for bimterial structures	2
Lab10	Numerical prototyping with parametric models	2
Lab11	Analysis of a coupled electro-thermo-mechanical field	2
Lab12	Methods of thermo-electric phenomena modelling	2
Lab13	Optimization of a micromechanical pressure sensor	2
Lab14	Individual projects - problem selection and analysis	2
Lab15	Individual project - assessment	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for laboratory class
N3. tutorials
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02	tests and laboratory reports
P = (F1+...F12)/12		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Zienkiewicz O.C., Taylor R.L., “The Finite Element Method: Volumes 1-3”, Butterworth-Heinemann, London, 2000
2. Thompson E., “Introduction to the Finite Element Method”, John Wiley and Sons, 2005
3. Kreyszig E., „Advanced Engineering Mathematics”, John Wiley and Sons, 2006

SECONDARY LITERATURE
1. Montgomery D., “Design and Analysis of Experiments”, John Wiley and Sons, 2005
2. William D., Callister Jr., “Materials Science and Engineering an Introduction”, John Wiley and Sons, 2007
3. Montgomery D., Runger G., “Applied Statistics and Probability for Engineers”, John Wiley and Sons, 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical prototyping of microelectronic structures
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U22	C1-C3	La1-La13	N1-N3
PEK_K01	K1MTR_K04, K1MTR_K05	C4	La14-La15	N4

SUBJECT SUPERVISOR

dr hab. inż. Artur Wymysłowski email: artur.wymyslowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w medycynie**
Name in English: **Microsystems in medicine**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No requirements

SUBJECT OBJECTIVES

C1. Familiarize students with the design and operation of selected microsystems and possibilities of their application in biology and medicine, as well as devices and apparatus microsystems for specific tasks
C2. Learn how to work with the selected microsystems for specific tasks in biology/medicine.
C3. Fusing ability to work independently and in a team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has a general knowledge of the structure and operation of the selected microsystem devices, and possibilities of their application in biology and medicine, he knows some devices and microsystem instruments for specific tasks in biology / medicine.

II. Relating to skills:
PEK_U01 - Student can work with selected microsystem devices and instruments designed for specific tasks in biology / medicine.

III. Relating to social competences:
PEK_K01 - Student is able to work independently and in laboratory group by adopting different roles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Microtechnologies in molecular genetics (DNA, chip, PCR)	2
Lec2	Cardiac assist devices, artificial heart	2
Lec3	Artificial sense organs: electronic hearing, bionic eye	4
Lec4	Invasive and non-invasive microsystems for measuring blood pressure	2
Lec5	Miniature robots for colonoscopy and endoscopy	1
Lec6	Tonometer, sensors and microsystems for medical diagnosis	1
Lec7	Lab-on-a-chips and biochips	1
Lec8	Test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Flow and mixing of the liquids in the microchannels	3
Lab2	Dosing of micro- and nanovolumes with conductivity detection	3
Lab3	Droplet microfluidic system	3
Lab4	Microcytometer to study biological cells	3
Lab5	DNA analyser with fluorometric detection	3
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides
N2. Laboratory: short tests beginning laboratory
N3. Tutorials
N4. Self study - preparation for laboratory exercises
N5. Self study – independent studies and preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Short tests beginning laboratory
F2	PEK_K01	Laboratory reports and participation in discussions
P = F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Bibliography

SECONDARY LITERATURE
Scientific magazines and materials from lectures

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microsystems in medicine
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1	Lec1-Lec7	N1, N3, N5

PEK_U01	K1MTR_U15	C2, C3	La1-La5	N2, N3, N4
PEK_K01	K1MTR_K03	C3	La1-La5	N3, N4, N5

SUBJECT SUPERVISOR

dr hab. inż. Anna Gorecka-Drzazga email: anna.gorecka-drzazga@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w motoryzacji**
Name in English: **Automotive microsystems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic physics (mechanics, electricity and magnetism)
2. Completion of the course Fundamentals of Electrical Engineering
3. Completion of the course Components and Electronic Systems

SUBJECT OBJECTIVES

C1. To familiarize students with the basic microsystems (sensor systems), used in automotive engineering
C2. Introduction to the structure, working conditions and measurement of the main parameters used in the above-mentioned sensor systems
C3. Strengthening teamwork skills

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has the basic knowledge of the operation, construction, properties and characteristics of sensor systems and sensors (including intelligent and microsensors) used in vehicles.

II. Relating to skills:
PEK_U01 - Able to select and use the appropriate sensors to measure various physical quantities, investigate the fundamental characteristics of the sensors and use them to control systems and control vehicles.

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group (a group of laboratory), taking part in a variety of roles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Sensor systems for automotive - historical overview	2
Lec2	Fuel supply systems - tasks, principles of operation, sensors	2
Lec3	Ignition systems - tasks, principles of operation, sensors	2
Lec4	Combustion control systems of air-fuel mixture	2
Lec5	Microsystems for active and passive safety	3
Lec6	Microsystems for navigation and driver information	2
Lec7	Test	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Lambda sensor for stoichiometric mixture	3
Lab2	Sensors: throttle position, absolute pressure (MAP), oil pressure, fuel level	3
Lab3	Sensors for the position and speed of the crankshaft	3
Lab4	Accelerometers	3
Lab5	Additional term	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. report preparation
N3. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	quiz, a report from the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Marek J. „Sensors for Automotive Technology”, Wiley-VCH, Darmstadt 2003
[2] Herner A. „Elektronika w samochodzie”, WKŁ Warszawa 2001
[3] Gajek A., Juda Z., Czujniki, WKŁ Warszawa 2008,

SECONDARY LITERATURE
[1] „Czujniki w pojazdach samochodowych”, Informator techniczny f-my Bosch, 2002
[2] „Mikroelektronika w pojazdach”, Informator techniczny f-my Bosch, 2002
[3] „Układy bezpieczeństwa i komfortu jazdy”, Informator techniczny f-my Bosch, 2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Automotive microsystems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1, C2	Lec1 - Lec6	N1

PEK_U01	K1MTR_U15	C1, C2	Lab1 - Lab5	N2, N3
PEK_K01	K1MTR_K03	C3	Lab1 - Lab5	N2

SUBJECT SUPERVISOR

dr inż. Janusz Markowski email: janusz.markowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fotonika**
Name in English: **Photonics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of Physics (including geometric optics) and fundamentals of the physics of solids
2. Successful completion of the course: Fundamentals of electrical engineering, Electronics Elements and Devices, Applications of the optoelectronics

SUBJECT OBJECTIVES

C1. To familiarize students with the basic optical phenomena in semiconductors, including the transmission of light in semiconductors and optical fiber, structure, parameters and conditions of opto-electronic components supply
C2. To familiarize with the semiconductor detectors and sources of light, their design and working conditions
C3. Persisting the ability to work in a group

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered and supported in theory, knowledge of photonics, including the knowledge necessary to understand the physical basis of optical components and systems for application areas sa well as student knows telecommunications optical track in particular in the automotive, energy and microsystems

II. Relating to skills:
PEK_U01 - Student can use known methods and mathematical models as well computer simulations for the analysis and performance evaluation of optoelectronic components and simple optical fiber systems, student can correctly use the selected methods and facilities to enable the measurement of the basic parameters of elements and integrated optoelectronic. Student can develop documentation for implementation of engineering tasks and prepare a text containing an overview of the results of the implementation of this task

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Optical phenomena in semiconductors	2
Lec2	Materials for optoelectronics	2
Lec3	Manufacturing technology of optoelectronic structures	2
Lec4	Ligth sources	2
Lec5	Advanced methods of detection and processing of light energy	2
Lec6	Displays	2
Lec7	Optoelectronics in technique	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introductory training	3
Lab2	Colour theory	3
Lab3	Ligth sources - LED, LD diodes	3
Lab4	Ligth radiation detectors	3
Lab5	Solar cells I	3
Lab6	Solar cells II	3
Lab7	Optrons	3
Lab8	Optical fiber track	3
Lab9	Lighting panels	3
Lab10	Supplementary term	3
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with presentations and discussion
N2. Laboratory: a short, 10-minute test at the beginning of the exercises,
N3. Self work - preparing for the lab exercises
N4. Self work - independent studies and preparation for the seminar on
N5. tutorials, consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	discussions, test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test at the beginning of the exercises, laboratory reports, evaluation class implementation exercises
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B. Mroziewicz, M. Bugajski, Wł. Nakwaski, Lasery półprzewodnikowe, WNT 1985,
[2] J. E. Midwinder, Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ 1995,
[3] J. I. Pankove, Zjawiska optyczne w półprzewodnikach, WNT 1984,
[4] J. Piotrowski, A. Rogalski, Półprzewodnikowe detektory podczerwieni, WNT 1985,
[5] B. Ziętek Optoelektronika, Wyd. UMK, 2004,
[6] Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT 2001,

SECONDARY LITERATURE
[1] A. Smoliński, Optoelektronika światłowodowa, WKŁ 1985,
[2] J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT 1986,
[3] J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN 1997,
[4] J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ 1997,
[5] M. Marciniak, Łączność światłowodowa. WKŁ 1998,
[6] G. Einarsson, Podstawy telekomunikacji światłowodowej, WKŁ 1998,
[7] K. Booth, S. Hill, Optoelektronika, WKŁ, Warszawa 2001,
[8] R. Bacewicz, Optyka ciała stałego, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1995.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Photonics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W02	C1, C2	Lec1-Lec8	N1-N5
PEK_U01	K1MTR_MM_U02	C1-C3	Lab1-Lab10	N2, N3, N5

SUBJECT SUPERVISOR

dr hab. inż. Ryszard Korbutowicz email: ryszard.korbutowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikro- i nanoelektronika**
Name in English: **Micro- and Nanoelectronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics.
2. Basic knowledge of mathematics.
3. Basic knowledge of chemistry.

SUBJECT OBJECTIVES

C1. To familiarize students with the techniques of modern production systems of micro-and nano-
C2. To familiarize students with the properties of components made using the techniques of micro-and nano-
C3. To familiarize students with the current state of technology and development trends of micro-and nano-

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has structured and theoretically founded knowledge of the materials, technology, construction and selected electrical parameters and stability of modern elements and components in electronic circuits and mechatronic systems.
PEK_W02 - The student knows and understands the basic processes involved in the manufacture of micro-devices and nano applied in mechatronics. Versed in the current state of technology and development trends of micro-and nano-electronics.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, development trends of modern semiconductor technology, a review of the fundamental processes of micro-and nanotechnology. Preparation of substrates (doped silicon, strained silicon, SiGe, SOI technology and SON), silicon epitaxy	2
Lec2	Thermal oxidation of silicon, the production of layers of dielectric and polysilicon LPCVD technique, dielectrics with high and small k, a porous ULK materials	2
Lec3	Advanced techniques for micro-and nanolitography (photolithography, electronolitography, rentgenolitography, ionolitography, interference lithographs, scanning probe lithography)	2
Lec4	Doping layers: diffusion and ion implantation, annealing (RTA)	2
Lec5	Cleaning of substrates, wet and dry etching processes of layers and structures of MEMS and NEMS	2
Lec6	Preparation of metallic contacts and connections (silicides, Al, Cu), thin-film materials used as diffusion barriers and etching stop layer	2
Lec7	Properties of individual nanoparticles: carbon nanotubes, nanodiament, graphene. Application in the new devices	2
Lec8	Fundamentals of thin and thick film technology.	2
Lec9	Principles of design thick film components.	2
Lec10	High temperature thick films - materials, processes, properties, application.	2
Lec11	Polymer thick films - materials, processes, properties, applications.	2
Lec12	MCM (Multichip Module).	2
Lec13	Technology LTCC (Low Temperature Cofired Ceramics) - materials, processes, properties.	2
Lec14	The use of LTCC ceramics in microelectronics.	2
Lec15	Technology development trends of micro-nano.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. tutorials
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. T. Norio, Nanotechnology: Integrated Processing Systems for Ultra-Precision and Ultra-Fine Products, OUP, England, 2000
2. S. Dimitrijev, Understanding Semiconductor Devices OUP, USA, 2000
3. Ch. P. Poole, F. J. Owens, Introduction to Nanotechnology, John Wiley & Sons, 2003
4. L.J.Maissel, R.Glang, Handbook of Thin Film Technology,Mc Graw Hill Book Comp., New York London, 1988
5. W.Menz, Microsystem Technology, 1999, Albert-Ludwigs University Freiburg, Germany
6. R.R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, New York, 2001

SECONDARY LITERATURE
Magazines Sensors and Actuators, Vacuum, Conference Proceedings (COE, ELTE, IMAPS Poland Chapter, Ceramic Microsystems).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Micro- and Nanoelectronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W01	C1-C3	Lec1-Lec15	N1, N2, N3

PEK_W02	K1MTR_MM_W03	C1-C3	Lec1-Lec15	N1, N2, N3

SUBJECT SUPERVISOR
Prof. dr hab. inż. Leszek Golonka email: leszek.golonka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma seminar**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS credit no greater than it is due to the resolution of the Council of the Faculty

SUBJECT OBJECTIVES

C1. The student's self presentation skills qualification from the scope of the knowledge, skills and social competence
C2. Persisting the ability to work in a group

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can present their own skills with a range of knowledge, skills and social competences typical for the direction of Mechatronics

III. Relating to social competences:
PEK_K01 - Student is able to think and act in a way that is creative and enterprising, he can interact and work in a group

PROGRAMME CONTENT		
Form of classes – Seminar		Number of hours
Sem1	Introduction	1
Sem2	Information about diploma work and diploma exam - requirements	1
Sem3	Overview and scope of the topics diploma works foreseen and the rules for creating the correct technical and scientific texts	4
Sem4	Multimedia presentations, CV (expanded version), discussion	4
Sem5	Discussion of the issues concerning diploma exam, comments	8
Sem6	Multimedia presentations of the diploma works, discussion	6
Sem7	Presentation and preparations for the diploma exam	4
Sem8	Summary of coursework and grading	2
		Total hours: 30

TEACHING TOOLS USED

N1. Presentation of selected issues relating to the thesis and discussion
N2. Preparing a multimedia presentation on the task issues - self work
N3. Independent study and preparation for diploma thesis final exam - self work
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	The ability to discuss the issues raised in the discussion, activity in the course classes

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1) Rules of studies at Wroclaw University of Technology
2) Publications from the scope of the thesis carried out
3) Lecture materials

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_MM_W05, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31, K1MTR_U32, K1MTR_U33	C1, C2	Sem3-Sem7	N1, N2, N4
PEK_K01	K1MTR_K03	C2	Sem2-Sem7	N1, N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Ryszard Korbutowicz email: ryszard.korbutowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca dyplomowa**
Name in English: **Diploma thesis**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				360	
Form of crediting				Examination	
Group of courses					
Number of ECTS points				12	
including number of ECTS points for practical (P) classes				12	
including number of ECTS points for direct teacher-student contact (BK) classes				12.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS deficit no greater than it is due to the resolution of the Faculty Council

SUBJECT OBJECTIVES

C1. Conduct by the student thesis on the basis of the acquired while studying structured, underpinned by the theory of general and detailed knowledge with a range of science and technical areas relevant to studiowanego the direction of Mechatronics
C2. Writing by a student "thesis" (as work) and to present an oral presentation concerning the issues of the scope of the study Mechatronics, on the basis of the information from the literature and the results of their own work
C3. Persisting the ability to work independently and in a team

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can create technical texts ("thesis") and multimedia presentations from the scope of the issues towards Mechatronics

III. Relating to social competences:
PEK_K01 - Student can work independently and interact in a group, taking different roles

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Collecting the literature of the subject and to become acquainted with it	0
Proj2	Own work - critical assessment and interpretation of laboratory results	0
Proj3	Writing a thesis as works	0
		Total hours: 0

TEACHING TOOLS USED

N1. Presentation of selected issues relating to the thesis and discussion
N2. Own work - study of literature from the scope of the topic of the thesis and research work
N3. Own work - writing technical and scientific text controlled by the promoter
N4. Consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Work in a semester, the deliver of thesis as works
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Specialist subject literature agreed with the promoter

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma thesis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_U01, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U19, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31, K1MTR_U32, K1MTR_U33	C2	Proj2, Proj3	N1, N3, N4
PEK_K01	K1MTR_K03, K1MTR_K10	C3	Proj1, Proj2, Proj3	N1, N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Ryszard Korbutowicz email: ryszard.korbutowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Laboratorium mikro- i nanoelektroniki**
Name in English: **Laboratory on micro- and nanoelectronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics
2. Basic knowledge of chemistry

SUBJECT OBJECTIVES

C1. Introducing students with the fabrication techniques of modern microelectronics devices
C2. Introducing students with the properties of the elements fabricated using -techniques of the micro- and nanoelectronics
C3. Introducing students with the organization and operation of modern microelectronic laboratories

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Students can design a manufacturing process used to manufacture electronic components including selected commercial and economic criteria, using appropriate methods, techniques, tools and materials. Apply principles of occupational health and safety, and knows the rules of working in a laboratory environment and industrial

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	The organization and operation of modern semiconductor laboratory	3
Lab2	The use of CVD technology (PECVD techniques, ICPCVD, RIE) in microelectronics	3
Lab3	Technological equipment for thick film and LTCC technology	3
Lab4	Fabrication of the microelectronic circuits using thick-film technology	3
Lab5	Fabrication of the microelectronic circuits using LTCC technology	3
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	small exam laboratory report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1) L. Golonka, K. Malecha, "Ceramic microsystems", Printpap, Łódź, 2011

SECONDARY LITERATURE
1) L. Golonka, "Technology and applications of low temeprature cofired ceramic (LTCC) based sensors and microsystems", Bulletin of the Polish Academy of Sciences, Technical Science, vol. 54, no. 2, 2006, 221-231

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laboratory on micro- and nanoelectronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MM_U03	C1-C3	La1-La5	N1

SUBJECT SUPERVISOR

dr hab. inż. Karol Malecha email: karol.malecha@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody numeryczne**
Name in English: **Numerical methods**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on mathematics
2. Basic knowledge on software engineering
3. Basic knowledge on computer skills

SUBJECT OBJECTIVES

C1. Familiarize students with numerical methods and algorithms used in engineering
C2. Familiarize students with prons and cons of numerical methods and techniques
C3. Hands-on learning the scrippting Python language
C4. Consolidation of skills for self and team work based on supplied teaching materials

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has the basic, structured and theoretically founded knowledge in the field of numerical methods applied in engineering. Range of the contained knowledge covers such problems as: error analysis, numerical differentiation and integration, solving linear and nonlinear equations and set of equations, numerical interpolation and approximation, single and multi-criteria optimization along with design of experiments
PEK_W02 - Contains the basic knowledge on numerical modelling of continuum and discrete simulation of physical phenomena in macro, micro and meso scale.

II. Relating to skills:
PEK_U01 - Is capable of selecting appropriate engineering methods, software tools and numerical algorithms in order to solve typical problems concerning numerical prototyping in engineering.
PEK_U02 - Is able to interpret the achieved results and use appropriate methods of experimental data validation
PEK_U03 - Can properly prioritize tasks in order to finalize a specified work concerning numerical prototyping in engineering

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to numerical methods, Python scripping language and Modelus software	2
Lab2	Numerical differentiation and integration methods	2
Lab3	Linear and nonlinear equations	2
Lab4	Linear and nonlinear set of equations	2
Lab5	Interpolation, approximation and extrapolation methods	2
Lab6	Numerical methods of solving partial differential equations	2
Lab7	Design of experiments methods and data analysis	2
Lab8	Individual project assessment	1
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for laboratory class
N3. tutorials
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W02	tests
F2	PEK_U01 - PEK_U03	laboratory reports
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Janowski WE., „Matematyka” tom I i II, PWN, 1968
2. Volk W., „Statystyka stosowana dla inżynierów”, WNT, 1973
3. Feynmann R.P.; „Feynmana wykłady z fizyki” tom I i II, PWN, 1968

SECONDARY LITERATURE
1. Kreyszig E., „Advanced Engineering Mathematics”, John Wiley and Sons, 2006
2. Montgomery D., “Design and Analysis of Experiments”, John Wiley and Sons, 2005
3. Pang T., “ An Introduction to Computational Physics”, Cambridge University Press, 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W04	C1-C3	La1-La7	N1-N3
PEK_U01	K1MTR_MM_U04	C1-C3	La1-La7	N1-N3

SUBJECT SUPERVISOR

dr hab. inż. Artur Wymysłowski email: artur.wymyslowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikroelektronika**
Name in English: **Microelectonics**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD041001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics.
2. Basic knowledge of mathematics.
3. Basic knowledge of chemistry.

SUBJECT OBJECTIVES

C1. Knowledge in the field of technology of microelectronic components
C2. Knowledge in the field of high-tech thin-and thick-film technology
C3. To familiarize students with the current state and development trends of micro-technology and nanoelectronics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has structured and theoretically founded knowledge of the materials, technology, construction and selected electrical parameters and stability of modern microelectronic components.
PEK_W02 - The student knows and understands the basic processes associated with the production of microelectronic devices. Versed in the current state and development trendsof microelectronic technologies.

II. Relating to skills:
PEK_U01 - Students can make arrangement in thick film and LTCC technology and measure the properties of the elements made thick-film technology.
PEK_U02 - The student can decide on how to learn and implement the process of self-education.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Monolithic and hybrid circuits. Electronic semiconductor device types: integrated circuits (ICs), opto-electronic components, discrete components, solar cells, components for recording and storing information, electro-mechanical devices.	2
Lec2	Semiconductors: intrinsic semiconductors, doped semiconductors, p-n junction, metal semiconductor junction.	2
Lec3	Electronic components: diode, bipolar transistor, FET and the MOS transistor, resistor in integrated circuit.	2
Lec4	Environment of technologylaboratory. The technological process of producing chips: the crystal structure of silicon and crystallization techniques. Substrates, silicon epitaxy manufacturing steps. Measurement of substrates and heterostructures.	2
Lec5	Oxidation, diffusion and implantation of dopants into semiconductor. Technology stations.	2
Lec6	Preparation of the pattern in the process of lithography. Chemical and plasma etching of dielectrics, metals and silicon.	2
Lec7	Deposition of polycrystalline silicon, silicon dioxide and silicon nitride using CVD method. CVD systems used in practice.	2
Lec8	Application of metallization techniques: thermal evaporation, evaporation using an electron beam and sputtering. Ohmic and Schottky contacts to the semiconductor. Metallization systems.	2
Lec9	Fundamentals of thin and thick film technology.	2
Lec10	Principles of design thick film components.	2
Lec11	High temperature thick films - materials, processes, properties, application.	2
Lec12	Polymer thick films - materials, processes, properties, applications.	2
Lec13	Modules MCM (Multichip Module). The assembly methods.	2
Lec14	Technology LTCC (Low Temperature Cofired Ceramics) - materials, processes, properties.	2

Lec15	The use of LTCC in microelectronics and microsystems. Technology development trends of micro-nano.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Modern semiconductor lab	3
Lab2	Etching and passivation technologies	3
Lab3	Techniques for making patterns	3
Lab4	Technological equipment for thick film and LTCC technology	3
Lab5	Measurement of thick-film components	3
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. tutorials
N4. laboratory experiment
N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02,	test
F2	PEK_U01, PEK_U02	laboratory report
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. T. Norio, Nanotechnology: Integrated Processing Systems for Ultra-Precision and Ultra-Fine Products, OUP, England, 2000
2. S. Dimitrijev, Understanding Semiconductor Devices OUP, USA, 2000
3. Ch. P. Poole, F. J. Owens, Introduction to Nanotechnology, John Wiley & Sons, 2003
4. L.J.Maissel, R.Glang, Handbook of Thin Film Technology,Mc Graw Hill Book Comp., New York London, 1988
5. W.Menz, Microsystem Technology, 1999, Albert-Ludwigs University Freiburg, Germany
6 R.R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, New York, 2001

SECONDARY LITERATURE
Magazines Sensors and Actuaturs, Vacuum, Conference Proceedings (COE, ELTE, IMAPS Poland Chapter, Ceramic Microsystems).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microelectonics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W09	C1-C3	Lec1-Lec15	N1-N5
PEK_W02	K2MTR_W09	C1-C3	Lec1-Lec15	N1-N5
PEK_U01	K2MTR_U09	C1-C3	Lab1-Lab5	N1-N5
PEK_U02	K2MTR_U17	C1-C3	Lab1-Lab5	N1-N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Leszek Golonka email: leszek.golonka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy RT i embedded**
Name in English: **Real-time and embedded systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE001001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about modern 8-, 16- and 32-bit and DSP microcontrollers
C2. Gaining knowledge of basic blocks peripheral of microcontrollers
C3. Gaining knowledge of the architecture and operation of real-time systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can explain the principle of operation of microcontrollers and digital signal processors.
PEK_W02 - Can explain the principle of operation of the major peripheral blocks.
PEK_W03 - Able to characterize the main features of real-time systems

II. Relating to skills:
PEK_U01 - Is able to select the right processor for a particular application.
PEK_U02 - Is able to select the right peripheral block for a particular application.
PEK_U03 - Is able to use, if necessary, real-time operation system

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Definitions	2
Lec2	Embedded systems - introduction. Basic components of embedded systems	2
Lec3	8-bit microcontrollers	2
Lec4	16-bit microcontrollers	2
Lec5	32-bit microcontrollers	4
Lec6	ADC and DAC converters	2
Lec7	DSP and DSC processors	4
Lec8	Serial interfaces	2
Lec9	Real Time Operating Systems - introduction, basic parameters	2
Lec10	Real Time Operating Systems - queuing, queuing algorithms	2
Lec11	Examples: FreeRTOS	2
Lec12	Examples: WinCE	2
Lec13	Test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the lab. Introduction to the development environment	3
Lab2	Programming Principles of 32-bit processors based on ARM core	3
Lab3	Interrupts	3
Lab4	ADC and DAC converters	3
Lab5	Serial and parallel interfaces	3
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. laboratory experiment N4. tutorials N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-03	Written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-03	discussions, written reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

•Furber S., “ARM System On-Chip Architecture”, Pearsons Educated Limited, 2000
•Franklin M., “Network Processor Design: Issues and Practices”, Elsevier, 2003
•Yui J., “The Definitive Guide to the ARM Cortex-M3”, Newnes, 2007

SECONDARY LITERATURE

•Lane J., “DSP Filter Cookbook”, Prompt, 2008
•WWW pages: www.atmel.com, www.ti.com, www.arm.com, www.analog.com

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Real-time and embedded systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W07	C1	Wy1-Wy5	N1,N2,N4
PEK_W02	K2MTR_W07	C2	Wy6-Wy8	N1,N2,N4
PEK_W03	K2MTR_W07	C3	Wy9-Wy12	N1,N2,N4
PEK_U01	K2MTR_U07	C1	La1-La2	N2,N3, N4,N5
PEK_U02	K2MTR_U07	C2	La3-La5	N2,N3, N4,N5
PEK_U03	K2MTR_U07	C3	La1	N2,N3, N4,N5

SUBJECT SUPERVISOR

dr inż. Grzegorz Budzyń tel.: 22309 email: grzegorz.budzyn@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Data Mining**
Name in English: **Data Mining**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCE001003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.3	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows basic principles of probabilistics and statistics
2. Is able to use a selected programming language

SUBJECT OBJECTIVES

C1. The student who has completed the course should know the purpose and application areas of the most prominent methods of data mining in business and scientific problems (such as predictive modelling, clustering, association rules mining, time series analysis).
C2. The student who has completed the course should know the most important statistical and/or machine learning algorithms used in data mining.
C3. The student who has completed the course is able to use a selected data mining tool to build and fine-tune classification or regression models.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows application areas of most prominent methods of data mining in business and science (including predictive modelling, clustering, association rules mining).
PEK_W02 - Knows the most important algorithms used by various methods of data mining.
PEK_W03 - Knows the data mining methodology applied in business problems (CRISP-DM, SEMMA).

II. Relating to skills:
PEK_U01 - Is able to select appropriate methods of data mining for a given data analysis problem.
PEK_U02 - Is able to implement predictive modelling task using a selected data mining tool.
PEK_U03 - Is able to fine-tune classification models in terms of sensititivity and specificity.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Purpose and application areas of the most important methods of data mining in business and science (methods considered: predictive modelling, clustering, association rules mining, time series analysis).	2
Lec2	Predictive modelling algorithms: regression. Fundamentals of the statistical learning theory, goodness-of-fit, feature selection in regression.	2
Lec3	Predictive modelling algorithms: classification. Theoretical foundation, Bayes classifier, Bayes error. Discriminant analysis (LDA, QDA).	2
Lec4	Linear methods in classiification - perceptron algorithm. Neural networks. SVM - general concept of the method.	2
Lec5	Decision trees - most important learning algorithms.	2
Lec6	Dimensionality reduction, PCA algorithm. Measures of predictive performance, ROC curve.	2
Lec7	Algorithms of clustering, kNN, hierarchical algorithms, SOM.	2
Lec8	Algorithms of association rules mining.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction to the selected data mining software tool.	4
Proj2	Building classification models based on different algorithms (decision trees, neural nets, logistic regression, non-parametric models). Estimation of predictive performance of the baseline models in terms of sensitivity and specificity, estimation of the ROC curve.	4
Proj3	Fine-tuning the models using different approaches to feature selection / dimensionality reduction (e.g. using the PCA method).	2
Proj4	Estimation of the classification error as a function of compexity/simplicity settings of different classifiers.	2
Proj5	Improving performance of classification using metalearning - boosting, bagging, model ensembles.	3

	Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. case study
N3. self study - preparation for project class
N4. tutorials
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P =		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	evaluation of the project results, presentation of the project
P = 0.5*F1_W + 0.5*F1_P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

J. Han, M. Kamber, Data Mining: Concepts and Techniques, Elsevier 2012
D. Larose: Data Mining Methods and Models, Wiley 2006

SECONDARY LITERATURE

T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Data Mining
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01- PEK_W03	K2MTR_W06	C1, C2	Lec1 - Lec8	N1,N4
PEK_U01- PEK_U03	K2MTR_U06, K2MTR_W06	C3	Proj1 - Proj5	N2,N3,N5

SUBJECT SUPERVISOR

dr inż. Henryk Maciejewski email: henryk.maciejewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Identyfikacja**
Name in English: **System identification**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE001004**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows foundations of probability theory and statistics
2. Knows foundations of control theory and typical descriptions of dynamical systems

SUBJECT OBJECTIVES

C1. Learning of methods of generation and analysis of random processes (inversion method, rejection method, correlation analysis)
C2. Study of typical models of dynamic systems, and the methods (parametric and nonparametric) of their identification (least squares method, kernel method)
C3. Knowledge of LabView for the system identification purposes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the methods of computer modeling of random environment
PEK_W02 - Knows parametric and nonparametric algorithms of linear and nonlinear model synthezis on the basis of uncertain data
PEK_W03 - Knows computer realizations of typical methods in system identification

II. Relating to skills:
PEK_U01 - Can use measurement data for building and testing the linear and nonlinear models under various prior knowledge
PEK_U02 - Is able to select appropriate model
PEK_U03 - Can perform experiments and use dedicated software

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Classes of identification problems and methods. Random number generation, inversion method, rejection method	2
Lec2	Foundations of estimation theory, estimation quality assesment. Limit theorems. Types of random convergence	2
Lec3	Estimation of cumulative distribution and probability density function. Parametric and nonparametric methods	2
Lec4	Estimation of the regression function. Parametric and nonparametric methods	2
Lec5	Linear system excited by the random process. Identification of linear dynamic systems by the least squares method, correlation method and maximum likelihood method	3
Lec6	Inverse filterring. Gauss-Markov method. Instrumental variables method. Numerical aspects. Spectral analysis. LU and SVD decomposition	2
Lec7	Nonlinear system identification. Hammerstein and Wiener systems. Summary. Final test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, used computer environment, simple experiments	2
Lab2	Generation and analysis of random processes. Trend analysis. Correlation analysis	2
Lab3	Dynamical system excited by random or deterministic signal	2
Lab4	Parameter identification of linear systems (AR, ARX, MA, ARMA, ARMAX) by the least squares method	2
Lab5	Model-type and model-order selection on the basis of empirical data	2
Lab6	Kernel estimation of nonlinear characteristics	2
Lab7	Real data analysis. Physical example. Summary	3

	Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. laboratory experiment N3. tutorials N4. self study - preparation for laboratory class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01..PEK_W03	Final test
P = F1 (pod warunkiem zaliczonego laboratorium)		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01..PEK_U03	Written tests, computer excersises, reports.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] L. Ljung. System Identication. Wiley Online Library, 1999.
[2] T. Söderström and P. Stoica. System Identication. NJ: Prentice
Hall, Englewood Cli¤s, 1989.
[3] D.R. Kincaid and E.W. Cheney. Numerical Analysis: Mathematics of
Scientic Computing, volume 2. Amer Mathematical Society, 2002.
[4] K.J. Keesman. System Identication: an Introduction. Advanced Textbooks In Control and Signal Processing. Springer, 2011.

SECONDARY LITERATURE
[1] Y.S. Chow and H. Teicher. Probability Theory: Independence, Interchangeability, Martingales. Springer Verlag, 2003.
[2] G. Strang. Introduction to Linear Algebra. Wellesley Cambridge Pr, 2003.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
System identification
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MSW_W07	C1, C2	Lec1..Lec7	N1, N3, N5
PEK_W02	K2MTR_MSW_W07	C1, C2	Lec4..Lec7	N1, N3, N5
PEK_W03	K2MTR_MSW_W07	C1, C2	Lec1..Lec7	N1, N3, N5
PEK_U01	K2MTR_MSW_U09	C3	Lab1..Lab3	N2, N3, N4
PEK_U02	K2MTR_MSW_U09	C3	Lab4..Lab7	N2, N3, N4
PEK_U03	K2MTR_MSW_U09	C3	Lab1..Lab7	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Grzegorz Mzyk email: grzegorz.mzyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technika laserowa**
Name in English: **Laser techniques**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE001005**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability of independent learning
2. Ability of teamwork

SUBJECT OBJECTIVES

C1. Introduction into laser technique basics. The mostly used lasers types and their parametres.
C2. Presentation of the basic applications of laser techniques in technology, metrology, medicine, and telecommunications.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a broader and deeper knowledge of the physics necessary to understand the physical phenomena in the field of laser techniques.
PEK_W02 - Understands quantum mechanics principles of lasers operation. Knows the basic parameters of lasers, their types and applications.

II. Relating to skills:
PEK_U01 - Can carry out experiments in the field of laser technology and fiber optics. Is able to interpret the results.
PEK_U02 - To think and act in a creative way. Able to prioritize appropriately to fulfill the given task.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Physical basics of laser operation.	2
Lec2	Gas and solid state lasers.	2
Lec3	Semiconductor lasers.	1
Lec4	Modulation, detection and stabilisation of laser radiation.	2
Lec5	Laser metrology	2
Lec6	Basics af optical fibers.	2
Lec7	Fiber amplifiers and lasers.	2
Lec8	Lasers in medicine and telecommunications.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, safety isues in the laboratory, organising matters.	1
Lab2	He-Ne lasers. Modes of radiation, light diffraction, holography.	2
Lab3	Modulation of laser radiation.	2
Lab4	Michelson interferometer.	2
Lab5	Semiconductor lasers.	2
Lab6	Pulsed fibre laser.	2
Lab7	Laser micromachining 1 (galvo system with fiber laser).	2
Lab8	Laser micromachining 1 (plotter system with CO2 laser).	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. self study - self studies and preparation for examination
N4. self study - preparation for laboratory class
N5. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
P = Średnia ocen z kolokwium i zaliczenia laboratorium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	report from laboratory exercise
F2	PEK_U02	report from laboratory exercise
P = Średnia ocen ze sprawozdań		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B. Ziętek, Optoelektronika, Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 2011
[2] Koichi Shimoda, Wstęp do fizyki laserów, PWN,Warszawa, 1993
[3] Franciszek Kaczmarek, Wstęp do fizyki laserów, PWN, Warszawa, 1878
[4] M Szustakowski Elementy techniki światłowodowej, WNT Warszawa 1992r

SECONDARY LITERATURE
[1] Z. Bielecki, A. Rogalski „Detekcja Sygnałów Optycznych”, WNT, Warszawa 2001
[2] A. Kujawiński, P. Szczepański, Lasery. Fizyczne podstawy, Oficyna Wydawnicza Politechniki Warszawskiej, 1999
[3] J.E.Midwinter Światłowody telekomunikacyjne, WNT Warszawa 1983

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser techniques
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MSW_W03	C1, C2	Wy1 - Wy8	N1, N2, N3
PEK_W02	K2MTR_MSW_W03	C1, C2	Wy1 - Wy8	N1, N2, N3
PEK_U01	K2MTR_U13	C1, C2	La1 - La8	N4, N5
PEK_U02	K2MTR_U13	C1, C2	La1 - La8	N4, N5

SUBJECT SUPERVISOR

dr inż. Pawel Kaczmarek email: pawel.kaczmarek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane sterowanie**
Name in English: **Advanced control engineering**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE001006**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows basic concepts of control theory.
2. Has an elementary knowledge in system identification.

SUBJECT OBJECTIVES

C1. Acquiring knowledge of basic linear, adaptive and robust control algorithms. Acquiring knowledge about construction of fuzzy and predictive control techniques.
C2. Acquiring ability to tune controllers for different types of controlled objects.
C3. Acquiring ability to apply LabView software for implementation of advanced control algorithms.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows theoretical basis and working ideas of linear controllers. Knows basic tuning algorithms for PID controllers.
PEK_W02 - Knows formal system's description in state space. Knows the main concepts of adaptive and predictive controllers.
PEK_W03 - Knows basic architectures of robust and fuzzy control algorithms.

II. Relating to skills:
PEK_U01 - Is able to select and tune linear controllers for different types of plants/objects.
PEK_U02 - Is able to select control strategy (adaptive, robust or predictive) appropriate for given task.
PEK_U03 - Applying LabView is able to construct control system equipped with fuzzy logic controller.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Discrete time-invariant and time-variant systems. Linear and nonlinear systems.	2
Lec2	Linear controllers. Stability analysis. Selected tuning algorithms for PID controllers.	2
Lec3	State space description of linear systems.	2
Lec4	Adaptive control - selected topics.	2
Lec5	Predictive control - selected topics.	2
Lec6	Robust control. Model Following Control.	2
Lec7	Fuzzy logic control.	2
Lec8	Summary. Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Discrete time-invariant and time-variant systems. Linear and nonlinear systems. Superposition principle.	2
Lab2	Linear controllers. Stability analysis. Tuning.	2
Lab3	Analysis of systems described in state space.	2
Lab4	Adaptive control.	2
Lab5	Predictive control.	2
Lab6	Robust control.	2
Lab7	Fuzzy control.	2
Lab8	Summary. Final marks.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Final test
P = F1 (warunek konieczny: zaliczenie laboratorium)		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	Partial tests. Homework.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

J. Brzózka, Regulatory i układy automatyki, Mikom 2004
W. Greblicki, Teoretyczne podstawy automatyki, Oficyna Wydawnicza PWr, 2001

SECONDARY LITERATURE

https://dyplomy-10.pwr.wroc.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced control engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MSW_W07	C1, C2		N1, N2
PEK_W02	K2MTR_MSW_W07	C1, C2		N1, N2
PEK_W03	K2MTR_MSW_W07	C1, C2		N1, N2
PEK_U01	K2MTR_MSW_U09	C3		N2, N3, N4
PEK_U02	K2MTR_MSW_U09	C3		N2, N3, N4
PEK_U03	K2MTR_MSW_U09	C3		N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Paweł Wachel email: pawel.wachel@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka powierzchni**
Name in English: **Surface Diagnostics**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE041001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge, skills & competences due to courses of Physics.

SUBJECT OBJECTIVES

C1. Mastering of problems connected with physical interpretation of phenomena occuring at solid state surface.
C2. Practical application of surface analysis methods in surface characterisation & surface structures diagnostics.
C3. Ability of authoritative evaluation of parameters determining the nature of solid state surface.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge in a domain of physics necessary to understand physical effects occuring in semiconductor surface structures.

II. Relating to skills:
PEK_U01 - He is able to determine physico-chemical parameters of real surface by means of available diagnostic methods.

III. Relating to social competences:
PEK_K01 - He is able to properly identify & effectively solve dilemmas connected with his profession.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Preliminary information, lecture programme. The role of surface & semiconductor surface structures in micro- & nanoelectronics of semiconductors.	2
Lec2	Solid state surface, differences between surface & bulk crystal, ideal surface, real surface, surface reconstruction & relaxation.	2
Lec3	Structural & surface defects, technology of atomically flat surface.	2
Lec4	Real surface characterisation: geometrical & physico-chemical parameters, atomic structure (surface crystallography), electron structure (band structure).	2
Lec5	Methods of surface analysis, classification criteria, diagnostic methods for semiconductor nanotechnology.	2
Lec6	Investigation of surface atomic structure by means of electron diffraction techniques LEED, RHEED.	2
Lec7	Selected spectroscopic methods for qualitative & quantitative evaluation of chemical composition & surface purity (AES, SIMS, ESCA).	2
Lec8	Final test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with transparencies, slides & discussion.
N2. Tutorials.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Final test.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.A. Szaynok, S. Kuźmiński, Podstawy fizyki powierzchni półprzewodników, WNT Warszawa 2000,
2.J. Szuber, Powierzchniowe metody badawcze w nanotechnologii półprzewodnikowej.

SECONDARY LITERATURE
1.A. Oleś, Metody doświadczalne fizyki ciała stałego, WNT Warszawa 1998,
2.M. Dąbrowska-Szata, Spektroskopia głębokich poziomów w strukturach półprzewodnikowych, OW PWr, Wrocław 2009,
3.M. Dąbrowska-Szata, Dyfrakcja odbiciowa elektronów o dużej energii w badaniach powierzchni ciała stałego, OW PWr, Wrocław 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Surface Diagnostics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W09	C1, C2	Lec01 - Lec08	1, 2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maria Dąbrowska-Szata tel.: 71-320-2593 email: maria.dabrowska-szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria Kwantowa**
Name in English: **Quantum Technology**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE041002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge, skills & competences due to courses of Physics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge dealing with the rules of quantum theory and new technologies determining civilsation shape of XXI century.
C2. Practical application of quantum effects in nanostructures.
C3. Acquisition of knowledge connected with the newest achievements of quantum technology in nanoelectronics & computer science.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He understands quantum description of physical reality.

II. Relating to skills:
PEK_U01 - He is able to determine nanostructures parameters & explain physical phenomena existing in nanostructures.

III. Relating to social competences:
PEK_K01 - He is able to properly identify & effectively solve dilemmas connected with his profession.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Quantum theory - new phenomena, new rules. Quantum description of physical reality, basic definitions of quantum technology.	2
Lec2	Superconductivity as an example of quantum effect.	2
Lec3	Nanostructures, low-dimensional structures QWs, QWws, QDs, SLs, heterojunctions, heterostructures.	2
Lec4	Technology of low-dimensional structures, epitaxial techniques (revue).	2
Lec5	Tools for quantum technology STM, AFM, DLTS. New technologies of quantum engineering.	2
Lec6	The newest achievements & applications of quantum technology, carbon nanoelectronics - graphen, carbon nanotubes.	2
Lec7	Logic operations with using quantum devices - quantum computer, molecular (biological) computer.	2
Lec8	Final test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with transparencies & slides.
N2. Tutorials.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01	Final test.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.G. Milburn, Inżynieria kwantowa, Wyd. Prószyński i S-ka, Warszawa 1999
2.E. Regis, Nanotechnologie – narodziny nowej nauki, czyli świat cząsteczka po cząsteczce, Wyd. Prószyński i S-ka, Warszawa 2001.

SECONDARY LITERATURE
"American Scientific" - selected issues.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Quantum Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W12	C1, C2, C3.	Lec1-Lec8	1, 2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maria Dąbrowska-Szata tel.: 71-320-2593 email: maria.dabrowska-szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy zarządzania**
Name in English: **Management Essentials**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM031002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No initial prerequisites are required

SUBJECT OBJECTIVES

C1. Acquiring knowledge about basic trends and management concepts
C2. Acquiring knowledge about the nature and mechanisms of an organization
C3. Acquiring knowledge about the regularity and management tools, as well as the analysis of management problems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to characterize different trends occurring in the evolution of organization and management theory, and to describe the most important concepts of both traditional and modern management
PEK_W02 - The student is able to characterize basic mechanisms of organization, to distinguish between types of organizational structures, to list components of the organization and its environment
PEK_W03 - The student is able to describe how to implement various functions in the organization and management style

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Management - its essence and meaning	2
Lec2	Evolution of the organization and management theory	2
Lec3	Organization as a management object in the surroundings	2
Lec4	Aims and functions of the management	2
Lec5	Organizational structure - conditions and evolution trends	2
Lec6	Essence of managerial work (management styles, management skills), human resources management	3
Lec7	Test	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management Essentials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W04, K1MTR_W28	C1-C3	Lec1-Lec7	N1

SUBJECT SUPERVISOR

dr inż. Joanna Gąbka tel.: 41-84 email: joanna.gabka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie informacyjne**
Name in English: **Information Technology**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM031003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. none

SUBJECT OBJECTIVES

C1. The harmonization of terminology in the field of information technology and to present the origins, history and current state of development of computer science.
C2. Strengthening the knowledge on the functioning of computers and provide general principles for constructing algorithms (computer).
C3. General guidance on the preparation of publications and technical presentations.
C4. Internet and privacy on the Internet, adherence to good manners online, law on the Internet, copyright law.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic principles of design and theoretical description of modern computers, knows the rules of binary arithmetic (integer and non-integer).
PEK_W02 - The student knows the basic principles of designing algorithms.

II. Relating to skills:
PEK_U01 - Able to effectively use the tools to support the creation of technical publications, can separate form from content.
PEK_U02 - Students can use the available "office tools" to solve basic engineering tasks.
PEK_U03 - The student can independently construct a simple algorithm solves the given simple problem.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Technical Publication. The content and form. Styles.	2
Lec2	Technical Publication. Automatically lists.	2
Lec3	Computers and computer arithmetic.	2
Lec4	Algorithms. Formal methods of presentation of the algorithm. Finite automaton.	2
Lec5	How to create algorithms?	2
Lec6	The computational complexity. "Difficult" task.	2
Lec7	Internet and around or "Cicer cum caule".	2
Lec8	quiz	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Styles and their modifications, illustrations, and working with a spreadsheet.	2
Lab2	Automatic tables of contents, illustrations, bibliography ...	2
Lab3	(Final) document formatting.	2
Lab4	Calculation errors. Python	2
Lab5	Errors - practical calculations.	2
Lab6	Computational capabilities of the computer.	2
Lab7	Elements of Programming (conditional statements, loops, ...) Interesting tasks.	2
Lab8	Summary and Assessment.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. computational laboratory experiment.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	quiz
F2	PEK_W02	quiz
P = F1+F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	laboratory report
F2	PEK_W02	laboratory report, quiz.
F3	PEK_U01	laboratory report
F4	PEK_U02	laboratory report
F5	PEK_U03	laboratory report, quiz.
P = F1+F2+F3+F4+F5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Algorithmics: The Spirit of Computing (3rd Edition) by David Harel and Yishai Feldman (Jun 11, 2004)

SECONDARY LITERATURE
2. Computers Ltd.: What They Really Can't Do (Popular Science) by David Harel (Dec 11, 2003)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Information Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C2	Lec1-Lec8	N1, N2, N3
PEK_W02	K1MTR_W02	C2	Lec1-Lec8	N1, N2, N3, N4
PEK_U01	K1MTR_U19	C3	Lab1 - Lab8	N1, N2, N3
PEK_U02	K1MTR_U19	C2, C3	Lab1 - Lab8	N1, N2, N3
PEK_U03	K1MTR_U19	C2	Lab1 - Lab8	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Wojciech Myszka tel.: +48(71)3202790 email: Wojciech.Myszka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ergonomia i BHP**
Name in English: **Ergonomics and safety**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM032001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases, estimate of professional risk on work positions	2
Lec3	Ergonomics as interdisciplinary science	2
Lec4	Labor biomechanics - science about threats for employee health discovering, being result of executable work	2
Lec5	Dangerous and harmful agents in work environment - mechanical agents and electric power	2
Lec6	Dangerous and harmful agents in work environment - noise, vibrations and lighting	2
Lec7	Dangerous and harmful agents in work environment - chemical and biological agents	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE
D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ergonomics and safety
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_W25, K1MTR_W26	C1 - C3	Lec1-Lec7	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika I (Statyka)**
Name in English: **Mechanics I (Statics)**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM032003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differentiation, integration)
2. algebra (at secondary level) + linear algebra (matrices, determinants)
3. Euclidean geometry and trigonometry

SUBJECT OBJECTIVES

C1. Solving of practical static and kinematic problems based on the laws of classical mechanics
C2. Implementing of static analysis of strength of machine elements
C3. The acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define the basic concepts in mechanics (force, moment of force). He knows the classical mechanics equations in statics. He knows some selected methods of solving trusses, beams and frames
PEK_W02 - has a knowledge of the geometry of the masses (static moments, moments of inertia and deviation)
PEK_W03 - He has a knowledge of the basic concepts of particle kinematics and the kinematics of a rigid body (speed, acceleration, number of degrees of freedom, the trajectory and motion equations)

II. Relating to skills:
PEK_U01 - He is able to solve typical engineering structures (trusses, beams, frames) under static load: reactions at the supports, the internal forces (as an analytic functions and their graphs)
PEK_U02 - He is able to determine the position of centre masses, static moments and moments of inertia of basic mechanical systems and the principal axes and moments of inertia in coplanar system
PEK_U03 - He can calculate the velocity and acceleration of any points of typical mechanical systems and their components

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Outline of vector algebra	2
Lec2	Force, moment of force, the main vector and main moment of forces, equilibrium conditions, the axioms of statics. Changing of the moment’s pole	2
Lec3	Concurrent force system. Trusses. Method of separated nodes	2
Lec4	Determination of the reaction forces in the case of coplanar force systems (applying in the beams, trusses, plane frames, etc.)	2
Lec5	Ritter’s method to determining the forces in selected truss members. The reduction of coplanar force system. Culmann’s method.	2
Lec6	The internal forces in statically determinate beams (analytical method)	2
Lec7	Determination of internal forces in the frames	2
Lec8	Centre of masses in discrete and continuous systems. Static moments	2
Lec9	Moments of inertia, parallel and rotational transformation	2
Lec10	principal axes and moments of inertia in coplanar system	2
Lec11	Particle kinematics (trajectory, velocity, acceleration). Curvilinear motion, tangential and normal acceleration. Kinematics in the natural and polar coordinate system	2
Lec12	The notion of a rigid body. Degrees of freedom. Classification of the motion of a rigid body. Formulas for calculation the velocity and acceleration in the general motion case.	2

Lec13	Kinematics of rigid body rotation. Rotational velocity and acceleration. Plane motion. Methods for determining the velocity of the plane motion (instantaneous center of rotation, centroid)	2
Lec14	Acceleration in plane motion of a rigid body. Instantaneous center of accelerations.	2
Lec15	Test	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Basic operations on vectors: analytical and graphical summation, scalar and vector multiplication, etc.	2
Cl2	Determination of forces in the bars of planar systems (trusses) by separated nodes method using equilibrium equations and polygon of forces	2
Cl3	Determination of reaction forces in bearings of any planar systems by analytical methods	2
Cl4	Determination of reaction forces in bearings of spatial systems (one example)	1
Cl5	Determination of forces in freely selected truss rods (by Ritter's method)	1
Cl6	Test 1: vectors, trusses	1
Cl7	Determination of internal forces in beams	1
Cl8	Determination of internal forces in beams (cont.). Articulated beams.	2
Cl9	Determination of internal forces in frames (simple planar frames at most with one node)	2
Cl10	Test 2: the internal forces in planar systems	1
Cl11	Determination of mass centres and static moments in discrete multi-mass systems.	1
Cl12	Determination of mass centres and static geometrical moments in static continuous planar systems.	2
Cl13	Determination of the moments of inertia in planar discrete-continuous systems and deviation moments relative to any axis by application Steiner's law.	2
Cl14	Determination of the position of the principal central axis of inertia and values of the principal inertial central moments for planar systems (one example).	2
Cl15	Test 3: centres of masses, static and inertial moments.	1
Cl16	Solving the problems of particle kinematics in the Cartesian coordinate system.	2
Cl17	Solving the kinematic problems of rotation and translatory motion of rigid body.	2
Cl18	Determination of velocity in rigid body plane motion	2
Cl19	Test 4: kinematics	1
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. 4 tests instead of two colloquia forcing students to more systematic own work during the semester, including greater use of consultation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written and oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test 1 and 2 and/ or oral replies
F2	PEK_U02	test 3 and/ or oral replies
F3	PEK_U03	test 4 and/ or oral replies
P = 2 jeśli ocena F1=2. Jeśli nie to P=(2F1+F2+F3):4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. B. Gabryszewska, A. Pszonka: "Mechanics", Part 1: Statics, WUT, 1988
2. J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
3. J. Misiak: "General Mechanics. Statics and Kinematics ". Volume I, WNT, Warsaw, 1993
4. M. Kulisiewicz St. Piesiak: "The dynamics of mechanical systems in technical tasks" Part I: "Fundamentals of Kinematics", WUT, 2002
5. C. Witkowski, "Exercises in mechanics." Part I. "Kinematics". WUT. 1999
6. Z. Jaśniewicz , "Exercises in statics “ WUT. 1996

SECONDARY LITERATURE
1 J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
2 B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
3 J. Leyko: "General Mechanics", WNT, Warsaw, 1980
4 S. Piasecki, J. Rżysko: "Mechanics" WNT, Warsaw, 1977,
5 W. Siuta: "Engineering Mechanics", WNT, Warsaw, 1968

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics I (Statics)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W01, K1MTR_W02, K1MTR_W08	C1, C2	Lec 1 to Lec 15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MTR_U08	C1, C2	CL 1 to Cl 19	N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika II (Dynamika)**
Name in English: **Mechanics II (Dynamics)**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM033002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. mathematical analysis (differentiation, integration)
2. differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of the principles of classical dynamics for typical mechanical systems (discrete systems: a material point, system of material points with holonomic constrains, rigid body).
C2. Resolving some technical problems of structure and mechanical systems under dynamic loads.
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define key concepts in the dynamics of mechanical systems (momentum, angular momentum, force of inertia, work, kinetic and potential energy)
PEK_W02 - He knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance)
PEK_W03 - He knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert's principle). He is familiar with the term of conservative system and with energy conservation law. He knows the dynamics equations of rotational motion and
plane motion of a rigid body.

II. Relating to skills:
PEK_U01 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion of a point.
PEK_U02 - He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using Newton's second principle. It can calculate the frequency of free vibration for systems with one degree of freedom of the linear viscous damping and without damping.
PEK_U03 - He can derive the equations of motion and calculate its parameters (rotational velocity and acceleration) for rigid body loaded by torque and moves rotation. He can determine the reaction force constraints under dynamic loads. It can calculate the kinetic and potential energy for complex mechanical systems. He is able to apply the energy conservation law to determine the differential equations of conservative system

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. The basic principles of classical mechanics. Kinematics and dynamics. Models of discrete and continuous dynamical systems in mechanics.	2
Lec2	A brief reminder of the kinematics of the material from the previous semester. Addendum: Kinematics of relative motion (Coriolis acceleration)	2
Lec3	Newton's second law (applicable in the dynamics of the free and constrained point)	2
Lec4	The vibrations of the one-mass single degree of freedom system with the linear viscous damping and without damping. Complex notation. Free vibrations.	2
Lec5	Harmonically forced vibration, frequency characteristics, resonance. Dynamic and kinematic excitations	2
Lec6	The forces of inertia and d'Alembert's principle. Momentum, and momentum principle. Angular momentum and angular momentum principle.	2
Lec7	The notion of work. Elementary work. The kinetic and potential energy. The principle of work and kinetic energy equivalence.	2
Lec8	The principle of conservation of energy. Conservative systems. Examples of applications.	2

Lec9	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems	2
Lec10	The principle of the center of mass motion and the principle of momentum in multi-mass systems	2
Lec11	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation.	2
Lec12	Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness	2
Lec13	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces.	2
Lec14	Angular momentum in the plane motion of a rigid body and dynamics of plane motion.	2
Lec15	The kinetic energy of a rigid body in a general motion. König's theorem. Determination of the differential equations of motion and natural frequency of the dynamical conservative systems based on the energy conservation law.	2
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Practical problems of plane motion of rigid body	2
Cl2	Practical problems of kinematiks of relative motion of point	2
Cl3	Solving examples of tasks with dynamic free material point using Newton's second law (rectilinear and curvilinear motion)	2
Cl4	Test 1: kinematics of plane motion and / or the relative motion	1
Cl5	Examples of tasks from free vibration of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations)	2
Cl6	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy)	2
Cl7	Examples of the tasks of the dynamics and rotational motion of the rigid body. Dynamic force responses	2
Cl8	Final test	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written and oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	quiz, oral replies
F2	PEK_U02, PEK_U03	test, oral answer
P = (F1+3F2)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1 B. Gabryszewska, A. Pszonka: "Mechanics", Volume II "Kinematics and dynamics", WUT, 1998
2 J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
3 J. Misiak: "General Mechanics. Dynamics ". Volume II, WNT, Warsaw, 1993

SECONDARY LITERATURE

1 J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
2 B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
3 J. Leyko: "General Mechanics", WNT, Warsaw, 1980
4 M. Klasztorny: "Mechanics", Lower Silesia Ed. Education, Wrocław 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics II (Dynamics)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W09	C1	Lec. 1 to Lec. 15	N1, N4

PEK_U01, PEK_U02, PEK_U03	K1MTR_U01, K1MTR_U02	C2	Cl 1 to Cl 15	N2, N3, N4

SUBJECT SUPERVISOR
Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza i synteza układów kinematycznych**
Name in English: **Analysis and Synthesis of Kinematic Systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM034001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, analytical geometry, matrix algebra
2. Knowledge of fundamental laws in statics, kinematics and dynamics
3. Skill in fuction analysis, derivatives, fundamental operations on matrices and vectors

SUBJECT OBJECTIVES

C1. Acquire knowledge in topology, kinematics and dynamics of kinematic systems
C2. Acquire knowledge in basic mechanisms design (type and dimensional synthesis)
C3. Getting skills in determining kinematic system analysis (topology, kinematics, kinetostatics)

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Understands theoretical fundamentals of analysis and synthesis of kinematic systems
PEK_W02 - Has the knowledge of kinematic and kinetostatic analysis methods
PEK_W03 - Has the knowledge of dimensional synthesis of basic mechanisms

II. Relating to skills:
PEK_U01 - Is able to evaluate topological properties of kinematic systems
PEK_U02 - Is able to determine kinematic and kinetostatic quantities
PEK_U03 - Is able to create models of mechanisms

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms (links, joints, mobility, redundant constraints)	3
Lec2	Linkages (characteristics). Fundamental kinematic eguations	3
Lec3	Kinematics cont.	2
Lec4	Analytical methods in kinematics	2
Lec5	Planetary transmissions, harmonic drive	2
Lec6	Introduction to dynamics, inertia forces, joint forces	2
Lec7	Kinetostatic analysis, virtual work method	2
Lec8	Friction in joints	2
Lec9	Robot topology, characteristics, analysis of planar systems	2
Lec10	Analysis of manipulators cont.jacobian, forces	2
Lec11	Matrix notation for 3D systems	2
Lec12	Structural synthesis, conceptual design	2
Lec13	Dimensional sythesis of linkages	2
Lec14	Dimensional sythesis of linkages cont	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction, presentation of Adams system - examples of analysis	2
Proj2	Rules of drawing digrams of mechanisms, topology analysis, mobility (test, project)	2
Proj3	Introduction to modelling mechanisms in Adams	2
Proj4	Rules of creating models of mechanisms in Adams	2
Proj5	Rules of creating models of mechanisms in Adams cont (test)	2
Proj6	Mechanism position determination, instant centers of rotation (test, project)	2
Proj7	Kinematic analysis of linkages - velocity and acceleration determination using vector methods (test, project)	2

Proj8	Kinematic analysis of linkages - analytical methods (project)	2
Proj9	Inertia forces, kinetostatic analysis (test, project)	2
Proj10	Kinematics and kinetostatics in Adams (project)	2
Proj11	Planar manipulators - matrix method in kinematics (project)	2
Proj12	Modelling of manipulators using Adams - forward and inverse tasks, driving forces (project)	2
Proj13	Modelling of manipulators cont.	2
Proj14	Planetary transmission analysis - velocity ratio (project)	2
Proj15	Planetary transmission analysis cont.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. self study - preparation for project class
N3. individual project solution
N4. tutorials
N5. preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project defence
F2	PEK_U01, PEK_U02, PEK_U03	test
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; Miller S.: Theory of machines and mechanisms. Analysis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1996; Miller S.: Kinematic systems. Basics of design (in Polish). WNT Warszawa 1988; Gronowicz A. et al: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE
Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002; Miller S.: Theory of machines and mechanisms. Synthesis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1979

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analysis and Synthesis of Kinematic Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W09	C1, C2, C3	Lec1 - Lec15	N1, N2, N4, N5
PEK_U01, PEK_U02, PEK_U03	K1MTR_U09	C3	Pr1 - Pr15	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Antoni Gronowicz tel.: 71 320-27-10 email: antoni.gronowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM034002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.
PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2

Lec2	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec3	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	2
Lec4	Tolerance and machine parts measurement.	3
Lec5	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec6	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec7	Basics of coordinate masurement technique	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Measurements of linear dimensions.	2
Lab3	Measurements of angular dimensions. Direct and indirect measurements of cones.	2
Lab4	Identification and measurement of threads.	2
Lab5	Assessment of the geometrical structure of the surface.	2
Lab6	Identification and measurement of cylindrical gears.	2
Lab7	Measurements of selected shape deviations and displacement.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE

[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1MTR_W03	C1; C2; C3; C4; C5; C6	Wy1-Wy7	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1MTR_U29	C1; C2; C3; C4; C5; C6	La1 - La7	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1MTR_K03, K1MTR_K04, K1MTR_K09	C1; C2; C3; C4; C5; C6	La1 - La7	N1; N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy technik wytwarzania**
Name in English: **Fundamentals of manufacturing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM034003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			45		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students should have knowledge of technical drawing, marking dimensions and tolerances of form and position tolerances, surface roughness.
2. Students should have a basic knowledge of mathematics, physics and materials science.
3. The student should be able to overall planning of the experiment and solve simple technical problems.

SUBJECT OBJECTIVES

C1. Transfer of basic knowledge of manufacturing techniques used in mechanical and electronic industries.
C2. Transfer informations about the main ways and techniques of production, grouped in mechanical technologies such as: casting, welding, processing of plastic and machining.
C3. In the area of electronic discussion of such technologies as micro-and nanotechnology production of layers with different properties used in electronics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student is able to characterize the manufacturing techniques of different layers used in microelectronic integrated circuits.
PEK_U02 - He can choose the appropriate technology welding, casting and plastic forming and defining the basic parameters of these processes.
PEK_U03 - Students should be able to plan a laboratory experiment in the field of machining, and be able to carry out measurements and analyze the results.

III. Relating to social competences:

PEK_K01 - Students should be aware of professional behavior on the bench and know the main principles of safe operation of lathes.
PEK_K02 - Objectively examine the arguments, rational translations and justify their point of view using the knowledge of manufacturing techniques
PEK_K03 - Students should understand the need for continuous learning and deepen their knowledge and skills with the changing technical and social considerations.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Preparation of thick layer microelectronic circuits.	3
Lab2	Preparation of multilayer LTCC circuits.	3
Lab3	Preparation and characterization of semiconductor layers.	3
Lab4	Preparation and characterization of dielectric layers.	3
Lab5	Preparation and characterization of metal layers.	3
Lab6	Performing cast in sand molds and disposable assets.	3
Lab7	Precision casting using the lost model.	3
Lab8	Manufacture of plastic products.	3
Lab9	Welding (shielded metal Gas metal arc welding, gas tungsten arc welding , micro-plasma welding, gas welding)	3
Lab10	Welding and soldering (resistance and friction welding processes, soldering and brazing)	3
Lab11	Cold deformation and annealing, cupping test plates.	3
Lab12	Rolling of sheets and profile, cutting and bending	3
Lab13	Turning and drilling	3
Lab14	Methods of abrasive machining	3
Lab15	Milling and electrodischarge machining	3
		Total hours: 45

TEACHING TOOLS USED
N1. laboratory experiment N2. self study - preparation for laboratory class N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	test, report on laboratory exercises
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Jaworski R. i inni. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr., Wrocław 1981
2.S. Kajzer, R. Kozik, R. Wusatowski: Wybrane zagadnienia z procesów obróbki plastycznej metali. Wyd. PŚl. Gliwice 1997
3.Techniki wytwarzania – obróbka ubytkowa. Laboratorium" pod redakcją Piotra Cichosza
Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002

SECONDARY LITERATURE

1.www.tworzywa.pwr.wroc.pl
2.www.dbc.wroc.pl/Content/7156/Techniki_wytwarzania_Spawalnictwo_A.Ambroziak_linkowane.pdf

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01; PEK_U02; PEK_U03	K1MTR_U03, K1MTR_U11, K1MTR_U29	C1; C2; C3	La1 -La15	N1; N2; N3

PEK_K01; PEK_K02; PEK_K03	K1MTR_K01, K1MTR_K05, K1MTR_K08	C1; C2; C3	La1 - La15	N2; N3

SUBJECT SUPERVISOR
dr inż. Marek Kołodziej tel.: 41-81 email: marek.kolodziej@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sieci przemysłowe**
Name in English: **Industrial networks**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM034101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PLC controllers

SUBJECT OBJECTIVES

C1. Explain the construction of industrial networks
C2. Explain the operation of industrial networks
C3. Explain the use of industrial networks

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the construction of industrial networks.
PEK_W02 - Can explain the operation of industrial networks.
PEK_W03 - Is able to select a network to an application

II. Relating to skills:
PEK_U01 - Is able to design industrial network.
PEK_U02 - Can build an industrial network.
PEK_U03 - Can set up a network of industrial

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The issue of electronic control and monitoring in industrial environments	2
Lec2	Network models	2
Lec3	The physical layer	2
Lec4	Data link layer	2
Lec5	Examples of industrial networks - construction, characteristics, application areas	3
Lec6	Methods for data exchange in industrial networks. Network Configuration. Specialized software.	3
Lec7	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	PPi and MPI interfaces	2
Lab3	Modbus network	2
Lab4	AS-i network	2
Lab5	Interbus network	2
Lab6	Profibus network	2
Lab7	Profinet network	2
Lab8	CAN network	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Test, REPORT OF LABORATORY PRACTICE
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Solnik W., Znajda Z.: Komputerowe sieci przemysłowe Profibus DP i MPI. OficynaWydawnicza Politechniki Wrocławskiej, Wrocław 2004Kwiecień A.,: Analiza przepływu informacji w komputerowych sieciach przemysłowych.WPK J. Skalmierskiego, Gliwice 2000Mielczarek W.: Szeregowe interfejsy cyfrowe. Helion 1993

SECONDARY LITERATURE
Legierski T. i inni: Programowanie sterowników PLC, Wydawnictwo Pracowni Komputerowej JackaSklamierskiego, Gliwice 1998 Kasprzyk J. Programowanie sterowników przemysłowych, Wydawnictwo Naukowo-Techniczne, Warszawa 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Industrial networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W20	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6,	N1
PEK_W02	K1MTR_W20	C2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6,	N1
PEK_W03	K1MTR_W20	C3	Lec5	N1
PEK_U01	K1MTR_U20	C1	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_U02	K1MTR_U20	C2	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_U03	K1MTR_U20	C3	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy napędowe, elementy hydrauliczne i elementy pneumatyczne**
Name in English: **Drive systems, hydraulic components and pneumatic components**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM035002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of differential calculus. Basic knowledge of mechanics, materials, and automation.
2. Ability to conduct basic analysis of the workings of simple mechanisms. The ability to understand, use and transformation formulas describing the basic relationships and physical phenomena.
3. Basic ability to formulate conclusions on the basis of the knowledge or the results of a laboratory experiment.

SUBJECT OBJECTIVES

C1. Acquaint students with hydrostatic and pneumatic power systems, principles of operation, basic relations, mathematical models describing the elements of the systems, methods of control and regulation. Presentation of the latest trends in the integration of electronic components and elements of hydraulic and pneumatic systems. Miniaturization of hydraulic components.
C2. Present the student the role of individual components in the hydraulic and pneumatic power systems. Determination of the effect of the parameters of the individual elements on the mode of action the whole system. The acquisition of the knowledge needed to make aware changes in hydrostatic and pneumatic systems, which purpose is positive change the work parameters of the system.
C3. Acquisition by the student the teamwork skills. Formulation of proposals by a group of students based on the results of laboratory tests and summary them in writing form.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to define the principle of operation and basic parameters of hydraulic and pneumatic systems. The student is able to describe the work conditions which are necessary for the proper operation of hydraulic and pneumatic systems. The student is able to explain the impact of various system parameters on its performance.
PEK_W02 - The student describes the characteristics and principles of operation of the elements of hydraulic and pneumatic systems. The student independently analyzes the parameters of individual elements of systems by defining their principles of operation.
PEK_W03 - The student selects the individual components of hydraulic and pneumatic systems, creating the concept of a full system based on the initial assumptions. Student by exchanging elements or changing the control system interfere in existing hydraulic and pneumatic systems, making changes that have a positive impact on the output parameters of the whole system.

II. Relating to skills:
PEK_U01 - The student identifies and describes the principle of operation of the elements of hydraulic and pneumatic systems. Students performed a laboratory experiment on which assesses the impact of selected parameters on the operation of the element.
PEK_U02 - The student performs the laboratory experiments on the basis of which identifies the individual parameters of hydraulic and pneumatic systems. A student on the basis of their identifies and describes the physical phenomena whose existence has a significant impact on the performance of individual components or complete systems.
PEK_U03 - The student performs and controls the course of a laboratory experiment, records the results and makes them evaluated. The student collects and publishes the results in a written report and draws conclusions.

III. Relating to social competences:
PEK_K01 - The student takes part in the work of the group of students, the purpose of which is the performance of a laboratory experiment.
PEK_K02 - The student acquires abilities to present the results of their work in the form of a written report supplementing them orally during the consultation with the teacher.
PEK_K03 - The student independently searches for information and analyzes them based on the knowledge acquired during the course.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	To acquaint students with the scope of the course, the terms of credit and the subject literature. Basic knowledge of the mechanics of liquids and gases. Flow characteristics.	2
Lec2	The principle of operation of the hydrostatic drive. Hydraulic fluids and their properties.	2
Lec3	Contaminations - the sources, causes and effects. Analogies between the mathematical models of hydraulic systems.	2
Lec4	Filters and filtration. Classification of the filters, principle of operation, place of installation in the system.	2
Lec5	The efficiency of hydraulic systems, hydraulic efficiency.	2
Lec6	Volumetric efficiency and the total efficiency of the hydraulic systems.	2
Lec7	Energy generators: pumps and compressors. Construction and characteristics.	2

Lec8	Actuators: cylinders and motors. Construction and characteristics. Mathematical models.	2
Lec9	Control elements: flow direction, pressure and flow rate.	2
Lec10	Methods of controlling the speed of the hydraulic actuators.	2
Lec11	Volumetric control and regulation.	2
Lec12	The technique of the proportional control - the basics: elements and hydrotronic systems.	2
Lec13	Designing of the hydrostatic power systems.	2
Lec14	The heat balance of hydraulic systems. Components and systems of the micro hydraulics.	2
Lec15	Exam.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of ratings.	2
Lab2	Experimental designation of working fluid properties - compressibility.	2
Lab3	Experimental designation of the flow resistance in the hydraulic lines - linear resistance.	2
Lab4	Local resistance in hydraulic systems. Orifice as local resistance, the phenomenon of cavitation.	2
Lab5	Determination of characteristics a positive displacement pump.	2
Lab6	Static characteristics of a conventional directional spool valve.	2
Lab7	Examination of the hydrostatic transmission.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. report preparation
N4. self study - self studies and preparation for examination
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	axam

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	laboratory reports, oral response, participation in problems discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. W. Kollek, Basics of the designing hydraulic drives and controls., wydawnictwo: Oficyna Wydawnicza Polit. Wrocławskiej, Wrocław., rok: 2004, (in Polish)
2. E. Tomasiak, The drives and controls systems of the hydraulic and pneumatic.,wydawnictwo: Wydawnictwo Polit. Ślaskiej. Gliwice., rok: 2001, (in Polish)
3. S. Stryczek, Hydrostatic drive., wydawnictwo: WNT, rok: 1996, (in Polish),
4. A. Osiecki, The hydrostatic drive of machines., wydawnictwo: WNT, rok: 2004, (in Polish)

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Drive systems, hydraulic components and pneumatic components
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W1	K1MTR_W10	C1	Lec1÷Lec3	N2, N4, N5
PEK_W2, PEK_W3	K1MTR_W10, K1MTR_W24	C2	Lec4÷Lec14	N2, N4, N5
PEK_U1÷PEK_U3	K1MTR_U10, K1MTR_U23	C3	Lab1÷Lab7	N1, N2, N3
PEK_K1÷PEK_K3	K1MTR_K04	C3	Lab1÷Lab7	N1, N2, N3

SUBJECT SUPERVISOR
dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowniki PLC**
Name in English: **PROGRAMMABLE LOGIC CONTROLLERS**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM035102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the principles of operation of semiconductor electronic components.
2. Has a basic knowledge of industrial networks.

SUBJECT OBJECTIVES

C1. Making familiar with the construction of a PLC.
C2. Making familiar with the operation of the PLC.
C3. Making familiar with PLC programming languages.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a basic knowledge of the construction of a PLC.
PEK_W02 - Has a basic knowledge of the operation of the PLC.
PEK_W03 - Has a basic knowledge of PLC programming.

II. Relating to skills:
PEK_U01 - Can apply the appropriate PLC for the job.
PEK_U02 - Can configure the PLC.
PEK_U03 - Can program the PLC.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Principles of assessment of the course. Introduction. History of the PLC. Market PLC. Basic definitions.	2
Lec2	Architecture of PLC	2
Lec3	The principle of operation of the PLC. Program Structure and organization of memory.	2
Lec4	Standard graphical PLC programming languages.	2
Lec5	Standard text PLC programming languages.	2
Lec6	SFC sequence language	2
Lec7	Examples of applications using a PLC.	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	ILC 130 - software tools, configuration	2
Lab3	ILC 130 - programming.	2
Lab4	Logo! - software tools, configuration	2
Lab5	S7-1200 - software tools, configuration	2
Lab6	S7-1200 - programming	2
Lab7	S7-300 - software tools, configuration	2
Lab8	S7-300 - programming	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	grade point average.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Legierski T., Kasprzyk J., Wyrwał J., Hajda J.: Programowanie Sterowników PLC, Wyd. Prac. Komp. J. Skalmierskiego, Gliwice, 1998.Kwasniewski J.: Sterowniki PLC w praktyce inżynierskiej, Wyd. BTC, 2008.

SECONDARY LITERATURE
Simatic S7. Programowalny sterownik S7-1200. Podręcznik systemu. Siemens 2009.Logo!. Podręcznik. Siemens 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
PROGRAMMABLE LOGIC CONTROLLERS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W10, K1MTR_W33	C1	Lec1, Lec2,	N1
PEK_W02	K1MTR_W10, K1MTR_W33	C2	Lec3,	N1
PEK_W03	K1MTR_W10, K1MTR_W33	C3	Lec4, Le5c, Lec6, Lec7,	N1
PEK_U01	K1MTR_U16, K1MTR_U38	C1,C2	LA2,LA4, LA5,LA7	N2,N3,N4
PEK_U02	K1MTR_U16, K1MTR_U38	C1,C2	LA2,LA4, LA5,LA7	N2,N3,N4
PEK_U03	K1MTR_U16, K1MTR_U38	C3	LA3, LA4, LA6, LA8	N2,N3,N4

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia w produkcji przemysłowej**
Name in English: **Ecology in industrial manufacturing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM035201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has ordered knowledge of high school biology, chemistry and physics. He can interpret the basic relationship between human activities and behavior of living organisms and the environment.
2. He understands the need for industrial development and implementation of new solutions in the construction, operation and modernization of the equipment of the principles of sustainable development, the protection of natural resources and the environment.

SUBJECT OBJECTIVES

C1. Understanding the structure and functioning of living nature, ecotoxins action and the greenhouse effect. Understanding the risks of escalation of industrial human activity. Legal regulations in the field of environmental protection. Understanding the environmental management systems standard ISO 14000.
C2. Understanding the risks and ways of obtaining energy from conventional and renewable sources and principles of waste management - waste minimization and recycling, LCA method.
C3. Familiarizing with the design, operation and modernization of the equipment, favoring the protection of natural resources and the environment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows and understands the dangers of global warming, the development of technology, energy production, manufacturing and recycling
PEK_W02 - Student understands the need to introduce a new framework for environmental protection, environmental management systems is known, has expertise in the implementation of ISO 14000
PEK_W03 - Student knows and understands the risks of escalation of industrial man knows the rules and benefits of the implementation of environmental measures in the construction and operation of machinery

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Sources of risks arising from industrial activities and the operation of machinery, ectotoxins, the greenhouse effect, energy generation	2
Lec2	International conventions and Polish legislation on environmental protection	2
Lec3	Environmental management. Environmental management systems and existing standards BS, EMAS, ISO 14000 and others	2
Lec4	Ecological consequences of energy production from conventional and renewable sources	2
Lec5	Waste minimization, recycling - efficient and environmentally friendly way of waste management	2
Lec6	Waste management, waste source, treatment, energy recovery and safe disposal	2
Lec7	Biodegradability, toxicity, carcinogenicity and mutagenicity of supplies, polychlorinated biphenyls	2
Lec8	Environment-friendly materials in the operation of machinery - oils, greases, lubricating greases, Ecological aspects of the construction, operation and modernization of the equipment	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 ÷ PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Lewandowski W: Proekologiczne odnawialne źródła energii, WNT W-wa 2010 ; Mackenzie A., i inni: Ekologia, PWN W-wa 2009 ; Nierzwicki W: Zarządzanie środowiskowe, Polskie Wyd. Ekonomiczne, W-wa 2006 ; Rosik-Dulewska Cz: Podstawy gospodarki odpadami, PWN 2007

SECONDARY LITERATURE

Papers: "Czysta Energia", „Utrzymanie ruchu", „Recykling", „Nasze Środowisko" , "Ekotechnika"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology in industrial manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_M_W07	C1 - C3	Lec1-Lec8	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie układów mechatronicznych**
Name in English: **Basics of mechatronical design of systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM036001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge and skills of analysis, synthesis and modeling of kinematic systems
2. knowledge and skills of synthesis and modeling of control systems

SUBJECT OBJECTIVES

C1. The aim of the course is to familiarize students with the principles of construction, design, modern machinery in terms of mechatronics.
C2. The aim is to acquire the skill of analysis, modeling and design of a simple mechatronic systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has detailed knowledge of selected issues related to the design and modeling of mechatronic systems

II. Relating to skills:
PEK_U01 - Ability to design, integrate, and model the simple mechatronic system, and then verify that it works

III. Relating to social competences:
PEK_K01 - Is aware of the importance and understanding of non-technical aspects and impacts of mechatronics engineer, including its impact on the environment, and the related responsibility for own decisions
PEK_K02 - Able to interact and work in a group, taking the different roles

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Synergy in designing mechatronics. Examples of use. The structure of mechatronic systems.	3
Lec2	Design of machinery and equipment in terms of mechatronics.	2
Lec3	Methods of the type synthesis of kinematic systems, methods of exploration of alternatives	2
Lec4	Design and modeling of control systems in a dynamic analysis computer system	2
Lec5	Basics of actuators - characteristics, applications	2
Lec6	Selected mechatronic actuators in machine building - piezoelectric, step motor, servodrives	2
Lec7	Virtual Prototyping - examples of use (Hardware in the Loop, Rapid Prototyping)	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of design of mechatronic system. Presentation of the typical project	2
Proj2	Defining the overall concept, the tasks for the mechatronic system and the analysis and validation of the concept of a mechanical system	3
Proj3	Synthesis of mechanical part of mechatronic system - type synthesis	2
Proj4	Synthesis of mechanical part of mechatronic system - geometrical synthesis	2
Proj5	Building computational models - a preliminary verification of the concept	2
Proj6	The simulation researches to determine the basic properties of kinematic and dynamic	3
Proj7	Development of mechanical structure. Selection drives, gears, bearings, couplings, joints	3
Proj8	Model verification, simulation, analysis	2

Proj9	Develop an overall program strategy of mechatronic system, define tasks for the control system	2
Proj10	Determination of sensory data needs	2
Proj11	The selection of sensor and control systems	3
Proj12	The development of a general algorithm of mechatronic system operation and verify its correctness	2
Proj13	Presentation of mechatronic system design	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. self study - preparation for project class
N4. tutorials
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01, PEK_K02	Evaluation of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty, metody, przykłady. Wydawnictwo PWN , Warszawa 2001.
2. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne. Wydawnictwo Politechniki Białostockiej. Rozpr. Naukowe nr 44. Białystok 1997.
3. Denny K. Miu: M. Springer –Verlag, Nowy York 1993.
4. Craig J.: Wprowadzenie do robotyki. WNT 1993.
5. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003.
6. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007

SECONDARY LITERATURE

1. Bolton W.: Mechatronics. Longman, Nowy York 1999
2. Roddeck W.: Einfurung in die Mechatronik. B.G. Teubner Sttutgart 1997
3. MD. Adams – Reference Manual, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of mechatronical design of systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W24	C1	Le1-Le7	N1-N5
PEK_U01	K1MTR_U23	C2	pr1-Pr13	N1-N5
PEK_K01, PEK_K02	K1MTR_K02	C1, C2	Le1-Le7, pr1-Pr13	N1-N5

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Bałchanowski tel.: 71 320-27-10 email: jacek.balchanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przetwarzanie sygnałów**
Name in English: **Signal Processing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036103**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a knowledge of the basics of calculus, complex functions, ordinary differential equations, Laplace and "Z" transforms, the theory of probability, high-level programming language, knows the simple analog electronic circuits (current and voltage dividers, filters and amplifiers).
2. Students can integrate complex functions, solve differential equations by operators , has abilities in in "C programming".

SUBJECT OBJECTIVES

C1. Getting the ability to analyze signals in time and frequency domain.
C2. Acquisition of basic knowledge of algorithms and signal processing effects of one and two-dimensional signals (sampling, quantization, Fourier series, FFT, digital filtering, aliasing, image processing algorithms).
C3. Acquiring skills to design digital filters, FIR and IIR and their application in practice, learning methods for encoding and compression of data (images and 1D signals).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge of the parameters of continuous and discrete signals (power, energy, mean rms, amplification, attenuation).
PEK_W02 - Knowledge of the basic signal processing algorithms (sampling, quantization, encoding, reproduction analog signal from a digital signal, Fourier series, FFT, convolution, DCT).
PEK_W03 - Knowledge of the principles of digital filtering and FIR and IIR filter design.

II. Relating to skills:
PEK_U01 - Student can calculate the basic signal parameters (power, energy, mean, rms, THD)
PEK_U02 - Student is able to choose the sampling frequency of the signals low-and high pass-band, can prevent the effects of aliasing, analyze the frequency response (to analyze the spectrum of a signal), perform filtering images and make simple morphological operations.
PEK_U03 - Student is able to design and program digital FIR and IIR filter and use it in practice.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Prerequisites. Literature. The content of the lecture. The main terms of the signals processing. Deterministic and random signals. Kinds of signals (analog, digital, binary, with finite and infinite energy and power, finite and the infinite duration, finite and infinite amplitude).	2
Lec2	The definition of the trigonometric and the complex Fourierseries. Notation a periodic signal of infinite duration and finite amplitude as a superposition of sinusoidal components. Calculation of the complex and trigonometric Fourier coefficients. The concept of discrete spectral signal. Amplitude and phase spectra of periodic signals. Total harmonic distortion factor.	2
Lec3	Digital signals. Notation discrete signals. Basic concepts of digital signal processing - the frequency and the sampling rate.Analog to Digital processing. The concept of sampling, quantization and coding, Digital-Analog conversion.	2
Lec4	Ambiguity discrete signals in the time domain and frequency domain. Aliasing phenomenon. Kotielnikov-Shannon-Nyquist theorem.	2
Lec5	Algorithms of discrete (DFT) and fast (FFT) Fourier transform.	2
Lec6	Discrete convolution. Design of Finite (FIR) and infinite (IIR) impulse response digital filters.Stability of digital filters.	2
Lec7	Lossy compression and lossless image compression. The final exam.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Measurement distorted waveforms current and voltage. Analysis and synthesis of signals (Fourier series).	2
Lab2	Temperature measurements. Programming filters with finite impulse response (filters implemented by the convolution, moving average filters, filters windowed sinc function).	2

Lab3	IIR filters design. Filtration of low-bad signals.	2
Lab4	Image processing (filtration and morphology)	2
Lab5	The analysis of vibration signals from various sensors (numerical integration and differentiation of signals)	2
Lab6	Determination of the dynamic characteristics of the use of different types of excitations (pulse, white noise, chirp). FFT spectral analysis.	2
Lab7	Analysis of machine vibration at idle and under load (spectral analysis). Test grade.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
N4. laboratory experiment
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W02	Final exam, oral and written parts
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U02	short quiz, laboratory reports, participation i discussion, oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Smith S.W - Cyfrowe przetwarzanie sygnałów - praktyczny poradnik dla inżynierów i naukowców. BTC Warszawa 2007

SECONDARY LITERATURE

Lyons, R.G. -Wprowadzenie do cyfrowego przetwarzania sygnałów. WNT Warszawa 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Signal Processing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_W16	C1 - C3	Lec1 - Lect7	N1, N3
PEK_U01 - PEK_U03	K1MTR_U19, K1MTR_U21	C1 -C3	Lect1 - Lect7 Lab1 - Lab7	N2,N4,N5

SUBJECT SUPERVISOR

dr inż. Marcin Korzeniowski tel.: 42-55 email: marcin.korzeniowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechatronika w medycynie**
Name in English: **Mechatronics in medicine**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mechanics and strength of materials.
2. Knowledge of the basics of mechanical design
3. Knowledge of powertrain.

SUBJECT OBJECTIVES

C1. Presentation of the possibility of applying mechatronic solutions in medical devices and apparatus
C2. Directions of development of surgical techniques and medical robots and manipulators construction presentation.
C3. Possibility of applying the signals generated by the human body to control prostheses and artificial organs

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - have the knowledge to describe the basic issues of human musculoskeletal biomechanics
PEK_W02 - have the knowledge to propose the type and structure drive system supporting functions biomechanical inefficient or lost body parts
PEK_W03 - have the knowledge to propose a kind of biological signal that can be used to control the prosthesis or artificial organ

II. Relating to skills:
PEK_U01 - able to carry out physical properties tests of selected mechatronic systems used for the treatment and support functions of human locomotion
PEK_U02 - can use and modify the algorithms controlling the operation of mechatronic devices supporting human locomotion
PEK_U03 - able to interpret the results of physical testing of mechanical systems supporting human locomotion

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Human as a mecahtronical system	1
Lec2	Examples of mechatronic solutions in a device supporting human locomotion	3
Lec3	Mechatronic solutions supporting equipment used in surgery	3
Lec4	The use of mechatronic systems for medical diagnosis	2
Lec5	Mechatronic external fixators of long bones: fracture treatment, limb lengthening, limb axis correction	2
Lec6	Artificial organs: heart, heart prosthesis, heart - lung machine, kidney - the mechanical structure, drive systems, control	2
Lec7	Active artificial limbs: construction, drive systems, control	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Influence of the control system of hand bionic prosthesis on the grip accuracy	2
Lab2	Determination of force feedback parameters in a hand prosthesis	2
Lab3	Stiffness determination of mechatronical fixator for legs.	2
Lab4	Studies on impact of wheelchair load asymmetry on the accuracy of the control system working.	2
Lab5	Effect of wheelchair drive system configurations on the structure of the control algorithm work.	2
Lab6	Comparison of control algorithms for different types of six-legged walking robot gait - design algorithm	2
Lab7	Comparison of control algorithms for different types of six-legged walking robot gait - implementation	3
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	laboratory report, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Nałęcz M. (ed.), Biocybernetics and Biomedical Engineering, Volume 3: Artificial organs, Exit Academic Publishing House, Warsaw 2004
Morecki A., Knapczyk J.: Introduction to robotics, theory and components of manipulators and robots, ed. III, WNT, Warsaw, 1999

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronics in medicine
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W08	C1, C2, C3	Lec1, Lec2, Lec5	N1, N2
PEK_W02	K1MTR_M_W03	C1, C2	Lec2, Lec3, Lec4, Lec5, Lec7	N1, N2
PEK_W03	K1MTR_W23	C3	Lec1, Lec3, Lec6, Lec7	N1, N2
PEK_U01	K1MTR_M_U04, K1MTR_U02, K1MTR_U03	C1, C2	Lab1- Lab4	N3
PEK_U02	K1MTR_U16, K1MTR_U21	C1-C3	Lab1, Lab2, Lab5, Lab6	N3
PEK_U03	K1MTR_U03	C1-C3	Lab - Lab7	N3

SUBJECT SUPERVISOR

dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy mechatroniczne w technologiach wytwórczych**
Name in English: **Mechatronic systems in manufacturing technologies**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of manufacturing techniques, mechanical and structural design propulsion systems.
2. He has knowledge of the measurement object and process monitoring. He knows the principles of design and testing of control systems.
3. Able to analyze circuits used in technical documentation and interpret the results obtained objects.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge related to mechatronic systems used in manufacturing technologies.
C2. Acquiring the ability of selection to the manufacturing technology dedicated devices: sensors, actuators and mechatronic drives. He can choose the controls productive equipment used in specific mechatronic solutions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - know the basics of applications of mechatronic systems in a variety of manufacturing technologies, know dedicated to this: sensors, actuators and mechatronic units,
PEK_W02 - familiar with the basic principles of mechatronic design and control systems manufacturing facilities,
PEK_W03 - have knowledge of the selected mechatronic solutions for machining, metal forming and welding.

II. Relating to skills:
PEK_U01 - mechatronic solution is able to select a specific technology, manufacturing,
PEK_U02 - able to analyze the effects of the mechatronic system,
PEK_U03 - can design simple mechatronic system used in production systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Discussion of the role of mechatronicz
nch systems in manufacturing technology.	2
Lec2	Overview of sensors, actuators and mechatronic members for the various manufacturing technologies.	2
Lec3	Introduction to designing mechatronic technologies used mostly in manufacturing.	2
Lec4	Selected applications in mechatronics equipment for machining.	2
Lec5	Selected applications of mechatronics in metal forming.	2
Lec6	Selected applications of mechatronics in welding equipments.	2
Lec7	Final conclusions and recommendations for the design of mechatronic systems in manufacturing technologies.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Mechatronic systems used in the physical modeling of the metal forming.	2
Lab2	Mechatronic systems used in the clinching sheets.	2
Lab3	Mechatronic systems used in advanced measurement methods tempertury for manufacturing systems.	2
Lab4	Mechatronics in welding accessory (handles, wire feeders, darkening helmets).	2
Lab5	Mechatronics in equipment for soldering in microelectronics.	2
Lab6	Mechatronics in equipment for resistance welding.	2
Lab7	Welding robots.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03;	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	Entrance, laboratory report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
The development of the subject of the lecture provides a lecturer.

SECONDARY LITERATURE
Marek Gawrysiak: Mechatronics and Mechatronic Design, Białystok 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronic systems in manufacturing technologies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MTR_W09, K1MTR_W15, K1MTR_W23	C1-C2	Lec1-Lec7	N1
PEK_U01-PEK_U03	K1MTR_U03, K1MTR_U11, K1MTR_U15	C2	Lab1-Lab7	N2-N4

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Zimniak tel.: 21-62 email: zbigniew.zimniak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Monitorowanie maszyn i procesów**
Name in English: **Monitoring of machines and processes**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM037201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a firm knowledge of the structure and operation of the basic machinery of production. Knows the basic principles of design processes typical of machine parts.
2. Has a basic knowledge of calculus and statistics for the engineering signal processing and analysis.
3. Has a a basic understanding of sensory and build measurement systems.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge on the condition monitoring of production and their processes.
C2. Gaining knowledge of the processing, analysis and evaluation of the diagnostic signal.
C3. Acquisition of competence of accountability, integrity and fairness in the proceedings. Observance force in academia and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has basic knowledge of machine condition monitoring and process it implemented.
PEK_W02 - Has knowledge of various sources of interference with the equipment and appropriate research methods.
PEK_W03 - Has knowledge of the processing, analysis and evaluation of signals.

II. Relating to skills:
PEK_U01 - Provides support for used measurement and control equipment.
PEK_U02 - Able to analyze and evaluate the diagnostic signals.
PEK_U03 - Can choose the right way to measure, depending on the source of the interference of the machine.

III. Relating to social competences:
PEK_K01 - Takes responsibility and integrity in the conduct of laboratory experiments and objective evaluation of arguments.
PEK_K02 - Can think creatively and determine how to implement the research task.
PEK_K03 - Respects the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, Assessment and literature. Basic issues.	2
Lec2	Tasks systems monitoring, diagnosis and monitoring. Types of diagnostics and their goals.	2
Lec3	Monitoring the condition of machinery manufacturing.	4
Lec4	Supervising tools.	2
Lec5	Supervising the machining process.	2
Lec6	Supervising the accuracy of workpieces.	2
Lec7	Summary of lectures, additional explanations. Checking knowledge.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Supervising production process of cast iron.	2
Lab2	Supervising welding processes.	2
Lab3	Diagnostic equipment for plastic working.	2
Lab4	Diagnosis of CNC machine tools with the help of the tester QC10.	2
Lab5	Monitoring the machine geometry.	2
Lab6	Artificial intelligence tools in supervising of machines and processes.	2
Lab7	Processing and analysis of diagnostic signals.	3
		Total hours: 15

TEACHING TOOLS USED

N1. tutorials
N2. traditional lecture with the use of transparencies and slides
N3. self study - preparation for laboratory class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	test, report on laboratory exercises, participation in discussions of problem
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Żółtowski B., Cempel Cz.: "Engineering of machine diagnostics", Polskie Towarzystwo Diagnostyki Technicznej, Instytut Technologii Eksploatacji PIB Radom, Warszawa, Bydgoszcz, Radom, 2004
2. Cempel Cz., Tomaszewski F.: "Machine diagnostics. General. Examples of applications", Międzyresortowe Centrum Naukowe Eksploatacji Majątku Trwałego, Radom, 1992
3. Honczarenko J.: "Flexible manufacturing automation", WNT, Warszawa, 2000

SECONDARY LITERATURE

1. Czyszpak T.: "Application of fuzzy inference system in the diagnosis of machine tools and machining process", Prace Naukowe Katedry Budowy Maszyn - Politechnika Śląska 1427-9347 nr 2/2008, Gliwice, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Monitoring of machines and processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W03, K1MTR_W11	C1	Lec1 - Lec7	N1, N2
PEK_W02	K1MTR_W03, K1MTR_W11	C1	Lec1 - Lec7	N1, N2
PEK_W03	K1MTR_W03, K1MTR_W11, K1MTR_W15, K1MTR_W17	C2	Lec1 - Lec7	N1, N2
PEK_U01	K1MTR_U02, K1MTR_U03	C1, C2, C3	Lab1 - Lab7	N3, N4
PEK_U02	K1MTR_U17, K1MTR_U21	C1, C2, C3	Lab1 - Lab7	N3, N4
PEK_U03	K1MTR_U19, K1MTR_U21	C1, C2, C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K01	K1MTR_K02, K1MTR_K04, K1MTR_K05, K1MTR_K07	C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K02	K1MTR_K05, K1MTR_K06	C1, C2, C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K03	K1MTR_K01, K1MTR_K08, K1MTR_K09	C3	Lab1 - Lab7	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Tomasz Jankowski tel.: 41-74 email: tomasz.jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **SCADA i HMI**
Name in English: **SCADA AND HMI**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM037204**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PROGRAMMABLE LOGIC CONTROLLERS

SUBJECT OBJECTIVES

C1. Explain the construction of HMI and SCADA systems
C2. Explain the operation and design of HMI and SCADA systems
C3. Explain the use of HMI and SCADA systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the construction of HMI and SCADA systems
PEK_W02 - Can explain the operation and design an HMI and SCADA system
PEK_W03 - He can propose the appropriate HMI or SCADA system for a specific application

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The issue of electronic monitoring and control of industrial processes applications	1
Lec2	Construction and operation of SCADA package for example packages In Touch Wonderware Corporation and Siemens WinCC.	2
Lec3	Features and components of packages.	1
Lec4	Tools and methods for creating synoptic screens.	1
Lec5	Animation of graphical objects and the creation and use of libraries of objects	1
Lec6	Scripting language.	2
Lec7	Timing diagrams in real time and present the history of the process charts.	1
Lec8	Alarms: definition, presentation, service, validation, view, save and print ..	1
Lec9	HMI-construction, operation, maintenance, programming	2
Lec10	Communication protocols, communication driver	1
Lec11	Industrial Databases	1
Lec12	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Programowanie systemów SCADA. WPK J. Skalmierskiego, Gliwice 2002

SECONDARY LITERATURE
Wonderware InTouch Podręcznik Użytkownika, Invensys Systems, Inc. 2005.
SIMATIC HMI WinCC flexible, Siemens, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
SCADA AND HMI
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19	C1	Lec1, Lec2,	N1
PEK_W02	K1MTR_W19	C2	Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11,	N1
PEK_W03	K1MTR_W19	C3	Lec1, Lec2, Lec9, Lec10,	N1

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika analityczna**
Name in English: **Analytical Mechanics**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differential and integral calculus)
2. Linear algebra (matrices, determinants), geometry, trigonometry
3. Mechanics I and mechanics II in range of study stage I

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of Lagrangian mechanics in the dynamics of mechanical holonomic systems (for systems with constrains depending and not depending from time). Knowledge of vibration analysis of linear holonomic conservative systems with many degrees of freedom.
C2. Ability to independently analyze complex mechanical systems with the holonomic constrains which are not depend on time to determine : differential equations of movement, natural vibration frequency spectrum, the modal matrix.
C3. The acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in conduct; observance of manners in the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can define a discrete mechanical holonomic system and its possible and virtual displacements. He knows the fundamental problem of dynamics. He knows the classification of dynamical systems in respect of the constrain types. He knows the general equation of dynamics and the principle of virtual work.
PEK_W02 - He knows the notion of generalized coordinates and configuration space of a dynamical system. He knows the concept of generalized forces (active and inertia). He knows the Lagrange's equations of the second kind.
PEK_W03 - He knows the vibration theory of linear systems with many degrees of freedom in the free vibration range.

II. Relating to skills:
PEK_U01 - He is able to apply the virtual work principle and d'Alembert's principle for holonomic systems
PEK_U02 - It can derive the differential equations of motion of discrete dynamical systems by using Lagrange's equations and by using the energy conservation law for conservative holonomic systems.
PEK_U03 - He can calculate the spectrum of natural frequencies and can determine the modal matrix for discrete conservative linear systems.

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Curriculum. Requirements. Examples of dynamic systems. Constrains and their types, classification systems for the sake of the constrain types (holonomic systems), possible velocities and possible displacements.	2
Lec2	The fundamental problem of dynamics, virtual displacement, the notion of ideal constraints, the general equation of dynamics, the virtual work principle.	2

Lec3	The dynamic general equation for the rotational and planar motion of a rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples).	2
Lec5	Generalized forces. Configuration space. Lagrange's equations (of II type).	2
Lec6	Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	1
Lec7	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes.	2
Lec8	Test	2
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements.	2
Cl2	Solving of static problems by using a principle of virtual work	2
Cl3	Solving of dynamic problems for discrete systems by using a dynamic general equation (d'Alembert's principle).	2
Cl4	Solving of selected dynamic problems of a rigid body in plane motion by using a dynamic general equation.	2
Cl5	Derivation of motion differential equations based on the energy conservation law and Lagrange's equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl6	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl7	Final test	2
Cl8	Credits. Improvement of marks	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculative-problematic exercises
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02,PEK_W03	written and oral test

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	Final test, oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. B. Gabryszewska, A. Pszonka, "Mechanics", part II, kinematics and dynamics, Wrocław University of Technology, 1988;
2. J. Zawadzki, W. Siuta, "General Mechanics", PWN, Warsaw, 1971;
3. B. Skalmierski, "Mechanics", PWN, Warsaw, 1982;
4. M. Lunn, A First Course in Mechanics, Oxford Science Publications, 1991

SECONDARY LITERATURE

1. M. Kulisiewicz, St. Piesiak, "Methodology of modeling and identification of mechanical dynamical systems", WUT. , 1994;
2. J. Leyko, "General Mechanics", WNT, Warsaw, 1980;
3. J. Giergiel, "General Mechanics", WNT, Warsaw, 1980

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analytical Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_W01, K2MTR_W04	C1	Lec 1 to Lec 8	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K2MTR_U01	C2	Cl 1 to Cl 8	N2, N3, N4

PEK_K01, PEK_K02, PEK_K03	K2MTR_K01, K2MTR_K06	C3	Lec 1 to Lec 8, Cl 1 to Cl 8	N1, N2, N3, N4

SUBJECT SUPERVISOR
Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Dynamika układów elektromechanicznych**
Name in English: **Dynamics of electromechanical systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the theory of vibrations.
2. Has a knowledge of design of mechatronic systems.
3. Has a knowledge of control in mechatronic systems.

SUBJECT OBJECTIVES

C1. Gaining knowledge of the modeling of electromechanical systems.
C2. Acquiring the ability to carry out the experimental research of electromechanical systems.
C3. Gaining skills in determining the dynamic characteristics of electromechanical systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the methods of formulating equations describing the dynamics of electromechanical systems.
PEK_W02 - Knows the ways of determining the dynamic characteristics of electromechanical systems.
PEK_W03 - Knows the principles of modeling of electromechanical systems.

II. Relating to skills:
PEK_U01 - Can formulate equations describing the dynamics of electromechanical systems.
PEK_U02 - Can determine the dynamic characteristics of electromechanical systems.
PEK_U03 - Can model the dynamic properties of electromechanical systems.

III. Relating to social competences:
PEK_K01 - effective information retrieval and critical evaluation.
PEK_K02 - Ability to work in a team aimed at appropriate division of responsibilities and effective solution of the assignments.
PEK_K03 - Ability to proper argumentation and justification of own point of view.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues.	1
Lec2	Vibrations of systems with one degree of freedom with damping and without damping.	2
Lec3	The vibrations of multi degrees of freedom systems. The equations of motion - Lagrangian method.	2
Lec4	Modal analysis in the study of the dynamics of mechanical systems.	2
Lec5	Modelling of electromechanical systems. AMESim software.	2
Lec6	Determination of the dynamic characteristics of electromechanical systems.	2
Lec7	Models of DC and inductive motors - coupling between the electrical and mechanical part.	2
Lec8	The stability of electromechanical systems.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organizational issues.	1
Lab2	Determination of the natural frequency of the mechanical system.	2
Lab3	Modal analysis method on the example of the electric motor vibration.	2
Lab4	The study of dynamic characteristics of mechatronic devices.	2
Lab5	The study of dynamic characteristics of the hydraulic servo valve.	2
Lab6	Engine speed control using voltage inverter.	2
Lab7	Modelling of mechatronic system using the AMESim software.	2
Lab8	Credit.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation
N5. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Written-oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	oral answers
F2	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	report form laboratory classes
P = 0,4F1+0,6F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Canon R.H.: Dynamics of physical systems
2. Szklarski L.: Dynamika układów elektromechanicznych, 1982
3. Kaźminkowski M.: Automatyka napędu elektrycznego

SECONDARY LITERATURE
1. M. Gawrysiak: Mechatronika i projektowanie mechatroniczne, Białystok 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dynamics of electromechanical systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_W01, K2MTR_W04	C1-C3	Wy2 - Wy3, Wy5	N1. - N5.
PEK_U01, PEK_U02, PEK_U03	K2MTR_U01, K2MTR_U03, K2MTR_U04, K2MTR_U05, K2MTR_U11	C1-C3	Wy4, Wy6	N1. - N5.
PEK_K01, PEK_K02, PEK_K03	K2MTR_K01, K2MTR_K03	C1-C3	La3-La5	N1. - N5

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Interdyscyplinarny projekt zespołowy**
Name in English: **The interdisciplinary team project**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041005**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				90	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes				2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic understanding of the integration of mechanics, electronics and computer science.
2. He has expertise in the design and testing of control systems. He can choose a microcontroller or a dedicated system for the implementation of control or measurement.
3. Able to model systems, mechatronic systems in virtual design and carry out static and dynamic calculations for linear and non-linear problems.

SUBJECT OBJECTIVES

C1. Acquiring the ability self-solving tasks as part of an interdisciplinary mechatronic design.
C2. Teamwork and the ability to integrate multi-disciplinary tasks.
C3. The acquisition of social skills including the ability to work in a group of students with a view to effective solving mechatronics problem.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - able to select units mechatronic and mechanical solution to write algorithma of computer program;
PEK_U02 - can analyze the system, and the synthesis of solutions of a system implementing a specific function key;
PEK_U03 - able to optimize the selection of variants solution.

III. Relating to social competences:
PEK_K01 - search for information and the critical review;
PEK_K02 - team cooperation on methods for the selection strategy to deal with the problem of allowing the selection of the optimal solution;
PEK_K03 - objectively examine the arguments and justify their point of view.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Analysis of the resulting design task for the application of different variants of mechatronic solutions.	3
Proj2	Choosing a solution for mechatronic design task.	3
Proj3	The division interdisciplinary class group and assign specific tasks to perform.	3
Proj4	The term co-operation between the two groups zajęciowymi - input and output data.	3
Proj5	Working in interdisciplinary groups on assigned tasks.	18
Proj6	Inegracja interdisciplinary work groups to perform a task design.	6
Proj7	Evaluation of project tasks and look for better solutions.	3
Proj8	Optimization methods for solution design task.	3
Proj9	Evaluation and conclusions on the implementation of the final variant of the design task.	3
		Total hours: 45

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. case study
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K03	Evaluation of of development, defense project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Marek Gawrysiak: Mechatronics and Mechatronic Design, Białystok 1997.

SECONDARY LITERATURE
Given by the lecturer in accordance with the theme of the project.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The interdisciplinary team project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 PEK_U02 PEK_U03	K2MTR_MSW_U07, K2MTR_U10	C1,C2	Proj1-Proj9	1,2,3
PEK_K01 PEK_K02 PEK_K03	K2MTR_K03, K2MTR_K06	C3	Proj1-Proj9	1,2,3

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Zimniak tel.: 21-62 email: zbigniew.zimniak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Synteza mechanizmów**
Name in English: **Synthesis of Mechanisms**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowlege of topology, kinematics and kinetostatics of mechanisms
2. Knowledge of mathematical analysis, analytical geometry
3. Skill in mechanism analysis: drawing schemes, velocity and acceleration determination, kinetostatics

SUBJECT OBJECTIVES

C1. Acquire developed knowledge in topolog of kinematic systems
C2. Acquire of modern methods of dimensional synthesis of chosen mechanisms
C3. Getting skills in designing of chosen mechanisms

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has developed knowledge on mechanisms' topology - rationality, topology modification methods
PEK_W02 - Has the knowledge of linkage dimensional synthesis methods (with elements of optimization)
PEK_W03 - Has the knowledge of cam mechanisms design methods

II. Relating to skills:
PEK_U01 - Is able to modify topology of a mechanism to achieve rational solutions
PEK_U02 - Is able to synthesise geometry of some linkages
PEK_U03 - Is able to synthesise cam mechanisms

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Rattionality of mechanism topology - essence, modification methods	2
Lec2	Dimensional synthesis of linkages - tasks classification, some general problems	2
Lec3	Synthesis methods of chosen linkages	2
Lec4	Synthesis methods of chosen linkages, cont	2
Lec5	Cam mechanism synthesis - law of motion of a follower	3
Lec6	Cam mechanism synthesis - determination of basic dimensions and cam profile	2
Lec7	Synthesis of mechanisms with linear actuators	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Redundant constraints elimination (project)	2
Proj2	Linkages dimensional synthesis using SAM (project)	2
Proj3	Linkages dimensional synthesis using SAM (project)	2
Proj4	Dimensional synthesis of a chosen linkage (project)	2
Proj5	Dimensional synthesis of a chosen linkage (project)	2
Proj6	Synthesis of a cam mechanism ((project)	2
Proj7	Synthesis of a cam mechanism cont.	3
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. self study - preparation for project class
N3. individual project solution
N4. tutorials
N5. preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written/oral examination
P = ocena z egzaminu		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	project discussion
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Miller S.: Kinematic systems. Basics of design (in Polish). WNT Warszawa 1988; Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; Gronowicz A., Miller S.: Mechanisms (in Polish). Oficyna Wyd. PWr. 1996; Gronowicz A. et al: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE
Eckhardt H. D.: Kinematic Design of Machines and Mechanisms. McGraw-Hill 1998; Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999; Norton R.: Design of Machinery. An Introduction to the Synthesis and Analysis of Mechanisms and Machines. McGraw-Hill 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Synthesis of Mechanisms
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MTR_W02	C1, C2	Lec1 - Lec7	N1, N4, N5
PEK_U01- PEK_U03	K2MTR_U02	C2, C3	Pr1 - Pr7	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Antoni Gronowicz tel.: 71 320-27-10 email: antoni.gronowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza MES układów mechatronicznych**
Name in English: **FEM analysis of mechatronic systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041020**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of finite element method.
2. He has expertise in modeling of mechatronic systems to virtual prototyping (CAD).
3. He can design a mechatronic device, system or process technology using appropriate methods, techniques and tools or develop new tools

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the conduct of FEM analysis of mechatronic systems.
C2. Learning how to use the pre-processor and post-processor system, the construction of FEM models, mesh generation and creation of boundary conditions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - FEM advanced techniques known in the field of non-linear problems and contact simulation of electro-thermal-mechanical, electromagnetic, thermal and mechanical, piezoelectric and optimization methods using FEM,
PEK_W02 - FEM simulation method known MEMS, electronics and mechanical,
PEK_W03 - have knowledge of the methods of optimization techniques FEM technology of mechatronic components.

II. Relating to skills:
PEK_U01 - can handle pre-processor and post-processor, build FEM models, generate a grid and determine the boundary conditions
PEK_U02 - can choose the constitutive equations and material models used in FEM simulation of mechatronic systems.
PEK_U03 - can perform complex finite element analysis for mechatronic systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to finite element analysis of mechatronic systems. Constitutive equations and material models used in FEM simulation of mechatronic systems.	2
Lec2	Advanced FEM techniques for nonlinear problems, and contact information. Methods for solving nonlinear FEM.	2
Lec3	Simulations electro-thermal-mechanical MEMS. Performance criteria and the merits of the application in remeshing simulation.	2
Lec4	Simulations electromagnetic and piezoelectric mechatronic systems.	2
Lec5	Simulations of thermo-mechanical electronic and mechanical systems.	2
Lec6	FEM modeling techniques micromechanisms and micromachines.	2
Lec7	FEM optimization technology of mechatronic components.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Support pre-processor and post-processor. Construction of FEM models. Mesh generation and boundary conditions.	4
Lab2	The use of non-linear FEM and contact in the design of mechatronic systems.	2
Lab3	Numerical modeling of MEMS.	4
Lab4	Modeling of electromagnetic problems, piezoelectric used in mechatronic systems.	4
Lab5	Numerical modeling of thermo-mechanical electronic and mechanical systems.	4
Lab6	FEM modeling techniques micromechanisms and micromachines.	4
Lab7	Examples of optimization MES technology of mechatronic components.	2

Lab8	Modeling of selected mechatronic system.	6
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem exercises
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	Evaluation of the task
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Documentation MSC.Marc Volume IV, 2012, USA.

SECONDARY LITERATURE

Tomasz Zagrajek, Grzegorz Krzesiński, Piotr Marek: Finite element method in structural mechanics. 2006, Warszawa.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
FEM analysis of mechatronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MTR_W13	C1	Lec1-Lec7	N1
PEK_U01-PEK_U03	K2MTR_U05, K2MTR_U14, K2MTR_U24	C2	Lab1-Lab8	N2-N3

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Zimniak tel.: 21-62 email: zbigniew.zimniak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowa diagnostyka pojazdów**
Name in English: **The computer diagnosis of cars vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Introduction to mechatronics 1.
2. The elements and lectronics circuits.

SUBJECT OBJECTIVES

C1. Presentation of the requirements necessary to identify appropriate diagnostic system.
C2. Presentation of automotive diagnosis.
C3. Perform the diagnostic process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Identifies appropriate diagnostic systems.
PEK_W02 - Explanation of principles of diagnostic systems.
PEK_W03 - Explains the principles of operation of the testing diagnostics.

II. Relating to skills:
PEK_U01 - One supports diagnostic systems.
PEK_U02 - One coordinates the diagnostic process.
PEK_U03 - One interprets test results.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The introduction to computerized vehicle diagnostics.	2
Lec2	Modes of transmission of sensor bus.	2
Lec3	OBD, OBDII and EOBD systems.	2
Lec4	Reading data obtained from EOBD system.	2
Lec5	The vibroacoustic engine diagnostics.	2
Lec6	Motor handle based on the diagnostic signals.	2
Lec7	The sensing and measurement of non-electrical signals.	2
Lec8	Load diagnostic systems of motor vehicles.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Analog measurement of the speed of the crankshaft the engine.	2
Lab2	Digital measurement of thecrankshaft speed.	2
Lab3	Diagnosis on a chassis dynanometer.	2
Lab4	Load diagnostic measurement.	5
Lab5	Vehicle fault codes based on the EOBD interface.	2
Lab6	The vibroacoustic engine diagnostics.	2
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. multimedia presentation
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Exam.
F2	PEK_W02	Exam.
F3	PEK_W03	Exam.
P = F1+F2+F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Laboratory report
F2	PEK_U02	Laboratory report
F3	PEK_U03	Laboratory report
P = F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Basztura C.: Komputerowe systemy diagnostyki akustycznej. Warszawa, Wyd. Politechniki Warszawskiej 1996.[2] Bocheński C., Janiszewski T.: Diagnostyka silników wysokoprężnych. Warszawa, WKŁ 1996.[3] Cempel C.: Diagnostyka wibroakustyczna maszyn. Poznań, Wyd. Politechniki Poznańskiej 1985.[4] Cempel C., Tomaszewski F.: Diagnostyka maszyn. Radom, Wyd. Techniczne 1992.[5] Czujniki w pojazdach samochodowych. Warszawa, WKŁ 2002, Informatory Techniczne Bosch.[6] Merkisz J., Mazurek S.: Pokładowe systemy diagnostyczne pojazdów samochodowych. Warszawa, WKŁ 2007.[7] Wróbel R.: Trends in vehicle electronics. Wyd. PWr, Wrocław 2011.

SECONDARY LITERATURE
[1] Moczulski W.: Diagnostyka techniczna metody pozyskiwania wiedzy. Gliwice, Wyd. Politechniki Śląskiej 2002.
[2] Myszkowski S.: Diagnostyka Pokładowa. Warszawa, Instalator Polski 2001.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The computer diagnosis of cars vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W05, K2MTR_MMP_W06	C1	Wy1 Wy2 Wy3	N2
PEK_W02	K2MTR_MMP_W05, K2MTR_MMP_W06	C2	Wy1 Wy2 Wy3	N1 N2
PEK_W03	K2MTR_MMP_U04, K2MTR_MMP_U07	C1 C3	Wy4 Wy7	N1
PEK_U01	K2MTR_MMP_U02, K2MTR_MMP_U04, K2MTR_MMP_U07	C3	Wy2 Wy4 La1 La2 La5	N3
PEK_U02	K2MTR_MMP_U02, K2MTR_MMP_U06	C2 C3	La1 La2 La3 La4 La5 La6	N1 N3
PEK_U03	K2MTR_MMP_U07, K2MTR_MMP_U08	C1 C3	La2 La4 La5	N1 N3

SUBJECT SUPERVISOR

dr inż. Radosław Wróbel tel.: 71 347-79-18 email: radoslaw.wrobel@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechatronika w pojazdach samochodowych**
Name in English: **Mechatronics in automotive vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in mathematics, physics, and write in the art,
2. Knowledge and skills in the field of electrical engineering, electronics and optoelectronics, sensors and actuators,

SUBJECT OBJECTIVES

C1. Knowing the main mechatronic systems in motor vehicles
C2. Ability synergy of knowledge in the areas: mechanics, electronics and computer science
C3. Learning basic concepts of mechatronics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can call the individual components and mechatronic systems of a motor vehicle
PEK_W02 - He has knowledge of the techniques of measurement of physical quantities in the study and control of mechatronic systems in vehicles
PEK_W03 - He has knowledge of modern mechatronic systems car driver assistance systems, engine management and on-board diagnostic

II. Relating to skills:
PEK_U01 - Can formulate the principle of operation of sensor bus and car diagnostic systems
PEK_U02 - He knows the rules for the integration of different disciplines (electronics, automation, sensing and hudrauliki) in hydrotroniczne systems.
PEK_U03 - It can analyze the structure and operation of various mechatronic systems for use in vehicles

III. Relating to social competences:
PEK_K01 - Understand the need for continuous training
PEK_K02 - The awareness level of security in terms of mechatronic solutions used in vehicles
PEK_K03 - Appreciating the need to raise their professional skills, personal and social

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts related to construction vehicles and the role of mechatronic systems in modern vehicles	2
Lec2	Intelligent vehicle	2
Lec3	Data bus in the car.	1
Lec4	On-board diagnostic systems and station	2
Lec5	Sensors measured values and drivers for use in vehicles	2
Lec6	Systems of comfort and travel (parking, cruise control, ambient identification, navigation, vehicle security)	2
Lec7	Passive safety of vehicles and pedestrians.	2
Lec8	Driver assistance systems (ABS, ABC, ASR, ESP, DISTRONIC etc.)	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Select the type of vehicle	1
Proj2	Select the type of vehicle system	1
Proj3	Design assumptions - term limits	1
Proj4	Finding solutions	2
Proj5	Choosing a solution for the preliminary design	2
Proj6	Design of mechanical	2
Proj7	Design of electronic	2
Proj8	Design of information	2

Proj9	Design drawings and diagrams. Description of the solution	2
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
F3	PEK_W03	test
P = F1+F2+F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Defense project
F2	PEK_U02, PEK_K02	Defense project
F3	PEK_U03, PEK_K03	Defense project
P = F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Schmid D. Mechatronics REA Warsaw 2002
Turowski, J. Basics of mechatronics AHE, Lodz 2008

SECONDARY LITERATURE
Magazines: among others. Measurement, Automation and Robotics, Drives and Controls

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronics in automotive vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W11	C1	Wy1 - Wy8	N1, N2
PEK_W02	K2MTR_MMP_W03	C2	Wy1 - Wy8	N1, N2
PEK_W03	K2MTR_MMP_W03	C1, C2	Wy1, Wy3, Wy4	N1, N2
PEK_U01	K2MTR_MMP_U06	C1, C2	Pr1 - Pr9	N1
PEK_U02	K2MTR_MMP_U06	C1, C2	Pr1 - Pr9	N1, N2
PEK_U03	K2MTR_MMP_U04	C1, C2, C3	Pr1 - Pr9	N1, N2
PEK_K01	K2MTR_K01	C1, C2, C3	Pr1 - Pr9	N1, N2
PEK_K02	K2MTR_K01, K2MTR_MMP_U09	C1, C2, C3	Pr1 - Pr9	N1, N2
PEK_K03	K2MTR_K01	C1, C2, C3	Pr1 - Pr9	N1, N2

SUBJECT SUPERVISOR

dr inż. Wojciech Ambroszko tel.: 71 347-79-18 email: wojciech.ambroszko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy hydrotroniczne i pneumotroniczne**
Name in English: **Hydrotronic and pneumotronic systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of machine power systems with particular reference to their requirements. The student understand the define depending the power flow in the power system and the equations describing the load impact on the physical parameters present in the power system.
2. The student has a basic knowledge of the control system of machines and equipment. The student be able to define the role and functions of the control system, and propose a preliminary concept of the control system based on the requirements.
3. The student is able to analyze and interpret the observed effects of a number of known power systems and identify their advantages and disadvantages.

SUBJECT OBJECTIVES
C1. The acquisition of basic knowledge about the pneumotronic hydrotronic systems, the analysis of the construction, principle of operation, structure, desirability of the application. C2. Acquiring the ability to conduct its own analysis of the pneumotronic and hydrotronic systems. Acquiring skills indication of the benefits of using these systems, with particular emphasis on the comparative analysis performed with the classic solutions hydrostatic and pneumatic systems. C3. Acquiring the ability to create a conception of the pneumotronic or hydrotronic system, based on the required motion parameters and transfered knowledge, in the form of examples of the already existing systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to describe the principle of operation, the individual elements and benefits of the hydrotronic and pneumotronic systems. Student can define differences in the operation of the pneumotronic and hydrotronic systems for classical hydrostatic and pneumatic power system.
PEK_W02 - The Student identifies the role of individual hydrotronic and pneumotronic components in the system, their impact on the operation of the system and is able to carry out preliminary selection of system components based on the operation requirements.
PEK_W03 - The student defines the role of the control system, is able to describe and explain its mode of action and identify the system desired features which, in combination with the parameters of the power transmission system formed the hydrotronic or pneumotronic system with the favorable working parameters or allows the new applications.

II. Relating to skills:
PEK_U01 - The student analyzes the principle of operation and determines the impact of sample components to the hydrotronic and pneumotronic systems. Students draw graphs of variation of components selected parameters, based on laboratory experiment.
PEK_U02 - The student analyzes and evaluates the work of the sample hydrotronic and pneumotronic systems. The student plans and carries out the system laboratory experiment, the results of which are the subject to analysis.
PEK_U03 - The Student plans the laboratory experiment, performs independently combining each elements of the system, is responsible for the proper installation and performs a series of laboratory experiments, the results of which are analyzed and reported together with its own interpretation.

III. Relating to social competences:
PEK_K01 - The student takes part in the work of the group of students, the goal of which is the joint planning and perform of a laboratory experiment.
PEK_K02 - The student acquires skills to present the results of their work in the written form report supplementing them orally during classes with the teacher.
PEK_K03 - The student independently searches for information and analyzes them based on the knowledge acquired during the course.

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Introducing students to with the scope of the course, the conditions of crediting and the course literature. The hydraulic and pneumatic modular connecting system.	2
Lec2	Comparative analysis of hydrostatic systems with the hydrotronic systems, the comparison of the example parameters.	2
Lec3	The hydraulic and pneumatic actuator speed control systems.	2
Lec4	Systems with multiple energy sources, accumulate energy of the liquid, example parameters.	2
Lec5	Stop and lock actuator movement, diagrams, method of implementation, examples of solutions.	2
Lec6	Synchronization of the actuators on the example hydrotronic systems, description and control functions.	2
Lec7	Adaptive control, overview, principle of operation, applications.	2
Lec8	Completion of the course.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	The series and parallel connection of the system actuators.	2
Lab3	The use of the hydraulic rectifier.	2
Lab4	The sequencer with the pressure switch.	2
Lab5	The tandem arrangement of the pneumatic actuators.	2
Lab6	The testing of the parameters of hydrostatic system with the Load-Sensing valve.	2
Lab7	Sequencer systems controlled by the course of time.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. traditional lecture with the use of transparencies and slides
N3. self study - preparation for laboratory class
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01÷PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03 PEK_K01÷PEK_K03	the written report, the verbal response, the preliminary presentations to the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. W. Kollek: Fundamentals of hydraulic drive. SINH Wrocław 1989. (in Polish)
2. W. Kollek: Basics of the designing hydraulic drives and controls. Oficyna Wydaw. Polit. Wroc. Wrocław 2004. (in Polish)
3. Z. Szydelski: Car vehicles. The drive and hydraulic control. WKŁ Warszawa 1999. (in Polish)
4. W. Szejnach: Pneumatic drive and control. WNT 1992. (in Polish)

SECONDARY LITERATURE
1. L. T. Wrotny: Designing machine tools. General problem and examples. WNT 1980. (in Polish)
2. W. Kollek, E. Palczak: Optimization of the hydraulic system components. Wydawnictwo Ossolineum, Wrocław 1994. (in Polish)
3. A. Pizoń: Hydraulic and electro-hydraulic control and regulation systems. WNT 1987. (in Polish)
4. Catalogues of the typical hydraulic and pneumatic components.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrotronic and pneumotronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W02	C1	Lec1÷Lec2	N2, N5
PEK_W02	K2MTR_MMP_W02	C1	Lec3÷Lec5	N2, N5
PEK_W03	K2MTR_MMP_W02	C1, C3	Lec6÷Lec7	N2, N5
PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	K2MTR_K03, K2MTR_K04, K2MTR_MMP_U04	C2, C3	Lab1÷Lab7	N1, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy mechatroniczne maszyn roboczych**
Name in English: **Mechatronic systems of working machines**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of sensors and measuring systems confirmed by the completion of relevant course
2. Has basic knowledge of automation confirmed by completion of relevant course

SUBJECT OBJECTIVES

C1. To gain knowledge of construction and principles of operation of typical mechatronic systems commonly used in working machines and industrial vehicles
C2. To gain skills in planning and conducting experimental research and diagnosis of mechatronic systems in working machines and industrial vehicles. To gain skills in analysis of construction and principles of operation of various automatic systems used in working machines
C3. To gain and consolidate competence in determining appropriate priorities to achieve the specific purpose

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of mechatronic systems of vehicles and working machines used in construction, mining, and transhipments
PEK_W02 - has knowledge of mechatronic systems for use in vehicles and agricultural machines
PEK_W03 - has knowledge of mechatronic systems used in cranes and warehouses

II. Relating to skills:
PEK_U01 - is able to carry out experimental studies, analyze the structure and operation and perform diagnostics of mechatronic system of industrial vehicle
PEK_U02 - is able to carry out experimental studies, analyze the structure and operation and perform diagnostics of crane mechatronic system

III. Relating to social competences:
PEK_K01 - has expanded and well established competence in determining priorities to achieve the specific purpose

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introduction to mechatronic systems in vehicles and working machines	1
Lec2	Mechatronic systems in drive systems of vehicles and working machines	2
Lec3	Mechatronic systems for support of the positioning process of manipulator of industrial vehicle	2
Lec4	Automatic systems for excavating and loading of crushed material	2
Lec5	Mechatronic safety and diagnostic systems in industrial vehicles	2
Lec6	Selected mechatronic systems used in agricultural machines	2
Lec7	Automation of storage and transhipment processes	2
Lec8	Overview of mechatronic systems used in cranes	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Experimental studies of an electric power transmission system start-up controlled process	2
Lab2	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab3	Examination of jib crane monitoring system	2
Lab4	Experimental research of control system of robot for diagnostics of guy ropes	2
Lab5	Experimental studies of stability monitoring and improvement system for industrial wheeled vehicle	2
Lab6	The investigation of the new generation's mechatronic steering system for articulated vehicle	2
Lab7	Experimental studies of an automatic scooping system of industrial vehicle	2

Lab8	Testing of a laser positioning system of transhipment vehicle manipulator	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U02, PEK_K01	laboratory reports, short tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r. [2] Dudziński P.: Lenksysteme für Nutzfahrzeuge - Theorie und Praxis. Springer, 2005r.

SECONDARY LITERATURE

[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki iMagazynowania, 1998r. [2] Piątkiewicz A., Sobolski R.: Dźwignice. Tom I i II. WNT, Warszawa 1977r

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronic systems of working machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W03	C1	Lec1÷Lec5	2, 5
PEK_W02	K2MTR_MMP_W03	C1	Lec2, Lec5, Lec6	2, 5
PEK_W03	K2MTR_MMP_W03	C1	Lec2, Lec5, Lec7, Lec8	2, 5
PEK_U01	K2MTR_MMP_U04	C2	La4÷La8	1, 2, 3, 4
PEK_U02	K2MTR_MMP_U04	C2	La1÷La3	1, 2, 3, 4
PEK_K01	K2MTR_K04	C3	Lec1÷Lec8, La1÷La8	1, 2, 3, 4, 5

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane układy sterowania maszyn roboczych**
Name in English: **Advanced control systems of working machines**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of sensors and measuring systems confirmed by the completion of relevant course
2. Has basic knowledge of automation confirmed by completion of relevant course at university level
3. Has basic knowledge of microcontrollers confirmed by the completion of relevant course

SUBJECT OBJECTIVES

C1. To gain knowledge of the methods of synthesis, methods programming and design of control systems of working machines and industrial vehicles
C2. To gain skills of completion, programming and testing of control systems of working machinery and industrial vehicles
C3. To gain competence in the appropriate setting priorities to achieve the set by yourself or other tasks
C4. Consolidation of awareness and understanding of non-technical aspects of mechanical engineering, such as health and safety and environmental impact

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of elements and programming of controllers of typical mechatronic systems of working machines and industrial vehicles
PEK_W02 - has knowledge of methods of synthesis of advanced control systems for use in working machines and industrial vehicles
PEK_W03 - has knowledge of possibilities of using fuzzy control and neural networks in working machines and industrial vehicles

II. Relating to skills:
PEK_U01 - is able to program selected types of controllers and operator panels for use in control systems of industrial vehicles
PEK_U02 - is able to rationally choose the components for control systems of working machines and industrial vehicles
PEK_U03 - is able to test the correctness and efficiency of the applied control algorithms

III. Relating to social competences:
PEK_K01 - is able to properly identify priorities to realize tasks specified by him or others
PEK_K02 - is aware of and understand the non-technical aspects of mechanical engineering, such as safety and hygiene at work, environmental impact

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Presentation of the range of issues discussed in the course. Background information.	2
Lec2	Programmable controllers in control systems of industrial vehicles and their programming	2
Lec3	Microcontrollers in control systems of industrial vehicles and their programming	2
Lec4	Operator panels for industrial vehicles and their programming	2
Lec5	Actuators and adjusting devices used in control systems of working machines and vehicles	2
Lec6	Communication interfaces used in control systems of working machines and vehicles	2
Lec7	Standardized arrangements for addressing messages on the CAN bus of the vehicle. Creating and sending messages on the CAN bus, acquisition and processing of such reports using a sample controlers.	2
Lec8	Navigation systems used in control systems for working machines and industrial vehicles	2
Lec9	Vision systems in control systems of working machines and industrial vehicles	2
Lec10	The control systems of autonomous vehicles	2
Lec11	Control systems of devices for active vibration isolation	2
Lec12	Methodology for the synthesis of robust control algorithms on examples from field of the working machinery and industrial vehicles	2
Lec13	Methodology of synthesis of adaptive control algorithms with examples from the field of working machines and industrial vehicles	2

Lec14	Synthesis and applicability of fuzzy control and neural network in mechatronic systems of working machines and industrial vehicles	2
Lec15	Layers control on examples from field of warehouses and transshipment terminals	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Programming of the CAN bus communication between the components of the control system	2
Lab2	Creation and programming of the visualization system of operating parameters of the control system	2
Lab3	Choosing the components and programming of control system of industrial vehicle manipulator	2
Lab4	Choosing the components and programming of system to improve operational safety for exemplary working machine	2
Lab5	Programming of control unit of drive of industrial vehicle which is cooperating with the engine control unit	2
Lab6	Programming and testing of various advanced algorithms of excavator's manipulator control including those based on fuzzy logic	2
Lab7	Selection of components and programming of the control system of servo motor in the machine drive system	2
Lab8	Programming and testing of control system of hydrostatic vibration exciter	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01, PEK_K02	short tests, laboratory reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r. [2] Dudziński P.: Lenksysteme für Nutzfahrzeuge - Theorie und Praxis. Springer, 2005r.

SECONDARY LITERATURE
[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki i Magazynowania, 1998r. [2] Piątkiewicz A., Sobolski R.: Dźwignice. Tom I i II. WNT, Warszawa 1977r. [3] Bishop R. H.: The Mechatronics Handbook. CRC PRESS 2002r. [4] Vlacic L., M. Parent, F. Harashima: Intelligent Vehicle Technologies – Theory and Applications. Butterworth- Heinemann, 2001r. [5] Skoczkowski S., R. Osypiuk, K. Pietrusewicz: Odporna regulacja PID o dwóch stopniach swobody w praktyce. PWN 2006r. [6] PLUS+1 GUIDE - User Manual. Sauer-Danfoss 2012r. [7] W. Zimmermann, R. Schmidgall: Magistrale danych w pojazdach. WKiŁ, 2008r. [8] Piegat A.: Modelowanie i sterowanie rozmyte. Exit, Warszawa 1999r. [9] Nguyen H. T., Prasad N. R., Walker C. L.: A First Course in Fuzzy and neural control. Chapman and Hall/CRC, 2002r. [10] Brzózka Jerzy: Regulatory i układy automatyki. Wydawnictwo MIKOM, Warszawa, 2004r. [11] Niederliński A., J. Mościński, Z. Ogonowski: Regulacja adaptacyjna. PWN, 1995r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced control systems of working machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W04	C1	Lec1÷Lec7	2, 5
PEK_W02	K2MTR_MMP_W04	C1	Lec8÷Lec13, Lec15	2, 5
PEK_W03	K2MTR_MMP_W04	C1	Lec14	2, 5
PEK_U01	K2MTR_MMP_U05	C2	La1÷La8	1, 2, 3, 4
PEK_U02	K2MTR_MMP_U05	C2	La1÷La8	1, 2, 3, 4
PEK_U03	K2MTR_MMP_U05	C2	La1÷La8	1, 2, 3, 4

PEK_K01	K2MTR_K04	C3	Lec1÷Lec15, La1÷La8	1, 2, 3, 4, 5
PEK_K02	K2MTR_K02	C4	Lec1÷Lec15, La1÷La8	1, 2, 3, 4, 5

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Energooszczędne układy napędowe maszyn i pojazdów**
Name in English: **Energy-saving driving systems of earth moving machines and vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041108**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses	X				
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of the construction of vehicle propulsion systems and machines. Is aware of the impact of the solutions on the environment. It has an advanced knowledge of mathematics and physics.
2. Student has a basic knowledge of the design of control algorithms. He knows the proper terminology. It has a basic knowledge of the principles of operation of electronic components.
3. Can use measuring devices and systems. Able to work in groups in various roles, and to develop and formulate conclusions.

SUBJECT OBJECTIVES

C1. The aim of the course is to acquire the practical knowledge needed to design energy-efficient vehicles and powertrains in mechatronic systems working machines. Has the need to continue to receive information and the solutions on the environment.
C2. The aim of the course is the acquisition of knowledge in the construction and principles of operation of the various propulsion components and the ability to conduct experimental studies. Is able to perform functional analysis of various propulsion systems and their control. Able to model the selected items propulsion systems and their control systems. He has developed the ability to work in groups.
C3. The aim of the course is to acquire practical knowledge in the design and optimization of control systems for machines working. It can make a plan and carry out his experiment. Has the ability to publish the results and solutions applied.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - familiar with the terminology and can explain the rules of individual vehicle propulsion components and working machines
PEK_W02 - able to define the problems of the flow of energy in the propulsion system and identify work areas with impaired mechanisms of action
PEK_W03 - can choose the elements of traditional propulsion systems and hybrid and identify energy losses

II. Relating to skills:
PEK_U01 - can perform mathematical calculations determining the parameters of the test object
PEK_U02 - able to design a propulsion system so as to obtain its objective action
PEK_U03 - is able to specify a path for power and estimate the power dissipation in the proposed drive system

III. Relating to social competences:
PEK_K01 - student looking for information in the literature expanding their knowledge and skills
PEK_K02 - student communicates effectively with others solvers together specific issue
PEK_K03 - student proposes and devises a new possible solutions for applications in engineering

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of the propulsion system, hybrid types and propulsion systems, single and multi-source power systems. The principle of operation of the powertrain.	2
Lec2	Primary and secondary sources of energy: electrical, mechanical and electro-hydraulic, fuel-calorie concept.	2
Lec3	Fuel cells. The efficiency of energy processed. Power converters for AC and DC operated from vehicles.	2
Lec4	A detailed overview of the energy storage. The problems and limitations associated with it. Resistance and power consumption while moving.	2
Lec5	Structure parallel hybrid powertrain. The efficiency of transmission.	2

Lec6	The structure of serial and mixed hybrid propulsion systems. The efficiency of transmission.	2
Lec7	Construction of propulsion of "mild".	2
Lec8	Computational method for selecting the individual components of hybrid powertrains. Problems associated with the delivery of energy recovered to the source. The amount and efficiency of energy recovery based on the cycle of the vehicle.	2
Lec9	Recuperating and energy storage. Fine-tune the structure of the fuel to the vehicle drive cycle. Analysis of the possibility of reducing gas share of energy sources in the energy transfer.	2
Lec10	Analysis of the possibility of reducing engine power and efficiency of the transmission.	2
Lec11	The recuperative braking wheeled vehicles. Problems with receiving energy and preserving the direction of motion. Construction of hybrid brakes.	2
Lec12	The braking of ground working vehicles. The methodology and energy.	2
Lec13	The use of electronic circuits for controlling the earth working machines.	2
Lec14	Traction characteristics of hybrid vehicles. Unconventional methods of transmission.	2
Lec15	Modeling of hybrid drive systems for wheeled vehicles. Modeling of sources and receivers of energy.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Study the possibility of accumulation of energy in the hydrostatic drive system wheel loader working system.	2
Lab2	Performance testing of the propulsion system overhead traveling crane winch.	2
Lab3	Accumulation and recuperation of energy in the inertial propulsion system.	2
Lab4	Energy efficiency of the filling process of bucket i earth working vehicles	2
Lab5	Hydrostatic test drive of earth working machine.	2
Lab6	Accumulation and energy recuperation mechano-electrical and electrical drive systems.	2
Lab7	Modelling of vehicle propulsion systems and machines in an MBS.	2
Lab8	Research centers granular mining process. Effect of tool selection process for energy efficiency.	2
		Total hours: 16

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	exam
P = kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	report on laboratory exercises, short test
P = odpowiedzi ustne		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.„Propulsion Systems for Hybrid Vehicles", John Miller, IEE Power and Energy Series 45, 2004
2."Odnawialne źródła energii i pojazdy proekologiczne", Grażyna Jastrzębska, WNT, 2009
3.„Akumulacja energii w pojazdach", Antoni Szymanowski, WKŁ, 1984
4.„Alternatywne napędy pojazdów", Jerzy Merkisz, Wydawnictwo Politechniki Poznańskiej, 2006
5.„Modern Electric Vehicle Tehnology", C. Chan, Oxford Universtity Press, 2001
6."Electric vehicle technology explained", James Larminie, West Sussex, England ; Hoboken, N.J. : J. Wiley, cop. 2003
7.„Maszyny elektryczne pojazdów samochodowych", Eugeniusz Koziej, WNT, 1984

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Energy-saving driving systems of earth moving machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K2MTR_MMP_W03, K2MTR_MMP_W08	C1	Lec1-Lec7	N1,N3
PEK_W02	K2MTR_MMP_W08, K2MTR_MMP_W09	C1, C3	Lec8-Lec10	N1, N3
PEK_W03	K2MTR_MMP_W02, K2MTR_MMP_W03	C3	Lec11-Lec15	N1, N3
PEK_U01	K2MTR_MMP_U02, K2MTR_MMP_U04	C2	Lab1-Lab8	N2
PEK_U02	K2MTR_MMP_U05	C2	Lab1-Lab8	N2
PEK_U03	K2MTR_MMP_U01	C2	Lab1-Lab8	N2
PEK_K01	K2MTR_K01	C1, C2, C3	Lec11-Lec15	N1,N3
PEK_K02	K2MTR_K03	C2	Lab1-Lab8	N2
PEK_K03	K2MTR_K06	C1, C2	Lec11-Lec15, Lab1-Lab8	N1,N3

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041110**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					30
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes					0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Cross-sectional knowledge on the problems taught in the I and II degree of the studies.

SUBJECT OBJECTIVES

C1. To acquire the skill of presenting the diploma work.
C2. To acquire the skill of discussing the fundamental problems learnt in the I and II degree of the studies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - The student is supposed to be have the skill of discussing the problems presented in their diploma work as well as the fundamental problems learnt in the I and II degree of the studies.

III. Relating to social competences:
PEK_K01 - The student understands the need for continuing their education process and knows the educational possibilities

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, discussion of the structure and the way of editing the diploma work.	2
Sem2	Introductory discussion on the diploma works.	6
Sem3	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the fundamental areas.	2
Sem4	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the design area.	2
Sem5	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the technology area.	2
Sem6	Presentation of the students' work effects.	14
Sem7	Summary.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem discussion
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK, K01	Problem discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Students' own notes and the literature on the degree I and II subjects.
2. Poradnik inżyniera mechanika. Tom I-II, WNT 1968,1969, 1970

SECONDARY LITERATURE
1. http://www.wmech.pwr.wroc.pl/88431,91.dhtml (Instructions for the authors of diploma works)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MTR_U15, K2MTR_U19, K2MTR_U20, K2MTR_U22	C1, C2	Se2-Se5	N1, N2
PEK_K01	K2MTR_K07	C1, C2	Se1-Se7	N1, N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jarosław Stryczek tel.: 71 320-20-70 email: Jaroslaw.Stryczek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza modalna**
Name in English: **Modal Analysis**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041120**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. linear ordinary differential equations, differential and integral calculus
2. dynamics of mechanical systems (in range of Mechanics II stage 1 of study
3. Lagrange’s equation (in range of Analytical Mechanics)

SUBJECT OBJECTIVES

C1. Knowledge of vibration theory of linear systems with many degrees of freedom using the Laplace operator technique: transmittance matrix, Duhamel's formula, frequency response function, spectrum of natural frequencies, modal model, mode shapes, modal matrices, modal constants.
C2. The ability to measure dynamic signals and their analysis with the use of professional software for Fourier analysis of signals. Ability to use measuring apparatus and sensors in order to determine the mode shapes and modal parameters of real systems.
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the basic notions of vibration of discrete linear dynamic systems: generalized mass and generalized stiffness matrices, natural frequencies, modal parameters and modal matrices, mode shapes.
PEK_W02 - He knows the theory of linear systems in depiction of the Laplace transform: transmittance matrix, frequency response function, the Duhamel's formula. He knows the harmonic analysis applied to the vibration analysis of mechanical systems from a theoretical as well as practical (filters, spectral windows).
PEK_W03 - He knows the theoretical basis and application problems of experimental modal analysis .

II. Relating to skills:
PEK_U01 - He can determine the signals spectrum of displacements, velocities and accelerations and excited forces for real mechanical systems in laboratory environment and by computer simulation techniques
PEK_U02 - He can apply the Fourier and Laplace transform to vibration analysis of linear mechanical systems.
PEK_U03 - He can use a professional testing apparatus to measure and analysis of dynamic mechanical systems vibration in order to create a modal model of the real structure by using experimental modal analysis method.

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Harmonic oscillations. Harmonic analysis of signals. Fourier transforms.	2
Lec2	Laplace operator and its application in vibration theory of linear systems on the example of an oscillator with viscous damping	2
Lec3	Vibration theory of linear discrete conservative multi-degree-of-freedom systems. Free vibrations, modal parameters, mode shapes.	2
Lec4	The generalization of the theory of modal analysis on systems with proportional viscous damping	2

Lec5	Forced oscillations. Transmittance matrix. Frequency response functions	2
Lec6	The problem of modeling and identification of the real system using modal analysis. Modal model.	2
Lec7	Basis of experimental modal analysis	1
Lec8	Test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Getting familiar with the software Matlab, Simulink and Mathematica.	2
Lab2	Applications of harmonic analysis for nonlinear systems subjected to some non-periodic load (eg, shock loads).	2
Lab3	Computer analysis and by means of Laplace operator technique the free and forced vibration of a linear degenerate system (e.g. Maxwell type). Determination its frequency response function.	2
Lab4	Analysis the free and forced vibration of a linear two-mass and two-degree-of-freedom system using Simulink software. Determination of modal model of the system.	2
Lab5	Introduction to the professional test apparatus used in the experimental modal analysis method (sensors, vibration analyzers, specialized software, exciters, impact hammers) as an example of the selected system	2
Lab6	Determination of the spectrum of natural frequencies and mode shapes of any selected real system using experimental modal analysis	2
Lab7	Derivation of a modal model of a dynamical system selected in the laboratory: natural frequencies, modal mass, modal damping, modal matrix.	2
Lab8	Evaluating the reports and effects of activities. Credits.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02,PEK_W03	written and oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	laboratory reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. HM Irvine, Structural Dynamics, Allen & Unwin Ltd. 1986;
2. M. Kulisiewicz St. Piesiak, Methodology of modeling and identification of mechanical dynamical systems", WUT. , 1994;, House Publ. Wrocław University of Technology, 1994;
3. J. Ewins, Modal Testing: Theory and Practice, Research Studies Press Ltd., Reading 1984

SECONDARY LITERATURE

1. Dynamic Signal Analyzer HP 35665A, Concepts Guide, Hewleet-Packard Company, Washington 1991,
2. Ole Dossing, Structural Testing: Part 1 (Mechanical Mobility Measurements), Part 2 (Modal Analysis and Simulation), Bruel & Kjaer, 1988

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modal Analysis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03,	K2MTR_W01, K2MTR_W04	C1	Lec 1 to Lec 8	N1, N4, N5
PEK_U01, PEK_U02, PEK_U03,	K2MTR_MMP_U01	C2	Lab 1 to Lab 8	N2, N3
PEK_K01, PEK_K02, PEK_K03	K2MTR_K01, K2MTR_K03, K2MTR_K06	C3	Lab 1 to Lab 8	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza obrazów**
Name in English: **Digital images analysis**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041121**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student knows the basics of structured programming in C / C + +

SUBJECT OBJECTIVES

C1. Familiarizing with computer image analysis algorithms for filtering, segmentation and spatial modeling
C2. Introduction to the implementation of digital image analysis algorithms
C3. The introduction to the latest trends in the field of digital image analysis, decision support, virtual and augmented reality

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has structured knowledge of digital image formats, methods of image acquisition, image compression and digital image interpretation
PEK_W02 - Student has a basic knowledge of the methods of digital image filtering and segmentation of objects on digital images
PEK_W03 - Student has an elementary knowledge of new trends in the analysis of digital images, virtual and augmented reality.

II. Relating to skills:
PEK_U01 - Student can implement selected algorithms of filtering and image analysis (including quantitative analysis) and can
solve the problems in the area of filtration and analysis stand-alone
PEK_U02 - Student can analyze medical data in DICOM format using packaged applications
PEK_U03 - Student can prepare a dossier with a discussion of the results of image analysis

III. Relating to social competences:
PEK_K01 - Student can work on tasks stand-alone and in a group
PEK_K02 - Student can think and act creatively

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Saving digital images, methods of image acquisition, image compression and interpretation of digital images	1
Lec2	Saving digital images, methods of image acquisition, image compression and interpretation of digital images	2
Lec3	Computer analysis of digital images. Algorithms of image interpretation. Artifacts origin in digital images (including medical images). Methods of noise filtration.	2
Lec4	Algorithm of object recognition on digital images	2
Lec5	Examples of the use of image analysis in medicine and technology	2
Lec6	Algorithms for object recognition in images recorded in real time (video sequences)	2
Lec7	Virtual and augmented reality. New trends in the analysis of digital images.	2
Lec8	New trends in the analysis of digital images. Examples of systems for decision support based on the analysis of images.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Familiarizing with the basics of programming environment.	1
Lab2	Methods to load digital images in the following formats: BMP, JPEG, DICOM, other	2
Lab3	Methods of filtering of digital images	2

Lab4	Object recognition algorithms on digital images	2
Lab5	Quantitative analysis of digital images	2
Lab6	Application of the selected customized software for image analysis and spatial modeling	2
Lab7	Evaluation project / Visit to the laboratory of laparoscopic simulation	2
Lab8	Evaluation project	2
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. report preparation
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	report of the exercises laboratory
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	report
P = 0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Ryszard Tadeusiewicz, Mariusz Flasiński, Image recognition, National Scientific Publisher, Warsaw, 1991 (in Polish).
[2] Ryszard Tadeusiewicz, Przemysław Korohoda: Computer Analysis and
image processing, Telecommunications Advancement Foundation Publisher, Kraków 1997 (in Polish).

SECONDARY LITERATURE

[1] Jasjit S. Suri, David L. Wilson, Swamy Laxminarayan: Handbook of Biomedical Image Analysis. Kluwer Academic / Plenum Publishers, New York, Boston, Dordrecht, London, Moscow, 2005.
[2] Isaac Bankman: Handbook of Medical Imaging: Processing and Analysis Management (Biomedical Engineering), Academic Press; 1 edition (October 13, 2000)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Digital images analysis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W11, K2MTR_W12	C1	Wy1, Wy2	N1, N2
PEK_W02	K2MTR_W11, K2MTR_W12	C2	Wy3, Wy4, Wy5, Wy6	N1, N2
PEK_W03	K2MTR_W11, K2MTR_W12	C3	Wy7, Wy8	N1, N2
PEK_U01	K2MTR_U11, K2MTR_U12, K2MTR_U13, K2MTR_U17	C2	La1, La2, La3, La4, La5	N3, N4
PEK_U02	K2MTR_U11, K2MTR_U12, K2MTR_U13, K2MTR_U17	C1, C3	La6	N3, N4
PEK_U03	K2MTR_U11, K2MTR_U12, K2MTR_U13, K2MTR_U17	C1, C2, C3	La1, La2, La3, La4, La5, La6, La7, La8	N3, N4
PEK_K01	K2MTR_K01, K2MTR_K02	C1, C2, C3	La1, La2, La3, La4, La5, La6, La7, La8	
PEK_K02	K2MTR_K01, K2MTR_K04, K2MTR_K06	C1, C2, C3	La1, La2, La3, La4, La5, La6, La7, La8	

SUBJECT SUPERVISOR

dr inż. Ewelina Świątek-Najwer tel.: 71 320-21-93 email: ewelina.swiatek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania układów mechatronicznych**
Name in English: **Investigation of mechatronic systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041122**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge and skills that allow them to carry out measurements of the basic physical parameters
2. kinematic structure of mechanical parts knowledge
3. overall structure of control system knowledge

SUBJECT OBJECTIVES

C1. Knowing the general structure of mechatronic measurement and control systems, particularly mobile
C2. familiar with the methods of sensory data acquisition and analysis in mechatronics systems
C3. Learn how to design a conceptual structure of the measurement systems, particularly for mobile applications

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the design and carrying out experimental research in mechatronics systems
PEK_W02 - Has knowledge of how to use sensory systems and the data acquisition systems
PEK_W03 - Has knowledge of programming selected controllers of the mechatronic systems

II. Relating to skills:
PEK_U01 - He can design a measurement system and carry out measurements of selected parameters of the mechatronic system
PEK_U02 - He can program selected controllers of measurement mechatronic system
PEK_U03 - Able to interpret measurement data, perform analysis and prepare a report on the research

III. Relating to social competences:
PEK_K01 - Has awareness of the importance and responsibility of proper and fair conduct of experimental research
PEK_K02 - It has a sense of responsibility for the consequences of the process of preparing the experimental research
PEK_K03 - Able to interact and work in a group, taking the various roles

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechatronic systems - problems, methods, and examples of research in mechatronics	2
Lec2	Interfaces, transmission standards and data flow in mechatronic systems	2
Lec3	Getting, processing and data acquisition in mechatronic systems	2
Lec4	Converters and analysis of image data in mechatronics systems	2
Lec5	Control of the mobile mechatronic systems - general characteristics	2
Lec6	Algorithms and control systems in mechatronics - types, standards, functions and data processing	2
Lec7	Technology acquisition and processing of environment data	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the study of mechatronic systems, safety training	1
Lab2	The sensory systems investigation (report)	3
Lab3	Design and testing of linear drive control systems (report)	3
Lab4	serial or parallel manipulator research (report)	3
Lab5	Design and programming of image analysis system (report)	3
Lab6	Budowa and programming of the control unit - MCU or PLC (report)	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. informative lecture
N3. self study - preparation for laboratory class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = ocena z kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	report grade
P = ocena z raportów		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty, metody, przykłady. Wydawnictwo PWN , Warszawa 2001.2. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne. Wydawnictwo Politechniki Białostockiej. Rozpr. Naukowe nr 44. Białystok 1997.3. Denny K. Miu: M. Springer –Verlag, Nowy York 1993.4. Craig J.: Wprowadzenie do robotyki. WNT 1993.5. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003.6. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007

SECONDARY LITERATURE
1. Bolton W.: Mechatronics. Longman, Nowy York 19992. Roddeck W.: Einfurung in die Mechatronik. B

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Investigation of mechatronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_W11	C1,C2	Wy1-Wy3	N1-N4
PEK_U01 - PEKU03	K2MTR_MMP_U02	C2, C3	La1-La6	N1-N4

SUBJECT SUPERVISOR

dr inż. Jarosław Szrek tel.: 71 320-27-10 email: Jaroslaw.Szrek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Drgania układów mechanicznych**
Name in English: **Vibration of Mechanical Systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041123**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. linear ordinary differential equations, differential - integral calculus
2. dynamics of mechanical systems (in range of degree I of Mechanics II)
3. Lagrange's equations (in range of Analitical Mechanics)

SUBJECT OBJECTIVES

C1. Achieving basic knowledge in range of discrete mechanical system vibrations: linear and nonlinear systems, conservative, dissipative with different kinds of model damping, free and forced vibration- the frequency characteristics.
C2. The ability of a computer analysis of linear and nonlinear vibratory systems. Ability to apply basic analytical approximate methods in nonlinear oscillations theory.
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the analytical methods of vibration in terms of free and forced vibrations of a linear model with one degree of freedom with viscous damping. He knows the harmonic analysis of periodic and non-periodic signals (Fourier's operators).
PEK_W02 - He knows the fundamental notions of nonlinear dynamical systems analysis (phase space, phase trajectory, singular points, steady-state, the stability of solutions, the frequency characteristics)
PEK_W03 - Knows the basic methods of search of approximate steady solutions of nonlinear systems (a small parameter method, harmonic balance method).

II. Relating to skills:
PEK_U01 - Can set and calculate the dynamic response of linear systems with one degree of freedom for any excitations and for arbitrary initial conditions. Can use shock absorption method with applying this model.
PEK_U02 - He can determine the spectrum of complex time signals measured at any point of the real dynamic systems using analytical methods and professional vibration analyzers. He can set the frequency characteristics of dynamic systems.
PEK_U03 - He is able to build computer models for the analysis of linear and nonlinear dynamical systems and perform the simulation studies of vibration of such systems.

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. The mechanical vibratory systems. Kinds of vibration.	2
Lec2	Complex form of harmonic signals. Harmonic analysis of periodic and non-periodic signals (discrete and continuous spectrum).	2
Lec3	Vibration Analysis of a linear model with one degree of freedom with viscous damping: brief reminder of the mechanics of the second degree and studies, follow-up of the energy balance equation, the dynamic hysteresis loop and vibration absorption problems.	2
Lec4	Vibration of the systems with a larger number of degrees of freedom for conservative linear system with two degrees of freedom example.	2
Lec5	Basic methods of vibration analysis in nonlinear systems. Phase space. Topological methods. Stability of solutions.	2
Lec6	The small parameter and perturbations methods in non-linear systems. The method of harmonic balance. Frequency characteristics in non-linear systems on the example of the Duffing system.	2
Lec7	Vibrations of systems with non-linear viscous damping and dry friction.	1
Lec8	Test.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Getting familiar with the software Matlab and Simulink.	2
Lab2	Design in Simulink of a dynamical system with one degree of freedom and computer analysis of the free and forced vibration.	2
Lab3	Analysis of free and forced vibration of a linear two-mass system with two degrees of freedom using Simulink software	2
Lab4	Simulation studies of nonlinear Duffing type system. Study of the effect of the coefficient at non-liner term on resonant frequency.	2
Lab5	Experimental studies of vibration of selected real systems with a finite number of degrees of freedom (1 or / and 2). Introduction to the measuring apparatus, vibration sensors, methods of excitations, vibration analyzers.	2
Lab6	Simulation tests a nonlinear dynamic system proposed by the student and approved by the teacher.	2
Lab7	The simulation studies of systems with dry friction. Effect of dry friction on the forced harmonic vibration	2
Lab8	Evaluating the effects of activities, reports. Credits.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02	written and oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03,	laboratory reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Z. Osinski, Vibration Theory, PWN, Warsaw, 1978;
2. H. M. Irvine, Structural Dynamics, Allen & Unwin Ltd. 1986;
3. N. O. Myklestad, Fundamentals of Vibration Analysis, McGRAW-Hill Book Comp. , 1956

SECONDARY LITERATURE

1 M. Kulisiewicz, St. Piesiak, Methodology of Modeling and Identification of Mechanical Dynamical Systems, House Publ. Wrocław University of Technology, 1994;
2 C. Hayasihi, Nonlinear Oscillations in Physical Systems, WNT, Warsaw, 1968;
3 Z. Osinski, Damping of Mechanical Vibrations, PWN, Warsaw, 1979;
4 RA Struble, Nonlinear Differential Equations, PWN, Warsaw, 1965;
5 N. Minorski, Nonlinear Oscillations, PWN, Warsaw 1967

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Vibration of Mechanical Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03, PEK_U01,	K2MTR_W04	C1	Lec 1 to Lec 8	N1, N4, N5
PEK_U02, PEK_U03,	K2MTR_MMP_U01, K2MTR_U05, K2MTR_U12	C2	Lab 1 to Lab 8	N2, N3, N5
K2MTR_K01, K2MTR_K03, K2MTR_K06	K2MTR_K03, K2MTR_K04, K2MTR_K06	C3	Lab 1 to Lab 8	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie oraz badania mechatronicznych układów maszyn roboczych i pojazdów**
Name in English: **Modeling and virtual tests of mechatronic systems of working machines and vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041124**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the mechanics area
2. Has basic knowledge in the area of mechatronic systems
3. Has basic knowledge of working machines and industrial vehicles

SUBJECT OBJECTIVES

C1. To gain knowledge of methods of modeling of mechatronic systems working machines and vehicles
C2. To gain skills in modeling and virtual testing of mechatronic systems of working machines and vehicles
C3. To gain and consolidate competence in determining appropriate priorities to achieve the specific purpose

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of methods and means that can be used for modeling and virtual testing of working machines and vehicles
PEK_W02 - has knowledge of the modeling methods of industrial vehicles
PEK_W03 - has knowledge of how to take into account in the models: friction, stiffness of links of kinematic chains and properties of tires

II. Relating to skills:
PEK_U01 - is able to choose the rational submodels to achieve the final effect research
PEK_U02 - is able to modeling and carry out virtual tests of systems containing hydraulic, electrical and mechanical components

III. Relating to social competences:
PEK_K01 - has well established competence in determining priorities to achieve the specific purpose

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mathematical and simulation models used to describe the interaction of vehicle wheels or tracks with ground	2
Lec2	Mathematical models used to describe vertical vehicle dynamics	2
Lec3	Mathematical models used to describe horizontal vehicle dynamics	2
Lec4	Mathematical models used to describe kinematics and dynamics of typical manipulators of industrial vehicles	2
Lec5	The methods that take into account the stiffness of links in models of working machines	1
Lec6	Modeling of drive systems of working machines. Modeling of the torque converter. Engine model as part of the whole drive system model or model of the vehicle.	2
Lec7	Ways to develop models of mechanical system by introducing the model of the control system in commercial MBS programs	1
Lec8	Friction models in simulation studies of mechatronic systems of machines and working vehicles	1
Lec9	Modeling the behavior of operator (driver) of a vehicle	1
Lec10	Selected numerical methods of solving nonlinear differential equations used in the simulation studies - characteristics, comparison	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Mechatronic system to keep the wheels of field sprayer on the tractor wheel tracks - modeling	2
Lab2	Mechatronic system to keep the wheels of field sprayer on the tractor wheel tracks - simulation tests	2

Lab3	Mechatronic system to stabilize the position of the main beam field sprayer - modeling	2
Lab4	Mechatronic system to stabilize the position of the main beam field sprayer - simulation tests	2
Lab5	Energy recovery in the electric drive system of excavator manipulator rotation - modeling	2
Lab6	Energy recovery in the electric drive system of excavator manipulator rotation - simulation tests	2
Lab7	Modeling and simulation tests of traction control system in the vehicle with hydrostatic drive	3
		Total hours: 15

TEACHING TOOLS USED

N1. problem exercises
N2. laboratory experiment
N3. tutorials
N4. report preparation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U02, PEK_K01	laboratory raports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r. [2] Dudziński P.: Lenksysteme für Nutzfahrzeuge - Theorie und Praxis. Springer, 2005r.

SECONDARY LITERATURE

[1] Geradin M., Cardona A.: Flexible Multibody Dynamics. A Finite Element Approach. Wiley, 2001r. [2] Augustynowicz A.: Modelowanie typu kierowcy samochodu.Oficyna Wydawnicza Politechniki Opolskiej, Opole 2009r. [3] Shabana A. A.: Dynamics of Multibody Systems. Cambridge University Press, 1998r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modeling and virtual tests of mechatronic systems of working machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W01, K2MTR_MMP_W03	C1	Lec1÷Lec10	3, 5
PEK_W02	K2MTR_MMP_W01, K2MTR_MMP_W03	C1	Lec1÷Lec3	3, 5
PEK_W03	K2MTR_MMP_W01, K2MTR_MMP_W03	C1	Lec1, Lec5, Lec8	3, 5
PEK_U01	K2MTR_MMP_U01, K2MTR_MMP_U04	C2	La1÷La7	1, 2, 3, 4
PEK_U02	K2MTR_MMP_U01, K2MTR_MMP_U04	C2	La1÷La7	1, 2, 3, 4
PEK_K01	K2MTR_K04	C3	La1÷La7	1, 2, 3, 4, 5

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie elektrohydrauliczne**
Name in English: **Electrohydraulic control**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041125**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of classic mechanics and fluid mechanics.
2. Student possess basic knowledge of hydraulic components of drive systems: pumps, motors, cylinders, valves.
3. Student possess knowledge of construction of simple hydraulic systems.

SUBJECT OBJECTIVES

C1. Acquaint students with speed control methods of hydraulic actuator.
C2. Acquaint students with working principle of electrohydraulic components with continous operation (proportional valves and servovalves) and its application in hydraulic drive systems.
C3. Acquaint students with regulations techniques selected parameters of hydraulic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student schould be able to describe speed control of hydraulic actuator with use of electric control signal.
PEK_W02 - In the result of lesson student schould be able to explane working principle electrohydraulic valves with continous operation and determine their properties, e.g. dynamic characteristics.
PEK_W03 - In the result of lesson student schould be able to call and describe advanced hydrotronic systems equipped with regulation systems of selected parameters.

II. Relating to skills:
PEK_U01 - In the result of lesson student schould be able to build hydraulic and electrohydraulic systems and analyse their working principle.
PEK_U02 - In the result of lesson student schould be able to prepare to operation hydrotronic device and plan and execute tests of selected parameters. On the basis of tests results student schould be able to formulate appriopriate conclusions.
PEK_U03 - In the result of lesson student schould be able to design hydrotronic devive performing defined functions.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Methods of speed control of hydraulic actuator.	2
Lec2	Proportional valves as control components in systems.	2
Lec3	Hydraulic regulators and proportional directional control valves.	2
Lec4	Logic valves in proportional technique.	2
Lec5	Load-sensing - systems, efficiencies.	2
Lec6	Controllers in hydraulic systems.	2
Lec7	Regulation systems with electrohydraulic servovalves.	2
Lec8	Check.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Reversible systems.	2
Lab2	Fast movement systems.	2
Lab3	Throttle-serial speed control of hydraulic actuator.	2
Lab4	Throttle-parallel speed control of hydraulic actuator.	2
Lab5	Volumetric speed control of hydraulic actuator.	2
Lab6	Hydraulic actuator control with proportional directional control valve.	2
Lab7	Hydraulic actuator control with load-sensing directional control valve.	2
Lab8	Check.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4.
N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	colloquium.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	oral response for practical veryfication of design and buliding of systems.
F2	PEK_U02	report
F3	PEK_U01 PEK_U03	student's activity note
P = P=(2F1+F2+F3)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Tomasiak E.: Hydraulic and pneumatic drives and control (in polish). Wydawnictwo Polit. Slaskiej, Gliwice, 2001
Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.
Norvelle F. D.: Electrohydraulic control systems. Prentice-Hall INC, New Jersey 2000.

SECONDARY LITERATURE

Palczak E.: Dynamics of hydraulic components and systems (in polish). Wydawnictwo Ossolineum, Wrocław, 1999.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrohydraulic control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W02, K2MTR_MMP_W03	C1 C2	Lec1 Lec2 Lec3	N1
PEK_W02	K2MTR_MMP_W02, K2MTR_MMP_W03, K2MTR_W04	C2	Lec2 Lec3 Lec4 Lec7	N1
PEK_W03	K2MTR_MMP_W01, K2MTR_MMP_W02, K2MTR_MMP_W03	C3	Lec5 Lec6 Lec7	N1
PEK_U01	K2MTR_MMP_U03, K2MTR_MMP_U04	C1 C2 C3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N3 N4
PEK_U02	K2MTR_MMP_U02, K2MTR_MMP_U03, K2MTR_MMP_U04, K2MTR_U13	C1 C2 C3	Lab3 Lab4 Lab5 Lab6 Lab7	N2 N3 N4 N5
PEK_U03	K2MTR_MMP_U03, K2MTR_U14	C1 C3	Lab1 Lab2 Lab3 Lab4 Lab6 Lab7	N3 N4 N5

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy hydrotroniczne w pojazdach**
Name in English: **Hydrotronic systems in vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041126**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic principles of automation, hydraulic and pneumatic power systems, mechanics on the fields of the statics and dynamics, and industrial electronics.
2. Knowledge of the principles of operation and ability to carry out the analysis of the basic design of mechatronic systems used in the industrial. The ability to determine the benefits of the use of mechatronic systems in relation to the classical mechanical and electrical systems.
3. The ability to formulate the engineering task and its solution based on the present technology level.

SUBJECT OBJECTIVES

C1. Acquaint students with the construction, the principle of operation and benefits of the use the hydrotronic systems in vehicles. Presentation of the students selected hydrotronic systems currently applied in vehicles, describe the operating principle and the purposes of their application.
C2. Present the students a detailed discussion of selected hydrotronic systems used in the vehicles. Presentation of their construction, components, operating parameters and the possibility of them extension and modification.
C3. Strengthening the student's teamwork skills. Acquiring the ability to make their own analysis of the benefits of the use of the hydrotronic systems. Allowing the student to predict the impact of implemented or planned changes on the behavior of the whole system. Learning how the analysis of the entire hydrotronic system based on the parameters of the individual components in relation to working conditions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students can point out the hydrotronic systems aplied in vehicles, and describe their operating principles and basic parameters. The student can explain the benefits of the hydrotronic system applications and justifi whether it is the application well founded . Student is able to identify limits of these systems and the conditions for their exploitation and assembly.
PEK_W02 - The student is able to describe the function of each component of the hydrotronic systems in vehicles. Student is able to determine the impact of the parameters of individual elements to the system as a whole.
PEK_W03 - Student is able to create and describe the concept of the hydrotronic system, select the components of the system and define its operation. Student is able to make informed changes the structure or elements of existing hydrotronic systems to improve their operating parameters.

II. Relating to skills:
PEK_U01 - Student identifies the principle of operation and basic parameters of the selected hydrotronic systems use in vehicles. Students draw graphs showing the variation of the basic parameters of the system.
PEK_U02 - The student performs laboratory experiments. Based on the results of experiments student identifies and describes the physical phenomena whose existence has a significant impact on the operation of hydrotronic systems.
PEK_U03 - Student includes the results of the laboratory in a written report, analyze it and formulate conclusions which presents of the teacher.

III. Relating to social competences:
PEK_K01 - The student takes part in the work of the students group, the objective of which is common to conduct a laboratory experiment.
PEK_K02 - The student practices skills to present the results of their work in the form of a written report. Student participates in the problems discussion.
PEK_K03 - The student independently makes the selection of information, focuses on those that are useful to describe the phenomenas and principle of operation of the examined system which was tested during performance a laboratory experiment.

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	To acquaint students with the scope of the course, the terms of credit and the subject literature. The properties hydraulic and pneumatic systems in vehicles.	2
Lec2	Circuits with a hydraulic accumulator. Circuits with central power supply network.	2
Lec3	Brake systems, hydraulic and pneumatic. ABS hydraulic system.	2
Lec4	Systems of the hydraulic drive mechanism. Steering servos.	2
Lec5	Hydrokinetic couplings, application, description and parameters.	2
Lec6	Hydrokinetic torque converters, application, description and parameters.	2
Lec7	Hydropneumatic suspensions, vibration damper. Hydraulic systems of the fuel supply.	2
Lec8	Completion of the course.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	The testing of the system with the network of the constant flow or pressure.	2
Lab3	The testing of the system with the hydraulic accumulator.	2
Lab4	The testing of the steering servo.	2
Lab5	The testing of the load-sensing system.	2
Lab6	Volumetric control of the hydraulic systems in vehicles.	2
Lab7	The testing of the crane rotation mechanism.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4. traditional lecture with the use of transparencies and slides
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	oral response, participation in problems discussions
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	laboratory reports, participation in problems discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Stryczek S., Hydrostatic drive, WNT, Warszawa 1984, (in Polish),
2. W. Kollek, E. Palczak: Optimization of the hydraulic system components. Wydawnictwo Ossolineum, Wrocław 1994. (in Polish)
3. Z.Szydelski:The drive and hydraulic control in vehicles and mobile working machines. WNT Warszawa 1980, (in Polish)

SECONDARY LITERATURE

1. Pizon A.,Hydraulic and electro-hydraulic control and regulation systems, WNT, Warszawa 1987, (in Polish),
2. Garbacik A.: The study of the hydraulic systems design. Wydawnictwo Ossolineum 1997, (in Poish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrotronic systems in vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01÷PEK_W03	K2MTR_MMP_W02	C1, C2	Lec1÷Lec7	N2, N4
PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	K2MTR_K03, K2MTR_K04, K2MTR_MMP_U04	C3	Lab1÷Lab7	N1, N2, N3, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie laserowe**
Name in English: **Laser Technology**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041203**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of optics and optical systems impact on the light beam
2. Basic knowledge of electromagnetic radiation's interaction with matter
3. Knowledge of the heat treatment's issues and its impact on the changes taking place in the material

SUBJECT OBJECTIVES

C1. Acquiring knowledge of the construction and the laser processing operation's
C2. Acquiring the ability to select the appropriate laser system to the task in
C3. Independent acquisition of information and its use to solve engineering problems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the principles of operation and construction of high-power lasers
PEK_W02 - He knows the laser beam forming systems and the interaction of radiation with matter
PEK_W03 - He is familiar with the scope of lasers in manufacturing

II. Relating to skills:
PEK_U01 - He can choose the right laser system for a given treatment process
PEK_U02 - Acting in an appropriate way with the specialized laser equipment
PEK_U03 - Depending on the desired process he is able to select the appropriate beam forming system

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basics of high-power lasers	2
Lec2	Measurements of the laser beam	2
Lec3	Laser beam forming systems and laser safety	2
Lec4	Impact of the laser beam with matter	2
Lec5	Cutting with laser beam	2
Lec6	Use of laser to welding	2
Lec7	Laserl cladding and micromachining	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Overview of laser radiation generators	2
Lab2	Monitoring of the laser beam	2
Lab3	Laser cutting	2
Lab4	Welding using the laser beam	2
Lab5	Laser cladding	2
Lab6	Use of laser scanning head for machining	2
Lab7	Use of laser to hardening	2
Lab8	Evaluation	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
N4. demonstration of laser processes
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03,	short exam
P = średnia F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Kusiński: ”Lasery i ich zastosowanie w inżynierii materiałowej”, Wydawnictwo Naukowe Akapit, 2000.
E. Kannatey-Asibu: “Principles of Laser Materials Processing”, Wiley, 2009.

SECONDARY LITERATURE
J.C. Ion: „Laser Processing of Engineering Materials”, Elsevier, 2005.
W.M. Steen:, “Laser Material Processing”, Springer-Verlag, 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_MSW_W03	C1, C2	Lec1-Lec7	N1- N3, N5
PEK_U01, PEK_U02, PEK_U03	K2MTR_MSW_U03, K2MTR_MSW_U04	C1, C2, C3	Lab1-Lab7	N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Baraniecki tel.: 26-62 email: tomasz.baraniecki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zastosowanie urządzeń mechatronicznych w systemach wytwarzania**
Name in English: **Application of mechatronic devices in manufacturing systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041204**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of traffic control devices, mechatronic, has knowledge of the regulations, the interpolation and control of CNC and RC.
2. He has knowledge of the methods and tools for the measurement and monitoring of processes objects. He knows the rules on the identification of real objects, principles of design and testing of control systems.
3. He can propose a method for the measurement and monitoring of processes, objects, and interpret the results.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the use of devices mechatroniczych in different production systems.
C2. Learning how productive device control using the latest mechatronic solutions. Learning how to integrate physical microelectronic mechanical parts. Detailed knowledge of the dedicated to these devices: sensors, actuators and mechatronic drives.
Acquiring skills related to designing mechatronic systems manufacturing.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - knows mechatronic systems in the different production technologies, known control devices using the latest generation mechatronic solutions.
PEK_W02 - the methods of physical integration of microelectronics with mechanical parts, dedicated to these devices: sensors, actuators, drives, mechatronics and issues related to the design of such systems, mechatronics,
PEK_W03 - have knowledge of the specific application of mechatronics devices, machining, metal forming and welding.

II. Relating to skills:
PEK_U01 - can choose mechatronic systems for various manufacturing technologies,
PEK_U02 - able to integrate microelectronics with mechanical parts, choose the appropriate sensors, actuators mechatronic drives to different production technologies,
PEK_U03 - can design mechatronic systems used in the production systems used in industrial practice now and in the near future.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Discussion of key issues related to mechatronic systems occurring in different manufacturing technologies.	2
Lec2	Physical integration of microelectronics with mechanical parts.	2
Lec3	Distribution equipment into modules, implementing partial functions.	2
Lec4	Sensors used in manufacturing technologies.	2
Lec5	Actuators used in manufacturing technologies.	2
Lec6	Mechatronic drive technology used in manufacturing.	2
Lec7	Issues related to the design of mechatronic.	2
Lec8	Mechatronics in machining - introduction.	2
Lec9	Examples of applications mechatronics in the machining devices.	2
Lec10	Mechatronics in metal forming - introduction.	2
Lec11	Examples of applications of mechatronics in metal forming devices.	2
Lec12	Mechatronics in welding - introduction.	2
Lec13	Examples of applications of mechatronics in welding equipment.	2
Lec14	The use of mechatronics in assembly processes.	2
Lec15	Recent tendy in mechatronics applications in manufacturing technologies.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Mechatronics in oscillating-tensile-compressive torsion plastometer	2
Lab2	Construction and operation of stamping stations for electromagnetic process.	2

Lab3	Intelligent control system of the split blankholder hydraulic press.	2
Lab4	Measurements of dynamic deformation in the rotation hammer.	2
Lab5	2DArray heads for testing welded joints.	2
Lab6	Mechatronic aspects of welding power sources. Constant and steeply-sloping current-voltage characteristics.	2
Lab7	Welding robots. Programming.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	Entrance, laboratory report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Ganesh R. NaikI: NTELLIGENT MECHATRONICS, Croatia, 2011, Katarina Lovrecic.

Annalisa Milella, Donato Di Paola and Grazia Cicirelli: Mechatronic Systems, Applications, 2010, In-Tech intechweb.org.

SECONDARY LITERATURE
Marek Gawrysiak: Mechatronics and Mechatronic Design, Białystok 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Application of mechatronic devices in manufacturing systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MTR_MSW_W01	C1-C2	Lec1-Lec15	N1
PEK_U01-PEK_U03	K2MTR_MSW_U01, K2MTR_MSW_U03, K2MTR_MSW_U05	C2	Lab1-Lab7	N2-N4

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Zimniak tel.: 21-62 email: zbigniew.zimniak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technika ultradźwiękowa**
Name in English: **Ultrasonic Technique**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041206**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students know basic of harmonic motion and classical mechanics, electronics and problems of digital signal processing (spectral analysis).
2. Students can explain the phenomenon of piezoelectric and magnetostrictive, can perform amplifier design, the generator and the analog filter.

SUBJECT OBJECTIVES

C1. One of course purpose is to familiarize students with the principles of ultrasonic wave propagation in various media and the use of ultrasounds in industrial practice.
C2. During the course students will learn both the physical aspects of ultrasound waves and practical: passive (material testing, sensors) and active (eg, welding, cleaning) effects of ultrasounds.
C3. Making the students familiar to use ultrasonic measuring devices, the principles of selection of transducers and measuring heads for chosen application.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students know the rules of propagation of ultrasonic waves in a continuous medium, such as types of waves and phenomena at the medium boundary.
PEK_W02 - Knowing the methods of generation and receiving of ultrasound, can explain the phenomenon of acoustic emission.
PEK_W03 - Drawing an equivalent circuit of the piezoelectric and magnetostrictive transducer, using characteristic impedance of transducer can read and choose the parameters of the head (the resonant frequency, input impedance)

II. Relating to skills:
PEK_U01 - Ability to choose ultrasound devices for specific industrial applications.
PEK_U02 - Ability to interpret ultrasonic flaw detector indications (reading images A, B, C-scan), can calibrate ultrasonic flaw detector, perform ultrasonic testing of welds, spot welds, casts.
PEK_U03 - Ability to perform and interpret measurements of the thickness of materials and layers.

III. Relating to social competences:
PEK_K01 - Students are able to expand their knowledge of the ultrasonic technique using additional aids (books, journal articles, technical manuals).
PEK_K02 - Ability to rationally explain and justify their point of view using the knowledge of the ultrasonic technique
PEK_K03 - Student can work in a group, respecting the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Prerequisites. Assessment rules. Physical fundamentals of ultrasonic wave propagation (types of waves, the phenomenon on the medium boundary). Methods for visualization of the ultrasonic signal (A, B, C-scan).	2
Lec2	Transducers and ultrasonic probes (piezoelectric and magnetostrictive). Normal heads, angle heads and their application.	2
Lec3	Methods of ultrasonic testing in material characterization (reflection method, transmit, TOFD, acoustic emission).	2
Lec4	Methods for assessing the size of imperfections detected by ultrasound (DG, DGS).	2
Lec5	Ultrasonic testing of welds and pot welds. Matrix array for quality assessment of welding joints	2
Lec6	Ultrasonic measurement of the thickness. Active the application of ultrasound (ultrasonic cavitation).	2
Lec7	Scanning acoustic microscopy for material characterization.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Prerequisites. Discussion of safety rules. Ultrasonic measurements of materials with using normal longitudinal waves and transversal waves (angled probes).	2

Lab2	Velocity measurements of ultrasonic waves in elastic media.	2
Lab3	Measurements of mechanical properties of spot welds by 2D-Array probe.	2
Lab4	Ultrasonic testing of welding joints I. Measurement of thickness.	2
Lab5	Ultrasonic testing of welding joints part II . Assessing the size of imperfections detected by ultrasound (DG, DGS).	2
Lab6	Ultrasonic testing of constructions using acoustic emission.	2
Lab7	Ultrasonic testing of adhesive joints using B-scan visualization. Test grade.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. report preparation
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	report of laboratory excercises
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Śliwiński A., Ultradźwięki i ich zastosowania, WNT Warszawa 2001

SECONDARY LITERATURE
Lewińska-Romicka A. - Badania nieniszczące, WNT Warszawa 2001

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ultrasonic Technique
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MTR_MSW_W04	C1 - C3	Lect1-Lect7	N1
PEK_U01 - PEK_U03	K2MTR_MSW_U05, K2MTR_U13	C1 - C3	La1 - La3	N2, N3
PEK_K01 - PEK_K03	K2MTR_K03	C1 - C3	La1 - La3	N2, N3

SUBJECT SUPERVISOR

dr inż. Marcin Korzeniowski tel.: 42-55 email: marcin.korzeniowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy metrologii**
Name in English: **Metrology principles**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR031001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basics of metrology, physics, algebra, mathematical analysis and informatics.
2. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

C1. Understanding the essence of measurement to recognize true state and relations between physical quantities.
C2. Gaining knowledge of basic metrological concepts, unit system SI, rules of making measurements of physical quantities and basic properties of measurements sensors and apparatus.
C3. Gaining knowledge about signal processing, measurements systems, rules and properties of measurement process.
C4. Gaining basic knowledge about measurement interferences factors.
C5. Gaining basic knowledge about experiment planning and results elaboration and uncertainty analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has basic knowledge of metrology, understands essence of measurements and knows measurements methods
PEK_W02 - Knows basic properties of measurements apparatus and measurements systems.
PEK_W03 - Has basic knowledge of accuracy and measurement uncertainty.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Measurement essence and metrology significance in technics and economy. Technical and legal metrology. Basic terms. Measurements scales and units. SI system and basic units definitions. Measurement services.	2
Lec2	Standards and hierarchical unit scaling system. Measurements equipment: apparatus, systems, measurement chain. Sensors and their properties and application; conditions.	2
Lec3	Experiment planning and measurement methods: division dependent on conditions, properties, example of use.	2
Lec4	Analog and digital measurement instruments: types, components, I/O elements, A/C converters, microprocessor role; metrological properties; influence of interferences.	2
Lec5	Calibration and legalization of measurement instruments: sources of measurement error; conditions and procedures of calibration and legalization; accreditation requirements; errors and corrections calculation; calibration and legalization certificates.	2
Lec6	Measurement uncertainty and results elaboration: sources of uncertainty; division and rules of estimation, calculation of A-type uncertainty.	2
Lec7	Calculation of B-type standard uncertainty and enhanced uncertainty with proper trust level. Methods for results elaboration and presentation.	2
Lec8	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology principles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W03	C1, C2		N1, N2, N3
PEK_W02	K1MTR_W03	C3, C4		N1, N2, N3
PEK_W03	K1MTR_W03	C5		N1, N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Michał Lisowski email: michal.lisowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ochrona własności intelektualnej**
Name in English: **Protection of intellectual property rights**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR032001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. High school knowledge of country organization and role of law.

SUBJECT OBJECTIVES

C1. Gaining knowledge of the legal protection of intellectual property in the field of industrial property and copyright law.
C2. Understanding the principles of preparation patent specification.
C3. Ability to use patent information database.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has basic knowledge of principles of intellectual property protection in particular property in the field of industrial property and copyright law.
PEK_W02 - Knows the rules of preparation of patent and protection specification.
PEK_W03 - Is able to use patent information database.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic legal notion and the concept of law.	2
Lec2	The concept of intellectual property and legal basis of protection.	2
Lec3	Industrial property law and it scope.	2
Lec4	Patents, utility models, industrial designs.	2
Lec5	Principles of preparation of patent specification.	2
Lec6	Use of patent information, products and services.	2
Lec7	Copyright law in engineering work and protection of computer software.	2
Lec8	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Protection of intellectual property rights
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W05	C1		N1
PEK_W02	K1MTR_W05	C2		N1
PEK_W03	K1MTR_W06	C3		N1

SUBJECT SUPERVISOR

Prof. dr hab. inż. Michał Lisowski email: michal.lisowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wprowadzenie do programowania**
Name in English: **Introduction to programming**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR032101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic problems of computer science (Information technology).
2. Abilities of handling computer with the operating system WINDOWS.
3. The student is able to think and act creatively

SUBJECT OBJECTIVES

C1. Knowing and acquiring proficiency in use of principles of structural approach to creating algorithms.
C2. Knowing of principles of programming in the C language
C3. Mastering a skill of writing programs in the C language.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has knowledge in the scope of structural programming.
PEK_W02 - The student knows fundamentals of the C programming language.

II. Relating to skills:
PEK_U01 - The student is able to make use of principles of structural programming.
PEK_U02 - The student is able to write a simple program in the C programming language.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	An introduction. Algorithms. Principles of creating flow charts	2
Lec2	Ideas of programming: the structural programming, object-oriented programming	2
Lec3	General characteristics of the C programming language. Writing simple programs. Programming calculation of expressions.	2
Lec4	Entering data into a program from the keyboard. Display of calculation results on the screen	2
Lec5	Programming change of the order of the performed calculation. Entering iterations into a program.	2
Lec6	A concept of standard library. Its utilization in a program.	2
Lec7	Test I.	2
Lec8	Extracting the repetitive parts in a program.	2
Lec9	Considering a set of data of the same type.	2
Lec10	Handling address of indicated place in computer memory.	2
Lec11	Declaration of own types. Considering a set of data of different types.	2
Lec12	Handling of text.	2
Lec13	Writing data into a mass storage of a computer.	2
Lec14	Practical principles of writing programs.	2
Lec15	Test II	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Flow charts for simple algorithms.	2
Lab2	Flow charts for more complex algorithms.	2
Lab3	Writing, compiling and running simple programs.	2
Lab4	Reading data from the keyboard. Display of numbers and strings on the screen.	2
Lab5	Writing programs with use of bifurcation of control and jumps.	2
Lab6	Programs utilizing loops.	2

Lab7	Utilization of directives and macrodefinitions.	2
Lab8	Programming with use of functions	2
Lab9	Recurrent functions.	2
Lab10	Programming table operations.	2
Lab11	Introduction of pointers into a program.	2
Lab12	Writing programs with use of data structures and unions.	2
Lab13	Programming more advanced operations on strings.	2
Lab14	Creating programs which read input data from files and write results into files	2
Lab15	Writing programs with various elements of the C programming language.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02	activity at the classes
F2	PEK_W01 PEK_W02	tests
P = P=0.1*F1+0.9*F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02	activity at the laboratory classes
F2	PEK_U01 PEK_U02	reports from the laboratory classes

P = P=0.3*F1+0.7*F2

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Wirth N., Algorithms + Data Structures = Programs. Prentice-Hall, PTR Upper Saddle River, NJ, USA 1978.
[2] Kernighan B. W. , Ritchie D. M. , The C programming language. Prentice-Hall, Inc. Upper Saddle River, NJ, USA, 2011.
[3] Sexton C. , C Programming Made Simple. Elsevier Science, Oxford, 2011.

SECONDARY LITERATURE

[1] King K.N., C Programming: A Modern Approach, W. W. Norton & Company, 2008.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to programming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19	C1, C2	Lec1	N1, N4
PEK_W02	K1MTR_W19	C2	Lec2, Lec3, Lec4, Lec5, Lec6, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14	N1, N4
PEK_U01	K1MTR_U19	C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, La9, Lab10, Lab11, Lab12, La13, Lab14, Lab15	N2, N3
PEK_U02	K1MTR_U19	C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9, Lab10, Lab11, Lab12, Lab13, Lab14, Lab15	N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Kazimierz Wilkosz tel.: 71 32035-88 email: kazimierz.wilkosz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Instalacje elektryczne i układy zasilania**
Name in English: **Electrical installations and supply systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR033001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. In the scope of knowledge:
1.Student has the knowledge in the scope basics of the physics, particularly he understands the action of to get warm with electrical current and the mechanisms of heat transmission.
2.Student has the knowledge in the scope basics of the electrotechnics, he knows the basics elements electrical circuits, he knows the basics dimensions which characterize the electrical circuit, he knows to calculation of the simple electrical circuits.
2. In the scope of know-how:
1. Student knows the basics utilization of the computer.
3. In the scope of the competence:
1.Student conscious of the responsibility to assume his work.
2.Student conscious of the imminent of life and health in connexion with work by the electrical devices.
3.Student understands the need and knows possibility self-education, to improve the professional competences.

SUBJECT OBJECTIVES

C1. Acquirement the knowledge of the secure work by the electrical devises.
C2. The competently classification of the electrical low-voltage devices as well as the basics parameters of them.
C3. Acquirement the knowledge of solutions of the tasks and problems useful in choice of the supply and devices in the circuit of the electrical installation.
C4. Acquirement and record social competences which refer the readiness to the work in the team as well as independent, responsibility and honesty in the behaviour, consciousness of the results undertaken engineer's activity.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has the deeply and the verified knowledge in the scope of the construction and the appropriation of the individual part of the electrical installation.
PEK_W02 - Student has the deeply and the verified knowledge in the scope of the over-current and of the over-voltage protection in circuit of electrical installation. Student knows the basic parameters of the low-voltage switches.
PEK_W03 - Student knows the basic elements of the feeders cable of the direct current (DC) as well alternating current (AC) used in the scientific as well as the research laboratories. Student knows the parameters of them as well as he uses them.

II. Relating to skills:
PEK_U01 - Student is able to calculation of short-currents in the circuit of electrical installation in order to attain the choice of electrical apparatus as well as the test electrical shock protection.
PEK_U02 - Student is able to calculation of thermal effect as result flow the short-currents as well as the overload-currents in the wires and in the another elements of the electrical installation.
PEK_U03 - Student is able to choice the type of supply, parameters of circuit supply given another circuit in electrical installation as well as circuit in the laboratory.

III. Relating to social competences:
PEK_K01 - Student well establishment know-how co-operate in team by realization of the given task.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Preliminary information about the subject of the devices and installations electrical. System of the supply in electrical energy of customers.	2
Lec2	Elements of the electrical installation. Calculate of short currents 3-phase and 1-phase in installations circuits in order to attain the choice of electrical apparatus.	2
Lec3	Switches and fuses of the low voltage – construction and basic characteristics. Power electrical wiring and the rules them selection. Insulation and over-voltage protection.	2
Lec4	Thermal effects of the flow the short-currents as well the overload-currents in electrical installations. The thermal characteristics. Protection of the thermal effects.	2

Lec5	Low-voltage switchgear. Basics of the planning as well the projecting of the electrical installation. Electrical shock protection.	2
Lec6	Power quality, reliability of the supply, reserve and un-interruption source of supply.	2
Lec7	Feeder cable of the direct current (DC) as well of the alternating current (AC). Feeder cable utilization in the laboratory. Basics parameters and rules of choice.	2
Lec8	Colloquium for the course.	1
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Introductory classes. Discussion of the subject scope and credit of the course. Initial information of the subject of the supply system in power electricity and in electrical installations.	2
Cl2	Calculation of the short-currents in electrical installations in order to attain the choice of electrical apparatus.	2
Cl3	Calculation of the thermal effect in the wires as well in another elements of electrical installation. Thermal characteristics at short-currents as well at overload-currents.	2
Cl4	Calculation of the thermal effect at short-currents and protection against them in the electrical installations.	2
Cl5	Calculation of thermal effect at overload-currents. Protection criterion of the wires against these effects.	2
Cl6	Exemplary, basics the projecting calculation of electrical installations.	2
Cl7	Choice of the feeder to given lab-circuit as well as to electrical installation.	2
Cl8	Colloquium for the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. calculation exercises
N2. problem exercises
N3. problem discussion
N4. multimedia presentation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01	Colloquium
F2	PEK-W02	Lec3, lec5, Colloquium

F3	PEK-W03	Lec6, Lec7, Colloquium
P = 0,5F1+0,5F2+0,8F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-K01	Participation in problematical discussions.
F2	PEK-U01	Cl1, Cl2, paper test
F3	PEK-U02	Cl3, Cl4, Cl5, paper test
F4	PEK-U03	Cl6, Cl7, Colloquium
P = 0,4F1+0,6F2+0,8F3+0,8F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Markiewicz H., Urządzenia elektroenergetyczne, WNT, Warszawa, 2005.
Markiewicz H., Instalacje elektryczne, WNT, Warszawa, 2007.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical installations and supply systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK-W01	K1MTR_W10	C1, C2	Lec1, Lec2	N2, N4, N5
PEK-W02	K1MTR_W10	C2, C3	Lec3, Lec4, Lec5	N1, N2, N4, N5
PEK-W03	K1MTR_W10	C2, C3	Lec5, Lec6, Lec7	N1, N2, N3, N4, N5

PEK-U01	K1MTR_U01, K1MTR_U02	C1, C3	Cl1, Cl2	N1, N2, N3, N4, N5
PEK-U02	K1MTR_U03, K1MTR_U04	C1, C3	Cl3, Cl4, Cl5	N1, N2, N3, N4, N5
PEK-U03	K1MTR_U05	C1, C2, C3	Cl6, Cl7	N1, N2, N3, N4, N5
PEK-K01	K1MTR_K01	C4	Cl1 - Cl7	N2, N5

SUBJECT SUPERVISOR

dr hab. inż. Antoni Klajn tel.: 71 320 34 24 email: antoni.klajn@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo II**
Name in English: **Materials Science II**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR033002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of advanced mathematics on a level permitting to understand mathematical problems in engineering sciences. Knowledge of the principles and laws of physics in the field of classical electrodynamics (electrostatics, electricity, electromagnetic waves, optics) and selected topics in solid state physics.
2. He can correctly and efficiently apply knowledge of mathematics for qualitative and quantitative analysis of mathematical problems related to the field of corresponding engineering studies. He can correctly and efficiently apply the previously acquired principles and laws of physics to the qualitative and quantitative analysis of physical problems as engineering.
3. He knows the possibilities of the further knowledge development and improvement of competences at work.

SUBJECT OBJECTIVES

C1. Acquisition of theory- grounded knowledge about the properties of materials used in mechatronics, electrical engineering, electronics and optoelectronics
C2. Understanding the importance of smart materials and nanomaterials in science and technology
C3. Acquisition of skills related to research organization and materials diagnostics with carefully selected methods

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He/she has knowledge about the properties of conductive, semi-conductive, dielectric and magnetic materials. He/she understands the importance of smart materials and nanomaterials in science and technology.
PEK_W02 - He/she is able to describe the influence of external stresses on the physical characteristics of materials
PEK_W03 - He/she is able to appropriately select materials for specific applications.

II. Relating to skills:
PEK_U01 - He/she can independently determine the parameters of selected materials. He/she can make a critical analysis of the results obtained.
PEK_U02 - He/she can interpret the physical phenomena occurring during the materials examination and testing
PEK_U03 - He/she can use acquired and well chosen methods for the diagnostics of materials

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, literature, credit conditions. The electrical conductivity of metals. Wire, contact and thermoelectric materials	2
Lec2	Semiconductor materials. Varistors	2
Lec3	Dielectrics. Electrical conductivity, polarization, dielectric losses. Electric strength	2
Lec4	Inorganic insulating materials: ceramics, glass. Optical fibers.	2
Lec5	Insulating thermoplastic and thermoset materials. Composite materials	2
Lec6	The essence of magnetism. Basic properties. Soft and hard magnetic materials. Ferrites	2
Lec7	Electrets. Smart materials	2
Lec8	Nanomaterials	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Resistance measurements of solid and liquid dielectrics	3
Lab2	Determination of dielectric permittivity. Measurement of dielectric losses	3
Lab3	Dielectrics electric strength examination.	3
Lab4	Examination of magnetic properties of electrical steel sheets.	3
Lab5	Hall effect examination	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Short quiz before laboratory exercises
F2	PEK_U01, PEK_U02, PEK_U03	Report from the laboratory exercises
P = 0,5 F1 + 0,5 F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Newell J., Essentials of modern materials science and engineering, John Wiley and Sons, Inc. 2009[2] Celiński Z., Materiałoznawstwo elektrotechniczne, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2011[3] Blicharski M., Wstęp do inżynierii materiałowej, Wydawnictwo AGH, Kraków, 2009[4] Rutkowski J. I inni, Podstawy inżynierii materiałowej – laboratorium, Oficyna Wydawnicza Politechniki Wrocławskiej, 2005 [5] Lisowski M. - Pomiary rezystywności i przenikalności elektrycznej dielektryków stałych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2004[6] Hilczer B., Małecki J.- Elektrety i piezopolimery, PWN, Warszawa, 1992

SECONDARY LITERATURE
[1] Oleś A., Metody doświadczalne fizyki ciała stałego, WNT, Warszawa, 1998[2] Kolbiński K., Słowikowski J., Materiałoznawstwo elektrotechniczne, WNT, Warszawa,1988[3] Recent papers covering usage of materials in engineering

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_W02	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_W03	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_U01	K1MTR_U03	C3.		N3., N4., N5.
PEK_U02	K1MTR_U03	C3.		N3., N4., N5.
PEK_U03	K1MTR_U03	C3.		N3., N4., N5.

SUBJECT SUPERVISOR

dr hab. inż. Bożena Łowkis tel.: 71 320 39 81 email: bozena.lowkis@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie w Matlabie**
Name in English: **Programming in Matlab**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR033101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of programming in C language.
2. Basic knowledge of mechatronics.
3. Student can think creatively.

SUBJECT OBJECTIVES

C1. To assimilate knowledge to create Matlab programs to solve mechatronic tasks.
C2. To become skillful at the creation of the function reading and writing the external files.
C3. To be able to present the computation results as graphics using library programs.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can use matrix and array operations for solving mechatronic tasks.
PEK_U02 - Student can write the Matlab program containing the functions of reading input data and writing computation results and present them graphicaly.
PEK_U03 - Student can write the program which solve the simple mechatronic task using Matlab library.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Using Matlab for mechatronic calculations - basic matrix operations.	2
Lab2	Matlab instructions - if, switch, for, while, break, return.	2
Lab3	Import and export of data from disc to memory.	2
Lab4	Rules to create Matlab scripts for solving the linear equation set.	2
Lab5	Rules to create Matlab functions for solving the linear electric circuit.	2
Lab6	Rules used for graphical object programming.	2
Lab7	Creating graphics in Matlab using the example transients in basic electric circuits.	2
Lab8	Graphical user interface design for supporting the solution of square equation.	2
Lab9	Cooperation with external files - input and output functions for the solution of square equation.	2
Lab10	Creating the functions for solving the nonlinear mechatronic equations.	2
Lab11	The application of Matlab library functions to minimize the costs of energy generation.	2
Lab12	The application of Matlab library functions to solve differential equations describing the transient states in electric circuit.	2
Lab13	Harmonics analysis of time transients of voltages and currents.	2
Lab14	Statistical and graphical analysis of measurement data imported from external files.	2
Lab15	Final test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. Final test.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	report of laboratory exercises
F2	PEK_U01-PEK_U03	test
P = 0.6F1+0.4F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Mrozek B., Mrozek Z., Matlab and Simulink. User handbook. Hellion 2010. /in polish/
Brzóźka J., Dorobczyński L., Programming in Matlab. MIKOM 1998. /in polish/

SECONDARY LITERATURE

Sobierajski M., Łabuzek M.,Programming in Matlab for electricians. Wyd. PWr 2005. /in polish/
Stachurski M., Numerical methods in Matlab. MIKOM 2003./in polish/
Regel W., Symbolic nad numeric calculations in Matlab. MIKOM 2004./in polish/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming in Matlab
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K1MTR_U19	C1,C2,C3	Lab1-Lab14	N1,N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Marian Sobierajski tel.: 71 320 35 41 email: marian.sobierajski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia elektryczna**
Name in English: **Electrical metrology**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR034001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basics of metrology, physics, algebra, mathematical analysis and informatics.
2. Is able to identify and describe physical phenomena connected with electrical matter.
3. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

C1. Learn electrical measurement methods and techniques.
C2. Learn operation principles, properties and application possibilities of analog and digital measurement instruments and systems for electrical and non-electrical measurements.
C3. Learn rules of utilization measurements instruments and systems for electrical quantities measurements.
C4. Gaining practical skills of measurements uncertainty analysis and results elaboration.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of measurements methods and techniques of electrical quantities and is able to choose proper one for the task.
PEK_W02 - Knows principles of operation, properties and potential of analog and digital measurement instruments and systems for electrical and non-electrical measurements.
PEK_W03 - Knows rules of operation of measurements instruments and systems for electrical measurements.

II. Relating to skills:
PEK_U01 - Is able to use proper methods and instruments for measurements of basic electrical quantities.
PEK_U02 - Is able to estimate measurements uncertainty and elaborate measurement results.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Structure, principles of operation and properties of measurement instruments for electrical quantities. Rules of selecting measurements instruments in measurements processes. Analog instruments and converters and their properties.	2
Lec2	Digital instruments and A/D converters. Role of microprocessors in digital instruments. Metrological properties of digital multimeters. Measurements of DC voltage and current.	2
Lec3	Measurement of AC voltage and current. Parameters of variable in time electrical signal. Methods for measurements of sinusoidal voltage and current. Analog and digital voltmeters and ammeters and their properties.	2
Lec4	Resistance, impedance, inductance and capacitance measurements. Bridge and digital measurements methods and instruments for resistance measurements. Measurements of impedance components. Functional and metrological properties of impedance and impedance components measurements instruments.	2
Lec5	Single-phase and tree-faze power measurements. Analog and digital wattmeter. Digital electrical grid parameters meters.	2
Lec6	Analog and digital oscilloscope. Principle of operation and structure of analog and digital oscilloscope. Multichannel oscilloscope. Functional and metrological properties of oscilloscope. Oscilloscopic measurements.	2
Lec7	Measurements systems and their configuration. Elements of measurement system: measurements cards and data acquisition cards, signal conditioners, multiplexers. Data transfer, interfaces – types and properties. Virtual instruments – structure and application.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction	2

Lab2	DC voltage and current measurements with analog and digital instruments.	2
Lab3	AC voltage and power measurements	2
Lab4	Resistance measurements with analog and digital instruments.	2
Lab5	Impedance and capacitance measurements.	2
Lab6	Oscilloscopic measurements	2
Lab7	Time for missed classes	2
Lab8	Individual tests	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Oral and written test. Laboratory report. Final mark: middle with marks laboratory practices.
P = średnia z uzyskanych ocen cząstkowych		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical metrology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U03	C1 - C3		N2 - N5
PEK_U02	K1MTR_U03	C4		N3 - N5
PEK_W01	K1MTR_W03	C1		N1, N5
PEK_W02	K1MTR_W03	C2		N1, N5
PEK_W03	K1MTR_W03	C3		N1, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Michał Lisowski email: michal.lisowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy sieci komputerowych**
Name in English: **Components of computer networks**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR034101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of computer support.
It has a basic knowledge of functional systems.
It has a basic knowledge of computer programming.
It has a basic knowledge of information retrieval.
2. Is able to recognise key hardware and software parameters of personal computers
Is able to write computer programmes based on given algorithm
3. Is able to think and action in a creative and enterprising manner.

SUBJECT OBJECTIVES

C1. Has basic knowledge about computer communication and data exchange for engineering purposes
C2. Identifies basic design guidelines for building local computer networks
C3. Preparing to solve problems in the project team

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has a basic knowledge of computer communication and exchange of information in the activities of engineering
PEK_W02 - It has an elementary knowledge of modeling and programming network events
PEK_W03 - Knows the basic principles for the design of local area networks

II. Relating to skills:
PEK_U01 - Able to obtain the information from the literature and other sources in the field of communication connections compilation
PEK_U02 - He can use the built-in operating systems and communication procedures through elementary programming in C / C ++
PEK_U03 - Knows how to use available through a computer network resources processes and data servers

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The objectives and tasks of the networks in the activities of engineering. Multitasking and concurrency processes in modern computer systems.Sharing of information resources.	3
Lec2	Network topologies and to compare the physical layer Ethernet and Token Ring. Network frames. Logical structure of the network (LAN) and urban (MAN) and public (WAN) and separated (Corporate).Network protocols: IP, TCP, UDP. ISO model. Advantages and disadvantages of encapsulation and data decapsulator.	3
Lec3	Selected elements of the local network communication technology, Wi-Fi, Bluetooth, USB, RS232, RS485, GPIB.Dedicated applications for engineers: Matlab, LabVIEW. Programming interfaces and communications applications design principles.	3
Lec4	Communication in a client-server system. File servers and processes. Examples Programming Pascal, C / C ++ data in an Ethernet local area networks.Programming Fundamentals network communication TCP / IP and UDP / IP in C / C or Pascal and VBA.	3
Lec5	Terminal work and its importance in the management of distributed systems. Built-in communication procedures in selected network operating systems Linux and Windows (Winsock).	2
Lec6	Final test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	SSH terminal work sessions on networked systems. Commands Linux the information systems (Unix). Network file system and directories. SFTP secure data transmission.	2
Lab2	Shell Programming - shell variables. Process Control.	2

Lab3	Development of elementary procedures for network C on the basis of predetermined communication algorithm.	2
Lab4	Elementary programming procedures in C network based on the algorithm specified communication - monitoring and identification of network events.	2
Lab5	Elementary programming procedures in C network based on the algorithm specified communication - within the process control laboratory and project groups.	3
Lab6	Laboratory project client-server model. Programming in C client server of the steering tasks of teaching - Working in teams laboratory and design.	3
Lab7	Laboratory assessment.	1
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. self study - preparation for laboratory class
N4. tutorials
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Self-study distance -test partial Educational platform: http://eportal.eny.pwr.wroc.pl
F2	PEK_W01, PEK_W02, PEK_W03	Final test (final) in the presence of conducting classes in the computer lab. Educational platform: http://eportal.eny.pwr.wroc.pl
P = 0,15*F1+0,85*F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02, PEK_U03	The development of electronic sub-reports Educational platform: http://eportal.eny.pwr.wroc.pl

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Przewodnik po sieciach lokalnych, Greg Nunemacher, MIKOM (wydanie dowolne)
[2] Programowanie zastosowań sieciowych w systemie Unix, W.Richaed Stevens,WNT '95
[3] Platforma edukacyjna: http://eportal.eny.pwr.wroc.pl
[4] Netografia

SECONDARY LITERATURE

[1] Nowoczesne sieci miejskie,J.Jaworski, R.Morawski,J.Olędzki,WNT(wydanie dowolne)
[2] TCP/IP. Administarcja sieci, Craig Hunt, OW READ ME (wydanie dowolne)
[3] JAVA Kompendium programisty, Helion, (wydanie dowolne)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Components of computer networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 (wiedza) PEK_W02 PEK_W03	K1MTR_W19, K1MTR_W20	C1,C2	Lec1,Lec2, Lec3,Lec4, Lec5	N1,N2,N4
PEK_U01 (umiejętności) PEK_U02	K1MTR_U19, K1MTR_U20	C1,C2,C3	Lab1,Lab2, Lab3,Lab4, Lab5,Lab6	N2,N3,N4

SUBJECT SUPERVISOR

doc. dr inż. Jarosław Szymańda tel.: 2625 email: jaroslaw.szymanda@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie obiektowe w Matlabie**
Name in English: **MATLAB Object Oriented Programming**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR034102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of computer science, linear programming
2. Is familiar with Matlab software, can write, test and run own programs in Matlab
3. Student can think and act creatively. Student is able to work alone.

SUBJECT OBJECTIVES

C1. Getting to know the principles of object-oriented programming
C2. Acquiring the skills to use Matlab to write programs implementing mechanisms of object-oriented programming, and to solve engineering problems using these mechanisms

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is able to do practical algorithmization of any engineering task
PEK_U02 - Can apply object-oriented programming paradigm to solve practical engineering problems
PEK_U03 - Knows and applies the principles of good programming style. Is able to test, debug, document the code of the program

III. Relating to social competences:
PEK_K01 - Can competently, independently, making a multi-criteria analysis, work out the engineering task
PEK_K02 - Understand the need for regular and individual work to learn the course material

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Objects, classes, methods, attributes, structures, constructors, destructors	2
Lab2	Method overloading	2
Lab3	Inheritance, derived classes	2
Lab4	Operators, operator overloading	2
Lab5	I/O operations	2
Lab6	Double linked list	2
Lab7	Polymorphism and virtual functions	2
Lab8	Matlab Class Wizard	4
Lab9	Templates	2
Lab10	The implementation of cellular automatons algorithms such as Life, Mistermind, etc.	6
Lab11	Testing, debugging and documenting of the program	2
Lab12	Final evaluation. Reserve term	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory
N2. individual work - writing the program and documenting
N3. preparation of the report
N4. tutoring

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K02	activity in classes, participation in problem discussions, reports (program code, documentation)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Meyer B., Programowanie zorientowane obiektowo, Helion 2005, 2008
Register A.H.,A Guide to MATLAB Object-Oriented Programming, Chapman & Hall/CRC, 2007
Mrozek B., Mrozek Z., Matlab i Simulink. Poradnik użytkownika. Hellion 2010.
Brzóźka J., Dorobczyński L., Programowanie w Matlabie. MIKOM 1998.

SECONDARY LITERATURE
N.M. Josuttis, C++. Programowanie zorientowane obiektowo. Vademecum profesjonalisty, Helion 2003
Chomicz P., Ulijasz R., Programowanie w języku C i C++. Poradnik programisty.Wydawnictwo. PLJ, Warszawa, 1992
Liberty J., C++ dla każdego, Helion 2002
Prata S., Szkoła Programowania. Język C++, Helion 2006
Pratap R., Matlab 7 dla naukowców i inżynierów. MIKOM, Warszawa 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MATLAB Object Oriented Programming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U1 - PEK_U3	K1MTR_U19, K1MTR_U37	C1-C2	La1 - La12	N1, N2, N3, N4
PEK_K1 - PEK_K2	K1MTR_K01	C1-C2	La1 - La12	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Piotr Pierz email: piotr.pierz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy elektryczne**
Name in English: **Electrical Drives**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR035001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		90		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the field of physics, especially electrodynamics and electromagnetizm.
2. Has basic knowledge in the field of electrotechnics, including basics of DC and AC circuits theory.
3. Can properly and effectively apply the knowledge on the differential and integral calculus of single variable function for qualitative and quantitative analysis of mathematical problems connected with studying field of engineering.

SUBJECT OBJECTIVES

C1. Familiarizing students with the basic steady-state and dynamical performances of electrical drives.
C2. Familiarizing students with the basic converter-fed DC and AC motor drives, with speed control methods of mechatronic drives (including servodrives).
C3. Perfecting skills for measuring, data acquisition and elaboration of test results, their interpretation and analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge on basic elements of converter-fed drive, its operation regimes, can define and describe them. Can explain the principles of the operation and steady-state characteristics of the basic electrical and loading machines.
PEK_W02 - Can characterize and describe the basic methods used for speed control of the DC and AC motor drives.
PEK_W03 - Can characterize and describe the basic control structures of the DC and AC motor drives in open and closed-loop structures, including methods and structures for vector controlled servodrives.

II. Relating to skills:
PEK_U01 - Can calculate basic values characterizing operation of the DC and AC motors
PEK_U02 - Can choose the basic measurements equipment for electrical motors applied in choosen drive systems.
PEK_U03 - Can realize the experimental tests of chosen controlled electrical drives in laboratory set-up including their static and dynamical characteristics and analyse obtained results.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Electrical drive system - basic definition, components. Steady state characteristics of different types of motors and loading machines, regions of operation.	2
Lec2	Motion equation of electrical drive system, static and dynamic states, stable steady-state operation conditions. Influence of different types of mechanical connections to equation of motion.	2
Lec3	DC motor drive systems: construction and operation principle of DC motor with separate excitation, its mathematical model, dynamical performances. Converters supplying the DC motor.	2
Lec4	DC motor drive systems: speed control, breaking methods.	2
Lec5	Cascade structure of the speed and torque control of the DC motor. Controller adjustment methods, transient performances.	2
Lec6	Induction motor (IM) drive systems: principle of IM operation, its steady-state characteristics. Basic static converters supplying AC motors.	2
Lec7	Induction motor drive systems: speed control, breaking methods.	2
Lec8	Basics of frequency speed control method - scalar control: control rule, structure, performances.	2
Lec9	Basics of vector control principle of the IM speed and torque - main idea, control structure, dynamical performances, applications.	2
Lec10	Direct torque control method for the induction motor - main idea, control structure, dynamical performances, applications.	2
Lec11	Brushless DC and AC permanent magnet motors; contruction, principle ofoperation, basic methods for torque and speed control.	2

Lec12	Vector control method of the PMSM torque and speed - structures, dynamical performances.	2
Lec13	Basic requirements and parameters of servodrives. Electrical motors used in servodrives; permanent magnet DC and AC motors, step motors; main parameters and requirements.	2
Lec14	Design of servodrives with DC and AC motors - structures, analogies and differences depending on driving motor. Design rules for position controller, parameter adjustment, dynamics optimization.	2
Lec15	Development trends in electrical drive systems.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction - general description of laboratory set-ups, measurement equipment and measuring methods. Forming of characteristics of the DC motor with separate excitation iin different operation modes.	3
Lab2	Testing of the DC motor drive system supplied from the bidirectional controlled rectifier.	3
Lab3	Starting systems for squirrel-cage and slip-ring induction motors.	3
Lab4	Testing of the induction motor drive supplied form the voltage inverter -scalar control.	3
Lab5	Simulation tests of the cascade control structure of the DC drive system, with the stiff and elastic connection.	3
Lab6	Experimental tests of the cascade control structure of the DC drive system, with the stiff and elastic connection, in digital realization (with digital processor).	3
Lab7	Simulation tests of the field-oriented control of the voltage-inverter-fed induction motor drive system - vector control method.	3
Lab8	Experimental tests of the field-oriented control of the voltage-inverter-fed induction motor drive system - vector control method.	3
Lab9	Simulation tests of the voltage-inverter-fed PMSM motor drive system - vector control method.	3
Lab10	Experimental tests of the voltage-inverter-fed PMSM motor drive system - vector control method. Crediting with grade.	3
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. self study - preparation for laboratory class
N5. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_WO2, PEK_W03	short tests, written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Evaluation of short tests before laboratory exercisses.
F2	PEK_UO2, PEK_U03	Activity in the exercises and discussion.
F3	PEK_U01, PEK_UO2, PEK_U03	Evaluation of the written works and laboratory reports.
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

W. Leonhard, Control of Electrical Drives, Springer Verlag, 1990

Krishnan R., Electric Motor Drives – modeling, analysis and control, Prentice Hall, 2001

SECONDARY LITERATURE

Automatic Control of Converter-fed Drives, Elsevier, 1994

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical Drives
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K1MTR_W10	C1		N1, N2, N3
PEK_W02	K1MTR_W10	C1, C2		N1, N2, N3
PEK_W03	K1MTR_W10	C1, C2		N1, N2, N3
PEK_U01	K1MTR_U02	C2, C3		N4, N5
PEK_U02	K1MTR_U10	C2, C3		N4, N5
PEK_U03	K1MTR_U10	C2, C3		N4, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Teresa Orłowska-Kowalska email: Teresa.Orlowska-Kowalska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory - właściwości i zastosowania**
Name in English: **Sensors – properties and applications**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR035101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of physics, mathematical analysis, basics of metrology and electrical metrology, mechanics, electrotechnics.
2. Is able to identify and describe physical phenomena connected with mechanics and electrotechnics.
3. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

C1. Learn physical basics of classic and intelligent sensors. Learn most important parameters of sensors, and their use in mechatronics, automatics and measurement systems.
C2. Ability to select and use sensors for measurements of different physical quantities, and use of sensors in measurement, monitoring and control systems.
C3. Ability to examine basic sensor characteristics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has basic knowledge of properties, functioning and structure of sensors and sensors systems, intelligent sensors and microsensors.
PEK_W02 - Has basic knowledge of sensors application for different physical quantities measurements.
PEK_W03 - Has basic knowledge of sensors application in measurement, monitoring and control systems.

II. Relating to skills:
PEK_U01 - Is able to select and use proper sensor for different physical quantities measurements
PEK_U02 - Is able to use sensors in measurement, monitoring and control systems.
PEK_U03 - Is able to examine basic sensor characteristics.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classical and intelligent sensors in mechatronics, automatics and measurement systems. Measurement and double-state (switching) sensors. Static and dynamic properties.	2
Lec2	Passive and active temperature sensors (resistive, capacitive, thermoelectric, quartz resonance).	2
Lec3	Fiber optic and pyrometric temperature sensors.	2
Lec4	Mechanical quantities sensors. Tensiometers – properties and applications. Displacement, linear and rotational speed sensors.	2
Lec5	Vibration sensors. Optical motion sensors and their application in anti-theft systmes.	2
Lec6	Pressure and flow sensors. Gas sensors, humidity sensors.	2
Lec7	Electric and magnetic field sensors. Illumination sensors.	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction	2
Lab2	Investigation of static and dynamic properties of contact temperature sensors and their practical application	4
Lab3	Surface temperature measurements with contactless optical methods: pyrometric, thermovision camera. Measurements of air humidity.	4
Lab4	Investigation of properties of tensiometers and their practical applications (i.e. pressure measurements).	4
Lab5	Investigation of properties of inductive displacement sensors and layer thickness sensor. Inductive sensors for metal detection. Measurements of rotational speed.	4

Lab6	Optical distance measurements. Capacitive sensors and their application (i.e. liquid level sensors). Properties of intelligent motion sensors.	4
Lab7	Light sensitive sensors, illumination measurements.	4
Lab8	Missed classes time.	4
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. self study - self studies and preparation for examination
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	Oral and written test. Laboratory report.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors – properties and applications
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1		N1
PEK_U01 - PEK_U03	K1MTR_U15	C2, C3		N2 - N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Michał Lisowski email: michal.lisowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie systemów rozproszonych na bazie sterowników PLC**
Name in English: **Programming of distributed control systems based on PLC**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR035102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has knowledge of the theory of logic circuits.
2. He can develop a control algorithm of the selected industrial process.

SUBJECT OBJECTIVES

C1. Familiarize students with the structure of the distributed control systems of automation.
C2. The acquisition of basic knowledge of popular communication networks used in industrial automation.
C3. The acquisition skills programming of the automation devices in distributed control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It is able to characterize the structure of distributed automation systems.
PEK_W02 - It is able list and describe the basic communication networks used in distributed control systems.

II. Relating to skills:
PEK_U01 - He can connect and configure a distributed control system using popular industrial communication networks.
PEK_U02 - It is able to program controllers and industrial automation equipment to realize the selected industrial process.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Automation in the modern manufacturing plant. Structures of the industrial control systems.	2
Lec2	Structure and programming of OMRON CJ1M PLC. The CX-One software.	2
Lec3	Communication systems for industrial automation. ISO OSI Reference Model. Principles of data exchange in popular industrial networks.	2
Lec4	Communication in distributed automation systems using OMRON PLCs.	2
Lec5	Application of RS-232 and RS-485 interface for data exchange between automation devices. Communication using PC-Link network.	2
Lec6	Visualization of industrial processes - programming HMI terminals.	2
Lec7	Visualization of industrial processes - the Cx-Supervisor SCADA software.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the Rules and Regulations of internal safety lab. Establish rules for passing. General familiarization with laboratory equipment. Discussion of the laboratory exercises.	2
Lab2	Introduction to the CX-One software. Configuration and programming OMRON CJ1M controller.	2
Lab3	Getting to know the function libraries of the CX-Programmer software.	2
Lab4	Programming of serial ports. The exchange of data between controllers with PC-Link network.	2
Lab5	The use of communication modules PRM21 for data exchange using PROFIBUS network. Operation of the distributed I/O station GRT1-PRT.	1
Lab6	The use of communication modules DRM21 for data exchange using DeviceNet network. Operation of the distributed I/O station GRT1-DRT.	1
Lab7	Programming of control systems of selected models of advanced industrial processes.	4

Lab8	Giving reports, summary and pass the lab.	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01 PEK-W02	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-U01 PEK-U02	Rating of reports of completed projects.
F2	PEK-U01 PEK-U02	Assessment of prepare for laboratory exercises.
F3	PEK-U01 PEK-U02	Activity in laboratory classes.
P = 0,4*F1 + 0,3*F2 + 0,3*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Kasprzyk J., Programowanie sterowników przemysłowych, WNT
[2] Pawlak M., Sterowniki Programowalne, e-skrypt, ed. Politechnika Wrocławska, Wrocław 2010, available in Dolnośląska Biblioteka Cyfrowa,

SECONDARY LITERATURE
[1] Flaga S., Programowanie sterowników PLC w języku drabinkowym, BTC, Legionowo 2010
[2] Weigmann J., Kilian G., Decentralization with PROFIBUS-DP, Publicis MCD Verlag, Erlangen 2000
[3] Solnik W., Zajda Z., Komputerowe sieci przemysłowe Profibus DP i MPI, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2004.
[4] Laboratory instruction set, supplementary materials for the lecture, a set of technical documentation of PLCs.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming of distributed control systems based on PLC
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W10, K1MTR_W17, K1MTR_W33	C1	Lec1 Lec2 Lec3 Lec4	N1 N5
PEK_W02	K1MTR_W10, K1MTR_W17, K1MTR_W33	C2	Lec3-Lec7	N1 N5
PEK_U01	K1MTR_U15, K1MTR_U20, K1MTR_U38	C2, C3	Lab2-Lab7	N1, N2, N3, N4
PEK_U02	K1MTR_U15, K1MTR_U20, K1MTR_U38	C2, C3	Lab2-Lab7	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Marcin Pawlak email: marcin.pawlak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie MES w mechatronice**
Name in English: **FEM modelling in mechatronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has basic knowledge about differential calculus.
2. Student has basic knowledge about electrodynamics (electrostatics, electric current, magnetostatics, magnetic induction, electromagnetic waves)
3. Student is able to utilize theory of electromagnetic field to assess physical quantities.

SUBJECT OBJECTIVES

C1. Description of electromagnetic phenomena in electrical machines and devices.
C2. Introduction to universal method of computation of field (by finite element method) as a tool to evaluate induction, force and power loss parameters.
C3. Introduction to field analysis and designing of electrical machines and devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student is able to utilize commercial software to field and circuit-field computation.
PEK_U02 - Student is able to design 2-D field and circuit-field model of electrical machines and devices.
PEK_U03 - Student is able to assess results of computations of electromagnetic field.

III. Relating to social competences:
PEK_K01 - Student is able to cooperate in a teamwork for various roles.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Basic terms of electrodynamics and definitions of physical quantities.	2
Lab2	Principles of software to compute fields by finite element method. Training of simple software to compute electromagnetic fields (QuickField and FEMM).	2
Lab3	Construction of field model of electromagnetic device (QuickField and FEMM).	2
Lab4	Geometry construction of simple electrical device and material parameters of its elements.	2
Lab5	Mesh generation. Investigation of mesh quality on the computation results.	2
Lab6	Computation of magnetic field distribution on simple models of electrical devices.	2
Lab7	Analysis of numerical computation results. Methods of results presentation.	2
Lab8	Analysis of field computation results. Integral quantities computation (induction, force, torque).	2
Lab9	Planar-parallel model of device supplied by DC current.	2
Lab10	Planar-parallel model of device with permanent magnet.	2
Lab11	Field axial-symetrical model of electric device supplied by permanent magnets or DC current.	2
Lab12	Computation of magnetic field distribution and electromagnet parameters.	2
Lab13	Computation of magnetic field distribution and DC current actuator parameters.	2
Lab14	Computaion of magnetic field distribution and permanent magnet synchronous machine torque. Teamwork.	2
Lab15	Grades.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Turowski J., Obliczenia elektromagnetyczne elementów maszyn i urządzeń elektrycznych, WNT, Warszawa 1982

SECONDARY LITERATURE

Bianchi N., Electrical machine analysis using finite elements, CRC Taylor&Francis, Boca Raton, 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
FEM modelling in mechatronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U01	C3		N1
PEK_U02	K1MTR_U13	C3		N1
PEK_U03	K1MTR_U02	C3		N1
PEK_K01	K1MTR_K03	C3		N1

SUBJECT SUPERVISOR

dr hab. inż. Ludwik Antal tel.: 71 320 32 63 email: ludwik.antal@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Cyfrowe przetwarzanie sygnałów**
Name in English: **Digital signal processing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036103**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical knowledge of Laplace and Fourier transforms
2. Basic ability to programming in C and Matlab

SUBJECT OBJECTIVES

C1. Understanding and applying issues of digital signal processing
C2. Description and analysis digital systems in time and frequency domain
C3. Project and implementation of simple digital systems
C4. Effective working in groups, focused on creativity and collaboration

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has ordered knowledge of digital signal processing including: sampling theory, mathematical description and analysis of discrete systems in the time domain and frequency

II. Relating to skills:
PEK_U01 - Able to be used mathematical tools in programming environments for the description and analysis of digital signal processing problems
PEK_U02 - Able to design and implement the correct algorithms for digital signal processor

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, program, bibliography, conditions for course crediting, basic definitions and examples, discrete signals (mathematical model of discrete signal, the signal spectrum, aliasing)	2
Lec2	Discrete-time systems, LTI systems properties, models of systems, difference equations, convolution, impulse response, block diagrams, state space, systems classification, analog-to-digital conversion, periodic sampling, examples, sampling theorem, sampling of band pass signals.	2
Lec3	The z-transform, introduction, definition of the z-transform, relationship between the z-transform and the Laplace transform, basic properties. The inverse z-transform, methods and examples, partial fraction expansion, contour integration, region of convergence, solved problems.	2
Lec4	Using z-transform, transform analysis of systems, solving difference equations, system function, stability and causality. The discrete Fourier transform (DFT), introduction, definition and properties of the DFT, examples, relationship between the z-transform and the DFT. The inverse discrete Fourier transform (IDFT), overlapping effect, windows methods, and frequency resolution.	2
Lec5	Digital filters, introduction, notations, structures for FIR and IIR systems, the zero-pole method for filter design, filter specifications and classification, examples of filters.	2
Lec6	FIR filters, linear phase FIR design using windows, properties, design procedures, examples. IIR filters, introduction, structures for IIR filters, IIR filters design, impulse-invariant transformation, bilinear transformation.	2
Lec7	The Fast Fourier Transform, relationship between the FFT and the DFT, FFT algorithm, introductions, examples, radix-2 decimation-in-time FFT.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory organization, conditions for course crediting, group division.	1
Lab2	Signal processor programming - introduction (Signal Processor)	2

Lab3	Analog-to-digital conversion (Matlab)	2
Lab4	Generation of signals, real-time processing (Signal processor)	2
Lab5	Spectral analysis, FFT (Signal Processor)	2
Lab6	Digital filters (Matlab)	2
Lab7	Digital filters (Signal Processor)	2
Lab8	Corrections and evaluation of the course	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	oral answers
F2	PEK_U02	laboratory reports
P = 0.2*F1+0.8*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

T. P. Zieliński „Cyfrowe przetwarzanie sygnałów", 2005
A. V. Oppenheim, R. W. Schafer „Cyfrowe przetwarzanie sygnałów" 1989
R. G. Lyons „Wprowadzenie do cyfrowego przetwarzania sygnałów" 1999

SECONDARY LITERATURE

G. Marven, G. Ewers „Zarys cyfrowego przetwarzania sygnałów" 1999
W. Brodziewicz, K. Jaszczak „Cyfrowe przetwarzanie sygnałów" 1987
R. Gabel, R. Roberts „Sygnały i systemy liniowe" 1978
K. Steiglitz „Wstęp do systemów dyskretnych" 1977

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Digital signal processing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W21	C1, C2	Le1-8	N1
PEK_U01	K1MTR_U21	C3	La1-8	N2,N3,N4
PEK_U02	K1MTR_U22	C3	La1-8	N2,N3,N4

SUBJECT SUPERVISOR

dr hab. inż. Jacek Rezmer tel.: 71 320 2006 email: jacek.rezmer@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiały aktywne**
Name in English: **Active materials**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. KNOWLEDGE
1. Has a basic knowledge in physics, chemistry and materials science.
2. Has a basic knowledge in the field of metrology, including evaluation of the uncertainty of measurements.
2. SKILLS
1. Can apply knowledge of physics, chemistry and materials science to qualitative and quantitative analysis of the physical aspects of engineering problems.
2. Can estimate the uncertainty of measurements of electrical and non-electrical quantities made in laboratory conditions.
3. OTHER COMPETENCES
1. Understands the need to study the chosen field of study.
2. Understands the need for continuous life-long learning to master professional, social and competences.

SUBJECT OBJECTIVES

C1. To familiarize the student with the types, properties and applications of active and intelligent materials.
C2. To familiarize the student with the latest world trends and achievements in research on active and intelligent materials.
C3. To gain practical skills and knowledge of experimental characterization of selected properties of active and intelligent materials .

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Being able to explain the concept of active and intelligent materials, name and characterize their types in detail.
PEK_W02 - Iis able to provide and explain the physical phenomena responsible for the operation and functions of active and intelligent materials.
PEK_W03 - Is able to provide examples of application of active and intelligent materials in mechatronic systems and transducers.

II. Relating to skills:
PEK_U01 - Can experimentally determine the selected properties of active and intelligent materials.
PEK_U02 - Is able to interpret the results of experimental work carried out in the field of active and intelligent materials.
PEK_U03 - Can, on the basis of the obtained results and their conclusions, assess whether active material or a transducer using such material complies with the requirements of mechatronic system.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction: requirements and how to pass. Active , smart, multifunctioinal materials- basic concepts. An overview of the kinds of active materials. Color-changing materials. Electrochromic materials. E-paper.	2
Lec2	Light-emitting materials. Chemo-and electroluminescence.	2
Lec3	Shape-changing materials. Magneto- and electrostrictive materials, piezomaterials. Artificial muscles. Electroactive polymers.	2
Lec4	Electrothermal and thermoresponsive materials . Thermochromic materials. The viscosity-changing materials. Ferrofluids and materials displaying electroreology-related phenomena.	2
Lec5	Self-assembling and self-repairing materials. Biomaterials as matrices. Microcapsules.	2
Lec6	Materials sensitive to changes in pH. Polymer gels. Superhydrophobic, oleophobic and self-cleaning materials.	2
Lec7	MEMS and NEMS structures. Biomimetic materials.	2
Lec8	Final test.	1

		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction: requirements and how to pass. Overview of individual lab exercises. Health and safety training.	1
Lab2	Experimental characterization of electroactive polymer.	3
Lab3	Experimental characterization of piezoelectric material.	3
Lab4	Experimental characterization of electroluminescent material.	3
Lab5	Experimental characterization of electrothermal and thermoresponsive material.	3
Lab6	Extra laboratory exercise. Credition.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. case study
N3. laboratory experiment
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	short written tests, oral questioning
F2	PEK_U01-PEK_U03	reports of all scheduled and carried out lab exercises
P = 0,5*F1+0,5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Brian Culshaw, Smart structures and materials, Boston ; London : Artech House, cop. 1996
[2] Smart materials / ed. by Mel Schwartz, Boca Raton: CRC Press, Taylor & Francis Group, 2009
[3] Nanoengineering of structural, functional, and smart materials / ed. by Mark J. Schulz, Ajit D. Kelkar, and Mannur J. Sundaresan, Boca Raton, CRC Press, 2006.

SECONDARY LITERATURE

[1] Smart polymers: applications in biotechnology and biomedicine / ed. by Igor Galaev, Bo Mattiasson. 2nd ed., Boca Raton: CRC Press; 2008
[2] Theory and phenomena of metamaterials / ed. by Filippo Capolino, Boca Raton: CRC Press / Taylor & Francis Group, 2009
[3] Jerzy Wiciak, Wybrane zagadnienia redukcji drgań i dźwięków strukturalnych (Selected aspects of structural vibrations and sounds reduction), Kraków AGH Uczelniane WydawnictwaNaukowo-Dydaktyczne, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Active materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W02	C1, C2	Lec1-Lec7	N1, N2, N5
PEK_W02	K1MTR_MAP_W02, K1MTR_W02	C1, C2	Lec1-Lec7	N1, N2, N5
PEK_W03	K1MTR_MAP_U02	C1, C2	Lab1-Lab6	N1, N2, N5
PEK_U01	K1MTR_MAP_U02, K1MTR_U03, K1MTR_U24	C3	Lab1-Lab6	N3, N4, N5
PEK_U02	K1MTR_MAP_U02, K1MTR_U02, K1MTR_U22	C3	Lab1-Lab6	N3, N4, N5
PEK_U03	K1MTR_MAP_U02	C3	Lab1-Lab6	N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Paweł Żyłka tel.: 2659 email: pawel.zylka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma seminar**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037018**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS points in required range

SUBJECT OBJECTIVES

C1. Gaining ability to present own qualifications, knowledge, skills and social competences.
C2. Straightening the ability to think critically and work in team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is able to think critically and work in team.

III. Relating to social competences:
PEK_K01 - Introduction, general information about Master’s thesis and master's examination.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, general information about Master’s thesis and master's examination.	2
Sem2	Rules of proper technical and scientific paper preparation.	2
Sem3	Rules of proper multimedia presentation preparation, especially for master's examination.	2
Sem4	Review of current knowledge, aim and scope of individual diploma thesis – students presentations.	6
Sem5	Reports from progress in realization of students work – students presentation.	10
Sem6	Multimedia presentation of students prepared for diploma examintation – students presentation.	6
Sem7	Summary.	2
		Total hours: 30

TEACHING TOOLS USED

N1. Informative lecture
N2.
N3.
N4.
N5. Tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_K01	The appreciation of skill of solving in range of qualifying work the technical problems and their multimedia introduction as well as the leadership of discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08	C1		N1 - N5
PEK_K01	K1MTR_K04, K1MTR_K06	C2		N1 - N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Michał Lisowski email: michal.lisowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyka w budynku**
Name in English: **Building automation**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. In the scope of knowledge:
1.Student has the basic knowledge about the topology as well as elements of the electrical installation.
2.Student has the basic knowledge about the construction, the purpose of the switches and protection used in electrical installations.
3.Student has the well-ordered knowledge about the questions of the protection of the over-current as well as of the over-voltage in electrical installations of the building trade communal objects.
2. In the scope of know-how:
1.Student is able to create the supplementary schema of given circuit in the electrical installation as well as to count of the short-currents 1-phase and 3-phase.
2.Student is able to choice the basic parameters of the low-voltage electrical installations, as well as to use these parameters.
3.Student is able to use of the basic equipment and the software of the computer.
4.Student is able to gain the information form literature, data base as well as another sources.
3. In the scope of the competence:
1.Student understands the need and knows possibility self-education, to improve the professional, personal and socially competences.
2.Student conscious of the responsibility to assume his work as well as the readiness to subordinate to the rules work in the team and responsibility to in common realized task.

SUBJECT OBJECTIVES

C1. Understanding as regards to consist the idea building automation, intelligent building, system technique building and intelligent installation.
C2. Understanding of possibility to application the manner and technique knows from physics, electrotechnics as well as the digital transmission used to manage and to work the building automation.
C3. Acquirement the knowledge in the scope of topology, construction and structure logical representative of the systems intelligent installation as well as the learning the tool software used for the configuration of the installation.
C4. Acquirement the practical know-how of the planning and set the simple arrangements of intelligent installations in motion, in given system of the building automation by the use products of different manufacturers.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student understands the fundamental foundations of the building automation, building management system and intelligent installations.
PEK_W02 - Student has the basic knowledge about systems of the intelligent installations used in the practice, he knows advantages and short-coming these systems, to be able them objective compare.
PEK_W03 - Student has the knowledge about the catalogue basis of the equipment used in the traditional as well intelligent electrical installations.

II. Relating to skills:
PEK_U01 - Student is able to create a project of intelligent installation in the select system building automation, to programme, to test as well to insert of change in the system function.
PEK_U02 - Student is able to project as well to select devices (elements) of intelligent installation in the given building automation.
PEK_U03 - Student is able to elaborate the project specification of a scope intelligent installation in a select building automation.

III. Relating to social competences:
PEK_K01 - Student is able to co-operation in the team at realization of the make plans.
PEK_K02 - Student is able to think as well to work in the manner enterprising, as the man of initiative.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Preliminary information about the building automation, the building management system (BMS), the position of intelligent installations. Relay systems of the intelligent installation.	2
Lec2	Digital systems of control in the intelligent installations. Bus-bars system and manners of the code and the data transmission.	2
Lec3	General characterize of the system KNX. Topology of the system KNX. Division and the construction of the bus-device and the system-device. Physical address of the bus-device.	2
Lec4	Structure of the telegram and the manner of code in the system KNX.	2

Lec5	Structure logic in the system KNX. The groups address. Connection of the communications objects of the bus-devices in the group addresses. Tool program ETS (Engineering Tool Software), start of the installation.	2
Lec6	General characterize of the system LCN. Description of the module, topology of the installation. Tool software LCN-PRO. The example illustrative utilization of the system LCN.	2
Lec7	Intelligent wire-less system (xComfort, Fibaro).	2
Lec8	Colloquium for the course.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introductory classes. Settlement of the project content which were realized by the student. Display of the ready project, announcement of the bibliography and the credit for a course.	2
Proj2	Distribute of the exercises of project. Discussion of the manner of the calculation 3-phase and 1-phase short-currents.	2
Proj3	Selection of the cross-section of wires in a traditional electric installation, selection of the protection against over-current as well against over-voltage.	2
Proj4	Gradation and selection of the over-current protection in the particular unit of the electrical installation. Criterion of the terms to get warm in the conditions of overloads as well of short-currents. Test of the protection against an electric shock.	2
Proj5	Display of the system KNX and tool software ETS. Elaboration of the topology in the programme ETS. Exercises with utilization of the programme ETS.	2
Proj6	Elaboration of the logical structure in the system KNX. Putting of the group address and address groups.	2
Proj7	Connection of the communications objects of the bus-devices in the group addresses.	2
Proj8	Selection of the bus-devices in the project and they part in the building automation.	2
Proj9	Connection of the individual parts of intelligent installation in the system KNX in one whole in accordance with demands building automation.	2
Proj10	Elaboration of the tables with group addresses and physical addresses, utilization which follows in the specification of the project.	2
Proj11	Display of the system LCN and tool software LCN-PRO. Exercises at utilization the tool software LCN-PRO.	2
Proj12	Utilization of the programme LCN-PRO in the project to realization definite tasks.	2
Proj13	Elaboration the specification of the project in the traditional part of installation.	2
Proj14	Elaboration the specification of the project in the intelligent part of installation.	2
Proj15	Credit for a course of project.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - preparation for project class
N3. project presentation
N4. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01	Lec1, Colloquium
F2	PEK-W02	Lec2, Lec3, Lec4, Lec5, Lec6, Colloquium
F3	PEK-W03	Lec4, Lec5, Lec6, lec7, Colloquium
P = 0,5F1+0,6F2+0,4F3+0,6F4+0,5F5+0,5F6+0,6F7		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-U01	Proj1 - Proj7 Appreciation of the calculation part of the project
F2	PEK-U02, PEK-U03, PEK-K01, PEK-K02	Proj8 - Proj14 Appreciation of the calculation part of the project, the discussion with student
P = 0,7F2+0,7F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Markiewicz H., Instalacje elektryczne, WNT, Warszawa, 2007.

SECONDARY LITERATURE
Klajn A., Bielówka M.: Instalacja elektryczna w systemie KNX/EIB. Handbook INPE for electricians, SEP-COSiW, Warszawa, 2006.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Building automation
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK-W01	K1MTR_MAP_W03, K1MTR_MAP_W06, K1MTR_W19, K1MTR_W20	C1, C2.	Lec1, Lec2	N1, N2, N4
PEK-W02	K1MTR_MAP_W03, K1MTR_MAP_W06, K1MTR_W22, K1MTR_W27	C1, C2, C3.	Lec2, Lec3, Lec4, Lec6, Lec7	N1, N2, N4
PEK-W03	K1MTR_MAP_W06, K1MTR_W19, K1MTR_W20	C3, C4	Lec5, Lec6, Lec7	N1, N3, N4
PEK-U01	K1MTR_MAP_U04, K1MTR_MAP_U06	C4	Proj10, Proj12, Pr0j13, Proj14	N1, N3, N4
PEK-U02	K1MTR_MAP_U06, K1MTR_MAP_U08	C3, C4	Proj10, Proj12, Pr0j13, Proj14	N1, N3, N4
PEK-U03	K1MTR_MAP_U04, K1MTR_MAP_U06	C3, C4	Proj10, Proj12, Pr0j13, Proj14	N1, N3, N4
PEK-K01, PEK-K02	K1MTR_K01, K1MTR_K02	C4.	Proj1 - Proj14	N1, N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Antoni Klajn tel.: 71 320 34 24 email: antoni.klajn@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody numeryczne**
Name in English: **Numerical methods**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge about mathematical analysis and linear algebra
Has basic knowledge about developing algorithms and computer programming
2. Is able to write computer C programmes based on given algorithm
3. Recognises the need of continuous education, developing professional, personal and social competences and it able to define opportunities to do so

SUBJECT OBJECTIVES

C1. Introduction to selected numerical computational techniques for engineering purposes
C2. Preparation for problem solving in a design team
C3. Introduction to methods of algorithmization of computational procedures, monitoring and controlling of technological processes.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is able to source information about selecting numerical methods and procedures necessary to solve elementary engineering problems, from literature, databases and other sources
PEK_U02 - Is able to draft documentation describing execution of an engineering task and prepare a text discussing its results

III. Relating to social competences:
PEK_K01 - Is able to think and action in a creative and enterprising manner.
PEK_K02 - Is able to evaluate design team performance and perform a critical analysis.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Conversion and standardisation of floating-point numbers.	2
Proj2	Summation of infinite alternating trigonometric numerical series using the method of partial sum averaging as modified by Gill-Moler (G-M)	2
Proj3	Solving the Dirichlet electrostatic problem for two-dimensional geometrical areas (examples: Laplace's and Poisson's equation)	2
Proj4	Students in groups of two select a single project problem concerning application of computational techniques in engineering problems. Each project consists of the following stages: theoretical breakdown, algorithmization and programming, launching and testing the end-user application, preparing documentation. Project problems are different every year and are not repeated.	9
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. self study - preparation for project class
N3. tutorials
N4. case study
N5. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02	
F2	PEK_U01,PEK_U02 PEK_K01,PEK_K02	
P = 0.15F1+0.85F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Metody numeryczne, G.Dahlquist, A.Bjork, PWN (wydanie dowolne)
[2] Przegląd metod i algorytmów numerycznych - cz.1 i 2, J.i M. Jankowscy, WNT
[3] Wstęp do programowania systematycznego, N.Wirth, WNT (wydanie dowolne)
[4] Platforma edukacyjna: http://eportal.eny.pwr.wroc.pl
[5] Netografia

SECONDARY LITERATURE

[1] Algorytmy + struktury danych..., N. Wirth, WNT (wydanie dowolne)
[2] Macierze w automatyce i elektrotechnice, T.Kaczorek, WNT (wydanie dowolne)
[3] Handbook of mathematical functions, M. Abramowitz, I.Stegun, Washington 1964,
(Wydanie rosyjskie dostępne w czytelni Biblioteki Głównej PWr)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 PEK_U02	K1MTR_U01	C1,C2,C3	Pr1,Pr2,Pr3, Pr4	N1,N2, N3,N4,N5
PEK_K01 PEK_K02	K1MTR_K04, K1MTR_K06	C1,C2,C3	Pr4	N1,N2, N3,N4,N5

SUBJECT SUPERVISOR

doc. dr inż. Jarosław Szymańda tel.: 2625 email: jaroslaw.szymanda@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie cienkowarstwowe**
Name in English: **Thin-layer technologies**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037203**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the foundations of physics .
2. Has a basic knowledge of the materials science engineering

SUBJECT OBJECTIVES

C1. Understanding the physical basis of the generation and measurement of the vacuum.
C2. Understanding the technology of thin films .
C3. Knowledge of contemporary developments in the field of electrical materials technology .

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows basics of vacuum technology
PEK_W02 - Has a basic knowledge of the technology of thin films .
PEK_W03 - Has a basic knowledge of contemporary developments in the field of electrical materials technology .

II. Relating to skills:
PEK_U01 - Is able to select the right technology for obtaining layers of given chemical and physical parameters .
PEK_U02 - Is able to select the appropriate layer for specific applications in industry.
PEK_U03 - Is able to use vacuum techniques in thin film technologies .

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Acquainted with the subject , the requirements and the test requirements. Basic laws , definitions and concepts of thin-film techniques .	2
Lec2	Electrodeposition of layers	4
Lec3	Fundamentals of vacuum technology and vacuum measurement methods	4
Lec4	Chemical vapour deposition	6
Lec5	Physical vapour deposition	8
Lec6	Plasma methods of obtaining carbon layers .	2
Lec7	Methods of test for the basic parameters of the layers.	2
Lec8	Technologies for substrates preparation.	1
Lec9	Final test	1
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Vacuum evaporation	3
Lab2	The use of electron beam	3
Lab3	Preparation of carbon coatings by magnetron sputtering	3
Lab4	Preparation of high melting layers by magnetron sputtering .	3
Lab5	Plasma polymerisation	3
Lab6	Polymerization in the plasma at a frequency of 26 MHz .	3
Lab7	Reactive processes - obtaining oxide layers	3
Lab8	The study of electrical properties of thin films	3
Lab9	Spectrophotometric study of the chemical composition of the plasma.	3
Lab10	Additional classes	3
		Total hours: 30

TEACHING TOOLS USED
N1. problem lecture N2. multimedia presentation N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
F3	PEK_W03	test
P = O,4F1+0,3F2+0,3F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_UO1	test, lab report
F2	PEK_UO2	test, lab report
F3	PEK_UO3	test, lab report
P = O,4F1+0,3F2+0,3F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Kordus A., Plazma w technice, Wydawnictwo Uczelniane Politechniki Poznańskiej, Poznań, 1973[2] Burakowski T., Wierzchoń T., Inżynieria powierzchni, WNT, Warszawa 1995[3] Miernik K., Działanie i budowa magnetronowych urządzeń rozpylających, Radom 1999[4]Tracton A. A., Coating materials and surface coatings, CRC Press 2006

SECONDARY LITERATURE

[1]Posadowski W.M.: Niekonwencjonalne Układy magnetronowe do próżniowego nanoszenia cienkich warstw, Oficyna wydawnicza Politechniki Wrocławskiej, Wrocław 2001[2]Grill A., Cold plasma in materials fabrication, IEEE PRESS1994

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Thin-layer technologies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W07, K1MTR_W02	C1	Wy1, Wy3	N1, N2
PEK_W02	K1MTR_MAP_W07, K1MTR_W18	C2, C3	Wy2, Wy2, Wy4, Wy5, Wy6, Wy7, Wy8	N1, N2
PEK_W03	K1MTR_MAP_W07, K1MTR_W18	C2,	Wy2, Wy2, Wy4, Wy5, Wy6, Wy7, Wy8	N1, N2
PEK_UO1	K1MTR_U02	C1,	La1	N3
PEK_UO2	K1MTR_U03	C2, C3	La1, La2, La3, La4, La5, La6, La8, La9,	N3
PEK_UO3	K1MTR_U03	C2, C3	La1, La2, La3, La4, La5, La6, La8, La9,	N3

SUBJECT SUPERVISOR

dr inż. Jan Ziaja tel.: 38-27 email: jan.ziaja@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia i paliwa alternatywne**
Name in English: **Chemistry and Green Fuels**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMC041401**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals knowledge of the vehicle design and operation.
2. Fundamentals of chemistry.
3. Ability to exercise independent laboratory tests, supported by elemental manual dexterity. Basic knowledge of preservation of health and safety in the laboratory.

SUBJECT OBJECTIVES

C1. Understanding problems of manufacturing and using motor fuels including biofuels.
C2. Knowing the physical and chemical properties of biofuels and their production methods in the industry.
C4. Determination of biofuels using standardized analytical methods applied in the laboratory.
C5. Understanding the relationships between operation of vehicle and environmental issues.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowing the concepts of chemical and technological processes of production and use of biofuels.
Having knowledge on material and energy balances.
Recognition of the information data base of resources for production of biofuels and their products.
PEK_W02 - Being able to identify, describe and characterize the main sources of biofuel raw materials and standard fuels.
Knowing the properties of biofuels and basic rules for the selection of biofuels as fuels to supply drive systems.
Depth knowledge of the operating characteristics of fuels in vehicles.
PEK_W03 - Able to define the basic types of chemical processes used in the synthesis of biofuels.
Describing the core technology processes for the production of biofuels.
Knowing process of waste management, especially fuels and biofuels.

II. Relating to skills:
PEK_U01 - Ability to organize and carry out tests of physical and chemical properties of fuels.
Designing a technological process of biofuels as well as perform calculations of chemical balance.
Drawing conclusions from references.
Being able to make a presentation discussing key issues in manufacturing biofuels.
Providing critical substantive assessment of the technologies applied in the industry in terms of economic and environmental impacts, product quality and social factors.
Developing skills of knowledge through lifelong learning.
PEK_U02 - Able to plan and carry out a simple test for the determination of basic physical biofuels factors.
Respecting the safety rules in the laboratory.
Knowing how to calculate and interpret the tests results.
PEK_U03 - Performing basic operations in the chemical laboratory, carrying out chemical tests, recording their progress and drawing conclusions.
Using simple measurement tools.
Evaluating the quality of the energy carrier and describing its usefulness.

III. Relating to social competences:
PEK_K01 - Able to put into practice the theoretical knowledge and apply held skills.
PEK_K02 - Predicting the impacts of use of fuel for vehicles and the environment.
PEK_K03 - Understanding the need for formulating and providing the public with information and advice regarding use of biofuels.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction.	1
Lec2	Properties, classification and identification of petroleum products.	2
Lec3	Testing methods of properties of petroleum products.	3
Lec4	Properties, classification and identification of biofuels.	2
Lec5	Methods for producing biogas fuels.	2
Lec6	Natural gas and liquid fuels produced from natural gas.	2
Lec7	. Methanol, ethanol and other alcohols - properties and manufacturing.	3
Lec8	Blends of alcohol and gasoline - properties and manufacturing.	2
Lec9	Liquid fuels derived from coal processing – properties and manufacturing.	2

Lec10	Hydrogen - properties and manufacturing.	2
Lec11	Biodiesel - properties and manufacturing.	3
Lec12	Fuels other than alcohol coming from biological materials - properties and manufacturing.	2
Lec13	Properties of fuel additives.	1
Lec14	Problems of transportation, storage and distribution of green fuels.	1
Lec15	Liquefied petroleum gas (LPG) - properties and manufacturing.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Fuel sampling methodology.	1
Lab2	Gas density measurement by Schilling's method.	2
Lab3	Determination of CNG components.	3
Lab4	Designation of fractional composition of gasoline by distillation.	2
Lab5	Determination of the density and resin content in gasoline.	2
Lab6	Designation of fractional composition diesel fuel by distillation method.	2
Lab7	Designation of density and viscosity of biofuels.	2
Lab8	Cetan number calculation for biofuels and diesel oil.	2
Lab9	Preparation of methyl ester of rapeseed oil.	2
Lab10	Determination of residue after incineration of biofuels.	3
Lab11	Determination of low-temperature properties of biofuels.	3
Lab12	Determination of the corrosion resistance of fuel B-10.	2
Lab13	Designation of fuel ignition temperature B-10 fuel.	2
Lab14	Determination of the anilin point for B-10 fuel.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. multimedia presentation
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	written exam

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K03	written test
F2	PEK_U01-PEK_U03 PEK_K01-PEK_K03	report
P = F1 x 0,5 + F2 x 0,5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Kułażyński Marek: Green fuels, Automotive Engineering, Wrocław University of Technology; 2011, pp.103.
2. Kułażyński Marek, Sroka Zbigniew J: Green fuels laboratory, Automotive Engineering, Wrocław University of Technology, 2011. pp. 76.
3. Monagham M.L.; Future Gasoline and Diesel Engines, Fisita World, Seoul 2000
4. Pandit G.P.; Alternative Fuels for Future Vehicles, Automotive Engineering 1, 1996
5. Study material in hard copy and electronic version of Module_4 at the European Project Curriculum Development called CarEcology: “New Technological and Ecological Standards in Automotive Engineering”27876-IC-1-2005-1-BE-Erasmus-PROGUC-1, website http://project.iwt.kdg.be/cdcarecology
6. E.M. Goodgeer, Hydrocarbon Fuels, The Macmillan Press Ltd. 1995.
7. J. G. Speight The Chemistry and Technology of Petroleum Marcel Dekker Inc New York 1991

SECONDARY LITERATURE
1. UOP Laboratory Test Method for Petroleum and Its Products, Universal Oil Products Company DES Plained, Ilinois 2000
2. ASTM Standards on Petroleum Products and Lubricants , American Society for Testing Materials Philadelphia 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Chemistry and Green Fuels
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K2MBM_AE_W02, K2MBM_AE_W05, K2MBM_AE_W09	C1, C2, C3, C4	Lec1 to Lec15	N1, N4, N5
PEK_W02	K2MBM_AE_W02, K2MBM_AE_W05, K2MBM_AE_W09	C1, C2, C3, C4	Lec1 to Lec15	N1, N4, N5
PEK_W03	K2MBM_AE_W02, K2MBM_AE_W05, K2MBM_AE_W09	C1, C2, C3, C4	Lec1 to Lec15	N1, N4, N5
PEK_U01	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U04, K2MBM_AE_U10	C1, C2, C3, C4	Lab1 to Lab14	N2, N3
PEK_U02	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U04, K2MBM_AE_U10	C1, C2, C3, C4	Lab1 to Lab14	N2, N3
PEK_U03	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U04, K2MBM_AE_U10	C1, C2, C3, C4	Lab1 to Lab14	N2, N3
PEK_K01	K2MBM_AE_K05, K2MBM_AE_K06, K2MBM_AE_K07, K2MBM_AE_K09	C1, C2, C3, C4	Lab1 to Lab14	N2, N3, N4, N5
PEK_K02	K2MBM_AE_K05, K2MBM_AE_K06, K2MBM_AE_K07, K2MBM_AE_K09	C1, C2, C3, C4	Lab1 to Lab14	N2, N3, N4, N5
PEK_K03	K2MBM_AE_K05, K2MBM_AE_K06, K2MBM_AE_K07, K2MBM_AE_K09	C1, C2, C3, C4	Lab1 to Lab14	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Marek Kułażyński tel.: 71 320-62-02 email: marek.kulazynski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elektronika**
Name in English: **Electronics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMD031001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics, electrical engineering and chemistry at the high school level.
2. Ability to measure the basic electrical quantities.

SUBJECT OBJECTIVES

C1. Understanding the physical phenomena occurring in semiconductors.
C2. Understanding the construction's principles and applications of selected semiconductor devices and integrated circuits (analog and digital).
C3. Understanding the construction's principles and applications of basic electronic devices (power supplies, amplifiers, analog to digital converter, digital to analog converter, digital oscilloscope).
C4. Acquiring the ability to choose the active and passive electronic elements for specified applications (for construction of sensors used in mechanics).
C5. Usage of the acquired knowledge, presented during the lecture, for solving technical issues.
C6. Learning how to study the technical literature and to prepare the student for self-education.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has expertise in the field of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including the knowledge necessary to understand the basic physical phenomena occurring in electronic components and circuits and in their environment/surrounding.
PEK_W02 - The student understands the physical basis of the operation of semiconductor devices and the importance of their parameters.
PEK_W03 - The student has knowledge of the digital logic systems.

II. Relating to skills:
PEK_U01 - The student has the ability to choice the materials, components and equipment's construction according to the technical requirements and operating conditions.
PEK_U02 - The student can properly apply semiconductor devices in static and dynamic systems.

III. Relating to social competences:
PEK_K01 - The student understands the need for the use of new techniques and technologies in engineering activities and is able to identify goals and anticipate the effects of undertaken experimental work.
PEK_K02 - The student can work independently and in a team.
PEK_K03 - The student is able to select the priorities for fulfillment of the given task.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Development trends in electronics.	2
Lec2	Signals applied in electronics: analog and digital (description of the fundamentals of the signals).	2
Lec3	Description of the electronic components. Resistors, capacitors, semiconductor sensors (thermistors and photo-resistors).	2
Lec4	Physical principles of semiconductor electronic components.	2
Lec5	Outline of the technology of semiconductor devices.	2
Lec6	P-N junction: the mechanism of the formation of the junction, the direct current I-V characteristics of the diode.	2
Lec7	The temperature's and light's effect on the parameters of the p-n junction. Semiconductor sources and detectors of optical radiation: LED, laser diode, semiconductor lasers, photodiode, optocoupler).	2
Lec8	Bipolar transistors: design, operation principles, configurations, static characteristics, small-signal parameters.	2
Lec9	Electronic amplifiers: classification, one-stage low frequency amplifier in common emitter topolgy, operational amplifier.	2
Lec10	Thyristor - the semiconductor switching device: construction, operation principles, switching methods, static I-V characteristics, dynamic operation of the thyristor.	2
Lec11	Unipolar transistor: Field Effect Transistor, Junction Transistor - PNFET: the principle of operation, I-V characteristics, parameters.	2

Lec12	Unipolar transistor, Field Effect Transistor with Insulated Gate - MOSFET: principles of operation, I-V characteristics, parameters. Semiconductor DRAM memory.	2
Lec13	Digital Circuits: Basic logic functions, parameters. Logic gates of TTL and CMOS family: construction and parameters.	2
Lec14	Selected electronic devices: power supply systems, generators, oscilloscope, analog to digital and digital to analog converters.	2
Lec15	Final test	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture (Power Point presentation)
N2. Self-study
N3. Consultations
N4. Repetition of the presented material as a preparation for the laboratory classes
N5. Assessment of the laboratory classes: test regarding the knowledge about the topic of the exercise, report from the realized work during the classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

P. Hempowicz, R. Kiełsznia, A. Piłatowicz, J.Szymczyk i inni, Elektrotechnika i elektronika dla nieelektryków, WNT, 2004
A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1984
W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984
M. Polowczyk, A. Jurewicz, Elektronika dla mechaników, Wyd. Politechniki Gdańskiej, 2002

SECONDARY LITERATURE

M. Rusek, J. Pasierbiński, Elementy i układy elektroniczne w pytaniach i odpowiedziach, WNT, 1991
G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010
Ch. A. Schuler, Electronics. Principles & Applications, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W33	C1 - C4	Lec1 - Lec15	N1 - N3

SUBJECT SUPERVISOR

dr inż. Waldemar Oleszkiewicz email: waldemar.oleszkiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elektronika**
Name in English: **Electronics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMD032001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics, electrical engineering and chemistry at the high school level.
2. Ability to measure the basic electrical quantities.

SUBJECT OBJECTIVES

C1. Understanding the physical phenomena occurring in semiconductors.
C2. Understanding the construction's principles and applications of selected semiconductor devices and integrated circuits
C3. Understanding the construction's principles and applications of basic electronic devices (power supplies, amplifiers, analog to digital converter, digital to analog converter, digital oscilloscope).
C4. Usage of the acquired knowledge, presented during the lecture, for solving technical issues.
C5. Learning how to study the technical literature and to prepare the student for self-education.
C6. Acquiring the ability to choose the active and passive electronic elements for specified applications (for construction of sensors used in mechanics).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has expertise in the field of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including the knowledge necessary to understand the basic physical phenomena occurring in electronic components and circuits and in their environment/surrounding.
PEK_W02 - The student understands the physical basis of the operation of semiconductor devices and the importance of their parameters.
PEK_W03 - The student has knowledge of the digital logic systems.

II. Relating to skills:
PEK_U01 - The student has the ability to choice the materials, components and equipment's construction according to the technical requirements and operating conditions.
PEK_U02 - The student can properly apply semiconductor devices in static and dynamic systems.

III. Relating to social competences:
PEK_K01 - The student understands the need for the use of new techniques and technologies in engineering activities and is able to identify goals and anticipate the effects of undertaken experimental work.
PEK_K02 - The student can work independently and in a team.
PEK_K03 - The student is able to select the priorities for fulfillment of the given task.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Development trends in electronics.	2
Lec2	Signals applied in electronics: analog and digital (description of the fundamentals of the signals).	2
Lec3	Description of the electronic components. Resistors, capacitors, semiconductor sensors (thermistors and photo-resistors).	2
Lec4	Physical principles of semiconductor electronic components.	2
Lec5	P-N junction: the mechanism of the formation of the junction, the direct current I-V characteristics of the diode.	2
Lec6	Bipolar transistors: design, operation principles, configurations, static characteristics, small-signal parameters.	2
Lec7	Thyristor - the semiconductor switching device: construction, operation principles, switching methods, static I-V characteristics, dynamic operation of the thyristor.	2
Lec8	Unipolar transistor: Field Effect Transistor, Junction Transistor - PNFET: the principle of operation, I-V characteristics, parameters.	2
Lec9	Digital Circuits: Basic logic functions, parameters. Logic gates of TTL and CMOS family: construction and parameters.	2
Lec10	Final test	2
		Total hours: 20
Form of classes – Laboratory		Number of hours

Lab1	Introduction. Basic methods and measuring instruments. Description of the electronic components properties. Passive Components. I-V characteristics of the p-n junction (diode: universal, stabilization).	3
Lab2	Static characteristics of the bipolar transistor.	3
Lab3	The measurements of unipolar transistors: JFET and MOSFET transistors	3
Lab4	Additional term.	1
		Total hours: 10

TEACHING TOOLS USED

N1. Traditional lecture (Power Point presentation)
N2. Self-study
N3. Consultations
N4. Repetition of the presented material as a preparation for the laboratory classes.
N5. Assessment of the laboratory classes: test regarding the knowledge about the topic of the exercise, report from the realized work during the classes.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Marks from tests and reports from realized exercise
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
P. Hempowicz, R. Kiełsznia, A. Piłatowicz, J. Szymczyk i inni, Elektrotechnika i elektronika dla nieelektryków, WNT, 2004
A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1984
W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984

SECONDARY LITERATURE
Ch. A. Schuler, Electronics. Principles & Applications, McGraw-Hill, 2008
M. Rusek, J. Pasierbiński, Elementy i układy elektroniczne w pytaniach i odpowiedziach, WNT, 1991
G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01- PEK_W03	K1MBM_W33	C1 - C3	Lec1 - Lec10	N1 - N3

SUBJECT SUPERVISOR

dr inż. Waldemar Oleszkiewicz email: waldemar.oleszkiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska - geometria wykreślna**
Name in English: **Engineering graphics - descriptive geometry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031001 (MMM031301)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	30			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry
2. Student has ability to use of the drawing utensils.
3. Student has ability to draw basic geometric structures, such as division of a line's segment into n equal parts, plotting a regular hexagon.

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane as the basis for design recording (engineering drawing).
C2. Knowledge of the geometric structures restitution based on Monge's projections.
C3. Preparation for the design recording (engineering drawing) application.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge on geometric structure mapping onto drawing's plane using Monge's projection method and elementary knowledge in the field of axonometry.
PEK_W02 - Student can indicate an appropriate solution algorithm of mapping of the position and the relationship of the geometric formations in the space, as well as identifying the measures relationship.
PEK_W03 - Student can interpret the drawing, made by the Monge's method, showing localization of the element or geometric structure in the space.

II. Relating to skills:
PEK_U01 - Student can practically apply the principles of the Monge's projection method to map the elements and geometric structures (including solids) on the drawing plane.
PEK_U02 - Student can set the size of the dimensions characterized measuring tasks of geometry.
PEK_U03 - Student can provide restitution of the geometric structure on the basis of Monge's projectrion and submit the result by axonometric projection.

III. Relating to social competences:
PEK_K01 - Student is to work independently and solve problems involving Monge projection method.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions and principles of the parallel, rectangular projection by Monge's projection, the mapping of basic geometric elements (points, line, plane).	2
Lec2	Common elements - edges and breakdown points; parallel and perpendicular elements.	2
Lec3	Transformation of the position (rotation, revolved section, increasing of the revolved section) and the reference system transformation (additional projection plane).	2
Lec4	Solids - definitions; solid section as a set of common elements of the solid cutting plane, solid's breakdown points by a straight line.	2
Lec5	Cutting of the solids with projecting planes set - a modification of the initial solid's view, developed views.	2
Lec6	Penetration of the solids - transmission lines definition, the use of auxilliary cutting planes and reference system transformation.	2
Lec7	Projection in the three orthogonal planes; axonometry basis; completion of the missing solid projection - use of the axonometric projection.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Information on the drawing utensils and principles of the geometric structures drawing. Projection of a point and straight line, the mapping of a plane using her traces, identification of the basic elements localization in space using two orthogonal projection planes.	2

Cl2	Belonging of the basic geometric elements, completion of the missing projection; particular localization of the geometric elements.	2
Cl3	Edge as common element of two planes. Breakdown point as common element of straight line and plane. Particular cases of a common elements.	2
Cl4	Edge between flat figures (auxiliary projection planes application); breakdown point of the flat figure by straight line. Identification and construction of the parallel and orthogonal relationship between basic geometrical elements.	2
Cl5	Rotation and revolved section of the basic geometrical elements (rotation of a line's segment and plane); application of the localization transformation for measuring tasks (determination of the real size of a line's segment, angle, flat figure).	2
Cl6	Determination of the projections of plane geometrical structures with selected parameters and the desired position in space (increasing ofrevolved section of a plane figure). Application of the reference system transformation in measuring tasks and identification of the position (angle relative to the projecting plane, distance of the point from the plane, setting the points projections at a set distance from the plane).	2
Cl7	Test K1 (includes classes's 1 - 6 materal)	2
Cl8	The mapping of the elementary solids using Monge's projection, points and lin's segments belonging to the solid's walls identification; determination of the cross sections of polyhedra with projection planes.	2
Cl9	Determination of the polyhedra cross sections cutted by arbitrary planes. Determination of the cross section of the solids with surfaces. Solid's breakdown points by lines (use of auxiliary cutting planes containing penetrating straight line) determination.	2
Cl10	Developed view of a polyhedron and solid containing ruled surface. Cutting of the solid with projection planes as a modification of the initial form of solid - cutting of the polyhedron.	2
Cl11	Cutting of a solid of revolution. Polyhedra transmission lines determination.	2
Cl12	Solids (containing surfaces) transmission lines determination.	2
Cl13	Solid mapping onto three orthogonal projectionl planes.	2
Cl14	Solid mapping using axonometric projection. Determination of the missing solid projection modified by cutting planes. Relationship between Monge's projection and axonometric projection.	2
Cl15	Test K2 (includes classes's 8 - 14 materal)	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		15
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. problem exercises
N3. tutorials
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01- PEK_W03,	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02,	test no. 1, good rating is needed (min. 3.0)
F2	PEK_U01, PEK_U02, PEK_U03,	test no. 2, good rating is needed (min. 3.0)
F3	PEK_K01	evaluation of n (sheets) projects preparation, n = min. 4 - max. 8, good rating of each project is needed, F2 = (P1 + ... Pn) / n
P = [(F1+F2)/2]*4/5+F3*1/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (and later edition),
[2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998,
[3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001,
[4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005.

SECONDARY LITERATURE

[1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (and later edition),
[2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997,
[3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997,
[4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering graphics - descriptive geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W14	C1, C2, C3	Lec1, Lec2-Lec7	N1, N3
PEK_UO1, PEK_UO2, PEK_UO3	K1MBM_U14	C1-C3	Cl1-Cl6, Cl8-Cl14	N2. N3. N4
PEK_K01	K1MBM_K05	C1-C3	Cl1-Cl6, Cl8-Cl14	N4

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia materiałów**
Name in English: **Materials chemistry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031002 (MMM031302)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. high school level

SUBJECT OBJECTIVES

C1. Introduction with chemistry sections usable over study of related courses (meterial scicnce, metallurgy, polymers)
C2. Introduction with basic chemical knowledge enabling of chemical rules and physicochemical properties of technical materials particularly metals, alloys and polymers

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student should have basic chemical knowledge associated with structure of matter, states of matter.
PEK_W02 - The student should have basic inorganic knowledge associated with the structure of metals, alloys, electron conductivity as well as basic organic knowledge associated with fuels and polymers
PEK_W03 - The student should have basic knowledge associated wit physicochemical characterization techniques of construction materials.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The structure of matter, elements, periodic table, compounds	4
Lec2	Chemical bonds, molecules	2
Lec3	The states of matter	2
Lec4	Metals and alloys, solid state band theory.	2
Lec5	Electrochemistry, corrosion	2
Lec6	Basic crystallography, unit cell, symmetry elements, crystallographic defect	4
Lec7	Ceramic materials	2
Lec8	Selected topics of organic chemistry	4
Lec9	Polymers chemistry	2
Lec10	Selected methods of solid materials characterizations	4
Lec11	Qualifying class –test	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Chemical Principles, Atkins Peter William, Jones Loretta, Palgrave Macmillan

SECONDARY LITERATURE

Chemistry, Michell J. Sienlo and Robert A. Plane, both of Cornell University, Ithaca, New York.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials chemistry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 , PEK_W02, PEK_W03	K1MBM_W03, K1MBM_W06, K1MBM_W11, K1MBM_W13	C1,C2,C3	Lec1-Lec10	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie informacyjne**
Name in English: **Information technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031003 (MMM031303)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. none

SUBJECT OBJECTIVES

C1. The harmonization of terminology in the field of information technology, presenting the origins, history and current state of development of computer
C2. Strengthening the knowledge on the functioning of computers and provide general principles for constructing algorithms (computer)
C3. General guidance on the preparation of publications and technical presentations
C4. Internet and privacy on the Internet, adherence to good customs online, law on the web

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic principles of construction of modern computers, knows the rules of binary arithmetic (integer and non-integer), understand the causes of errors in the numerical calculations.
PEK_W02 - The student knows the basic principles of designing algorithms.
PEK_W03 - The student knows the basic principles of editing technical documents (style, including illustration, making presentations).

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The program. Requirements. Outline of the history of the development of counting and computer systems.	2
Lec2	Elements of a computer system.	2
Lec3	Binary logic, basic arithmetic operations, computers calculations,	2
Lec4	The operating system and its role. Different types of software (operating system, utility, ...)	2
Lec5	Algorithms. The basic algorithmic structures (for review, the division of tasks, dynamic programming, recursion, ...).	6
Lec6	Correctness of algorithms, "difficult" task.	2
Lec7	Programming languages: simple examples.	2
Lec8	Interesting use of computers (engineering graphics calculations)	4
Lec9	General information about technical publications	3
Lec10	Internet and related problems. Law and Internet.	3
Lec11	Test	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
F3	PEK_W03	test
P = (F1+F2+F3+F4+F5)/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Algorithmics: The Spirit of Computing (3rd Edition) by David Harel and Yishai Feldman (Jun 11, 2004)

SECONDARY LITERATURE

2. Computers Ltd.: What They Really Can't Do (Popular Science) by David Harel (Dec 11, 2003)
3. Computer Networking: A Top-Down Approach (6th Edition) by James F. Kurose and Keith W. Ross (Mar 5, 2012)
4. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin and Greg Gagne (Jul 29, 2008)
5. Algorithms + Data Structures = Programs (Prentice-Hall Series in Automatic Computation) by Niklaus Wirth (Feb 1976)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Information technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W04	C1, C2	Lec1, Lec2, Lec3, Lec4	N1
PEK_W02	K1MBM_W04	C2	Lec5, Lec6, Lec7, Lec8	N1
PEK_W03	K1MBM_W04	C3	Lec9, Lec10	N1

SUBJECT SUPERVISOR

dr inż. Wojciech Myszka tel.: +48(71)3202790 email: Wojciech.Myszka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologia materiałów inżynierskich**
Name in English: **Engineering Materials Technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031005**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge concerning physics and mathematics. Ability to use basic measuring equipment like slide caliper.
2. Ability to analyze information included in laboratory instructions
3. Ability to work in a team

SUBJECT OBJECTIVES

C1. Familiarization with metallurgical processes of ore conversion, production of steel and non-ferrous metals.
C2. Familiarization with basic methods of testing of mechanical properties of steel and non-ferrous metals and principles of forming of items with use of powder metallurgy.
C3. Obtaining and reinforcement of social competences connected with a teamwork with a goal to solve problems effectively.
C4. Familiarization with knowledge about basic mechanical properties of engineer materials like tensile strength, compressive strength, impact strength, hardness by participation in testing of given materials.
C5. Familiarization with methods of conducting of non-destructive testing like visual inspection, dye-penetrant examination, magnetic particle testing, radiographic and ultra-sonic testing by participation in testing given parts.
C6. Familiarization with technological tests and forming of items with use of powder metallurgy by participation in an experiment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of conducted lecture the student should be able to define the basic physical properties of engineering materials, to quote and to describe the ways of processing of ores the metals, to characterize the metallurgical processes of receiving the metals and the alloys of metals.
PEK_W02 - As a result of conducted laboratory the student should be able to define the mechanical properties of metals and the alloys, to describe the method of tests destructive and non-destructive, to characterize the method of carrying out the technological tests.
PEK_W03 - As a result of conducted classes the student should be able to distinguish basic engineering materials, to characterize their physical and mechanical properties, to identify method investigations of properties of engineering materials.

II. Relating to skills:
PEK_U01 - As a result of the lecture the student should be able to analyze processes metallurgical obtaining metal, compare the properties of engineering materials
PEK_U02 - As a result of laboratory classes student should be able to carry out in a limited range the basic test of tensile strength, compressive strength, impact tests, hardness tests and technological tests
PEK_U03 - As a result of the course the student should be able to obtain information from the literature, have the ability to self-learning, carry out measurements, determine the value and to evaluate certainty basic mechanical properties.

III. Relating to social competences:
PEK_K01 - Demonstrates skills needed in teamwork on improving methods of choice of a strategy to optimally solve problems assigned group.
PEK_K02 - Is able objectively evaluate the arguments rationally explain and justify his own point of view using the knowledge of the basics of engineering materials.
PEK_K03 - Respects the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization of groups. General information about properties of engineer materials	3

Lec2	Refractory materials and fuels in pyrometallurgy.	2
Lec3	Metallurgy of iron. Ore treatment, blast furnace process, production of steel	2
Lec4	Metallurgy of copper. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of copper and its alloys	2
Lec5	Metallurgy of zinc. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of zinc and its alloys	2
Lec6	Metallurgy of aluminum. Treatment of ores, production of aluminum oxide and distillation of aluminum.	2
Lec7	Production of high melting metals with use of powder metallurgy and methods of production of parts with use of metallic powders.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organization of groups, safety. Tensile test of metals	3
Lab2	General information about metals and alloys.	2
Lab3	Compression test and impact test	2
Lab4	Hardness measurement	2
Lab5	Non-destructive testing	2
Lab6	Technological tests	2
Lab7	Production of machine parts with use of powder metallurgy	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01-PEK_K03	oral answers, short tests
P = średnia z F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Z. Mirski. Technology and engineering materials testing, laboratory. Wrocław University of Technology Publishing House, 2010.
2. Krynicki L., L. Sozański. Technology of metals. Publisher University of Technology, 1994.

SECONDARY LITERATURE
Supplementary materials for exercises No. 1-5. W10 library (building B4, III floor)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering Materials Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W03	K1MBM_W10	C1, C2	Le1 - Le7	N1, N5
PEK_W02, PEK_W03	K1MBM_W10	C4, C5, C6	Le1 - Le7	N2, N3, N4
PEK_U01, PEK_U03	K1MBM_U20	C4, C5, C6	Lab1 - Lab7	N2, N5
PEK_U02, PEK_U03	K1MBM_U20	C4, C5, C6	Lab1 - Lab7	N2, N3, N4
PEK_K01, PEK_K03	K1MBM_K04	C3	Lab1 - Lab7	N2, N5
PEK_K02, PEK_K03	K1MBM_K04	C3	Lab1 - Lab7	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Piotr Białucki tel.: 42-71 email: piotr.bialucki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Statystyka inżynierska**
Name in English: **Statistics for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031007 (MMM031307)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of mathematics confirmed positive marks on the upper secondary school leaving certificate

SUBJECT OBJECTIVES

C1. Gaining basic knowledge of probability and mathematical statistics takes into account the aspects of application.
C2. Learn how to explore the figures in the field of construction and operation of equipment, organization and management, as well as optimization of design, technology and systems.
C3. Acquiring skills development (reduction) of data using statistical software (STATISTICA, MatLab, Gretl, R) and the possibility of a spreadsheet (Excel).
C4. The acquisition and consolidation of social skills including emotional intelligence involving the ability to work in a group of students with a view to effectively solve problems with regard to accountability, integrity and fairness in the proceedings.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has a basic knowledge of statistical methods for the analysis of databases of known basic descriptive statistics characterizing the engineering measurements, known principle groupings of data and compilation of the distribution,
PEK_W02 - Knows the basic theoretical distributions of discrete and continuous attributes, has a basic knowledge of the principles of estimating confidence intervals for the average value and its dispersion characteristics, has knowledge of the methods for parametric statistical hypotheses about the average value, the equality of the two values of the average of the value of homogeneity of variance and multiple variance.
PEK_W03 - Knows the basic method of verifying the non-parametric statistical hypotheses regarding the significance of differences in the structure of the data and categorical independent random variables, known methods of correlation and regression analysis for two or more continuous variables and methods for the analysis of time series.

II. Relating to skills:
PEK_U01 - Able to properly perform a statistical analysis of test results, formulate hypotheses, and based on the tests carried out to draw the appropriate conclusions: data reduction can make the right choice before statistics describing the average value, the dispersion and the shape of the distribution, it can from raw data to create a frequency distribution, and illustrate collection of data using a histogram, the empirical distribution function and graph frameset.
PEK_U02 - Able to fit the empirical data and theoretical distribution on the basis of estimated quantile values for selected probabilities, and estimate the probability for selected quantiles, can properly choose the type of statistical test and perform testing hypotheses about the average and distribution characteristics.
PEK_U03 - It can analyze the correlation characteristics in multivariate categorical data table can perform a regression analysis and correlation of two and more variables, estimate the parameters characterizing the strength and shape of the relationship.

III. Relating to social competences:
PEK_K01 - The acquisition and consolidation of competence in the following areas: information retrieval and its critical analysis, team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.
PEK_K02 - capacity building self-esteem and self-control and responsibility for the results of actions taken
PEK_K03 - independent and creative thinking

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Statistical methods of data analysis - the essence of statistical modeling. The descriptive analysis of the data: the forms of representation of statistical data, measures of association, variability, asymmetry and concentration.	2
Lec2	Development and presentation of statistical data. Grouping data - ranks simple and distribution. Histogram and empirical cumulative distribution.	2
Lec3	Random variables and their distributions. Numerical characteristics of the distribution. Selected discrete and continuous distributions. Inequality Czybyszewa. Elements of the theory of estimation - point estimate. Interval estimation of the mean value and variance. The confidence intervals.	2

Lec4	Parametric statistical hypotheses. Testing hypotheses about the average value, the equality of the two average values. Testing hypotheses about the rate structure and the structure of the equality of two ratios. Testing hypotheses about the variance and equality of two variances.	2
Lec5	Nonparametric hypothesis testing. Conformance Test chi-square, Kolmogorov-Smirnov test. Test of independence Pearson chi-square. Based measures based on chi-square. The odds ratio. Nonparametric tests: test Wald-Wolfowitz runs test, Wilcoxon rank-Mann-Whitney test.	2
Lec6	Correlation and regression analysis. The method of least squares. Pearson correlation coefficients and Spearman. Linear regression function. Multivariate regression analysis and correlation. The estimation of linear multiple regression function. The significance test for multiple regression coefficients. Estimation of the multiple correlation coefficient. The coefficient of determination.	2
Lec7	Univariate analysis of variance and post-hoc test: Tukey, Duncan and least significant difference. Kruskal-Wallis test and post-hoc test of Dunn. Methods of analysis of the dynamics of the phenomena - time series. Time series smoothing methods. Analysis of periodic fluctuations. Presentation of selected computer programs supporting statistical analysis STATISTICA, R, Gretl.	3
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Organizational matters. Introduction to using a spreadsheet. Math and statistics Excel. Generate a vector of continuous variables with normal distribution. Descriptive statistics - calculating measures of location, variability, asymmetry and concentration. Construction series distribution. A graphical representation of the data set - the histogram and the empirical distribution function.	3
Proj2	Basic distributions encountered in mathematical statistics: a normal distribution, Student, chi-square, F Snedecor. Probability density function and cumulative distribution. Point and interval estimation of the expected value, the rate structure (fraction), variance and standard deviation.	2
Proj3	Testing of statistical hypotheses. Parametric tests of significance for the expected value and the variance of the general population. The test for two variances for two medium and two indicators of the structure. Student's test for paired test, homogeneity of variance Bartlett's many, many medium homogeneity test (ANOVA).	2
Proj4	Non-parametric tests of significance - compatibility test Pearson's chi-square test, Kolmogorov sensor compatibility,. Test of independence chi-kwadrat2 panels - kontyngencyjne. Mann-Whitney test. Median test and Wilcoxon signed-ranks test. Rank sum test Kruskal-Wallis test to assess the relationship between two variables. Two-dimensional regression and correlation analysis. A scatterplot. Strength of the association correlation - correlation coefficient estimation, test of significance for the correlation coefficient, parameter estimation of linear regression function, a test of significance for the regression coefficient (slope of the regression line), the confidence interval for the regression coefficient.	2
Proj5	Multivariate analysis of correlation and regression. Estimation of the multiple regression function. The significance test for multiple regression coefficients. Estimation of the coefficient of determination and multiple correlation. Curvilinear regression. Logistic regression. Maximum likelihood estimation. Interpretation of the results of logistic regression.	2

Proj6	Univariate analysis of variance (ANOVA). Table of analysis of variance in one variable for the jednoczynnikowego. Analysis of the dynamics. Time series without periodicity and duration. Prediction methods. Development trend - a trend.	2
Proj7	Event History Analysis. Distribution function, the density function, survival function, hazard function. The life table. Kaplan-Meier curves. Cox proportional hazards model. Uncertainty evaluation of the overall result of the measurement. Disclosure of systematic errors. Disclosure of errors (gross errors). Uncertainty evaluation of the overall impact resulting from the effects of random and systematic. Methods of sampling. Drawing layered, collaborative, systematic. Non-random sample and load error.	2
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. case study
N3. calculation exercises
N4. self study - preparation for project class
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_K01	small exam, evaluation of computing project
F2	PEK_U02,PEK_K02	small exam, evaluation of computing project
F3	PEK_U03,PEK_K03	evaluation of computational design, project evaluation
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bobrowski D: Probability in technical applications. Warsaw 1986, WNT [2] R. Smith: Statistics for physicists. Warsaw 2002, PWN [3] Ostasiewicz W. (ed.): Statistical methods for data analysis. Wroclaw 1999, Publisher of Economics in Wroclaw [4] Zeliaś A., Pawelek, B., S. Wanat: Statistical Methods. The tasks and tests. Warsaw 2002, PWE

SECONDARY LITERATURE

[1] I. Bak, Markowicz I., Mojsiewicz M., K. Wawrzyniak: Statistics in tasks. Part I and II. Warsaw 2001. Publisher of Science and Technology [2] Cieciura M., Zacharski J.: Probabilistic methods in practical terms. Warsaw 2007, VIZJA PRESS & IT Sp. z oo [3] Dobosz M.: The computer-assisted statistical analysis of test results. Warsaw 2001, Academic Publishing House EXIT. [4] Frątczak E. Gach-Ciepiela Laws, Babiker H. event history analysis. Elements of the theory, some examples of applications. 2005 Warsaw School of Economics in Warsaw. [5] Puppet L: Fundamentals of engineering studies. Warsaw 2002, PWN. [6] Maliński M.: Computer-assisted mathematical statistics. Gliwice 2000, published by Silesian University of Technology [7] W. rods: Methods of data analysis examples. 2004 Częstochowa, Częstochowa University of Technology [8] Turzeniecka D.: Evaluation of uncertainties due to measurements. 1997 Poznan, Poznan University of Technology Publisher

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Statistics for Engineers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W01	C1, C2, C3	Lec1, Lec2	N1
PEK_W02	K1MBM_W01	C1, C2, C3	Lec3, Lec4, Lec5	N1
PEK_W03	K1MBM_W01	C1, C2, C3	Lec6, Lec7	N1,N5
PEK_U01	K1MBM_U04	C1, C2, C3	Pr1, Pr2	N2, N3, N4
PEK_U02	K1MBM_U04	C1, C2, C3	Pr3, Pr4, Pr5	N2, N3, N4
PEK_U03	K1MBM_U01, K1MBM_U05	C1, C2, C3	Pr6, Pr7	N2, N3, N4, N5
PEK_K01	K1MBM_K05	C4	Pr7	N5
PEK_K02	K1MBM_K04	C4	Pr7	N5
PEK_K03	K1MBM_K05	C4	Pr7	N5

SUBJECT SUPERVISOR

dr inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo I**
Name in English: **Materials Science I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031009 (MMM031310)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic of physic at the high school level
2. Basic of chemistry at the high school level

SUBJECT OBJECTIVES

C1. Knowledge of interaction between structure, manufacturing and properties the basic groups of engineering materials
C2. Knowledge of basic rules of selection materials applied for constructional elements in machines building
C3. Knowledge of basic crystallography and cristalline structures properties
C4. Knowledge of structures and properties of iron-cementite system alloys
C5. Knowledge basic properties of unalloyed steels

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know basic types and properties of materials
PEK_W02 - Know influence of basic manufacturing technoilogies on the basic materials properties
PEK_W03 - Know basic types and properties iron alloys structures

II. Relating to skills:
PEK_U01 - Able to assess the type of materials applied for engineering design
PEK_U02 - Can determine the structures of materials applied for engineering design
PEK_U03 - Can determine the basic properties of materials applied for engineering design

III. Relating to social competences:
PEK_K01 - Information retrieval and their critical analyse
PEK_K02 - Observance of custom and rules binding at academic environment

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classificationof engineerig materials. Relations between manufactiring processes, structures and properties of materials	2
Lec2	Mechanical and physical properties of materials and methods of their determination. The rules of materials selection at machine building	2
Lec3	Polymer materials - classification, structures, properties	2
Lec4	Ceramic and glass materials - classification, structures, properties	2
Lec5	Composite materials - classification, manufacturing methods, properties	2
Lec6	Metals reinforcement methods. Classification and method of metals formation	2
Lec7	Elements of crystallography. Build of real crystals. Defects of crystalline structures	2
Lec8	Equilibrium and criterion of equilibrium. Internal energy. Entropy, Free energy	2
Lec9	Phase transformation, Crystallisation. Allotropic and magnetic transformation	2
Lec10	Plastical deformation and recrystallisation	2
Lec11	Alloys. Build and types of alloys. Intermetallic phases	2
Lec12	Characteristic of phases presented in alloys of metals	2
Lec13	Pfase equilibrium diagrams of binary systems. Phase rule.	2
Lec14	Analyse basic types of phase equilibrium diagrams	2
Lec15	Iron-cementite equilibrium diagram. Analysis of diagram	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction. The aim and methods materials investigation. Construction and maintenaceof metallographic microscope	2
Lab2	Macroscopic investigations, analyse of fracture surfaces, macrostructures of materials and technological origin defects	2

Lab3	Macroscopic and microscopic investigation of composite materials	2
Lab4	Analyse of equilibrium binary system diagrams	2
Lab5	Investigation of microstructures of mono and multiphase alloys at etched and non-etched state	2
Lab6	Analyse of iron-cementite phase equilibrium diagram	2
Lab7	Analyse microstructures of iron-cementite diagram	2
Lab8	Summary and credit of laboratory practice	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. laboratory experiment
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	writen- oral examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K02	Introduction test, oral answers, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M.F.Ashby, D.R. Jones - Engineerig Materials

SECONDARY LITERATURE

M. F. Ashby- Materials Selection in Mechanical Design

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W10, K1MBM_W11	C1 - C5	Lec 1 - lec 15	N1 - N4
PEK_U01 - PEK_U03	K1MBM_U01, K1MBM_U02, K1MBM_U06	C1- C2	lab 1 - lab 8	N3 - N5
PEK_K01 - PEK_K02	K1MBM_K09	C1 - C5	lab 1 - lab 8	N2 , N3, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Włodzimierz Dudziński tel.: 320-37-80 email: wlodzimierz.dudzinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika I**
Name in English: **Mechanics I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031010 (MMM031310)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematics I (differenting, integrating)
2. Algebra, Linear algebra, (Matrix, Determinants)
3. Euklides geometry & Trigonometry

SUBJECT OBJECTIVES

C1. Solving technical problems on the basis of mechanics rules
C2. Making statical strength analysis of machines elements.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with
a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define basic quantities in Mechanics (Force and momentum). He knows conditions of static equilibrium of forces system.
PEK_W02 - He knows the Centroid of Area, the center of Gravity of a Mass, Moments of inertia, Product of inertia, Parallel–axis theorem, Rotation transformation of Moments of inertia, Iinertia Tensor, inertia ellipsoid, the principal axes.
PEK_W03 - He is able to define key concepts in Kinematics, motion of particle, trajectory, one–dimensional model. Velocity and acceleration in natural coordinates. Rigid body, The Degrees of Freedom, Classification of motions, Velocity and acceleration in general motion.

II. Relating to skills:
PEK_U01 - He can solve typical engineering structures (Trusses, Beams & Frames) under statical loading. Conditions of static equilibrium of forces system. Plane forces system reduction.
PEK_U02 - He can calculate the Centroid of Area, the center of Gravity of a Mass, Moments of inertia, Product of inertia, He can use Parallel–axis theorem, Rotation transformation of Moments of inertia, Iinertia Tensor, inertia ellipsoid, the principal axes.
PEK_U03 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion of a point. He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using the Newton's second principle.

III. Relating to social competences:
PEK_K01 - He can search information and is able to review it critically.
PEK_K02 - He can objectively evaluate the arguments as well as rationally explain and justify the own point of view.
PEK_K03 - He can observe customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Curriculum. Requirements. Literature.Theory of vectors algebra	2
Lec2	Force and momentum. Principal vector and principal momentum of forces system. Statics. Conditions of static equilibrium of forces system. The change of momentum point.	2
Lec3	Concurrent forces system.Trusses. Method of Joints.	2
Lec4	Plane forces system. Reactions in the statically determinate systems (Beams, Trusses, Frames).	2
Lec5	Conditions of static equilibrium of forces system. Plane forces system reduction.	2
Lec6	Internal forces in Beams (analytical methods, diagrams).	2
Lec7	Internal forces in Frames (analytical methods, diagrams).	2
Lec8	Centroid of Area. The center of Gravity of a Mass.	2
Lec9	Moments of inertia. Product of inertia. Parallel–axis theorem. Rotation transformation of Moments of inertia,	2
Lec10	Iinertia tensor, inertia ellipsoid. The principal axes.	2

Lec11	Kinematics, motion of particle, trajectory, one–dimensional model. Velocity, acceleration. Velocity and acceleration in natural coordinates.	2
Lec12	Rigid body, The Degrees of Freedom, Classification of motions, Velocity and acceleration in general motion.	2
Lec13	Plane motion and rotation over permanent axis. Planar motion of rigid body, velocity, center of circulation.	2
Lec14	Centroids, acceleration in a planar motion of rigid body.	2
Lec15	Relative motion. Kinematics in a general motion of rigid body. The Coriolis' acceleration.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Vectors algebra	2
Cl2	Trusses. Method of Joints. Analytical methods of trusses solving.	2
Cl3	Reactions in the statically determinate plane systems. Analytical methods.	2
Cl4	Reactions in the statically determinate space systems. Analytical methods.	1
Cl5	Analytical methods of trusses solving. The Ritter’s methods.	1
Cl6	Test 1: Vectors, Trusses	1
Cl7	Internal forces in beams (analytical methods, diagrams).	1
Cl8	Internal forces in beams (analytical methods, diagrams). Beams with Joints.	2
Cl9	Internal forces in Frames (analytical methods, diagrams).	2
Cl10	Test 1: Internal forces in plane structures	1
Cl11	Centroid of Area. The center of Gravity of discrete Multi-mass structures.	1
Cl12	Centroid of Area. The center of Gravity of continue-mass structures.	2
Cl13	Moments of inertia & inertia products. Parallel–axis theorem.	2
Cl14	Rotation transformation of Moments of inertia, inertia tensor, inertia ellipsoid. Principal axes.	2
Cl15	Test 3: The center of Gravity of a Mass. Moments of inertia.	1
Cl16	Kinematics of particle in orthogonal coordinates.	2
Cl17	Kinematics of rigid body. Plane motion and rotation over permanent axis.	2
Cl18	Velocity in a plane motion.	2
Cl19	Test 4: Kinematics (task by yourself choose.)	1
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides
N2. Calculation exercises
N3. Four small tests instead of two big make students more regular in the study
N4. Tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	oral-writing exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_K01	test 1 & 2 or/& oral answers
F2	PEK_U02,PEK_K02	test 3 or/& oral answers
F3	PEK_U03,PEK_K03	test 4 or/& oral answers
P = 2 jeśli ocena F1=2. Jeśli nie to P=(2F1+F2+F3):4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 1, Statics, John Wiley & Sons, Inc., New York, 1998
2. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 2, Dynamics, John Wiley & Sons, Inc., New York, 1998

SECONDARY LITERATURE
1. Mary Lunn, A First Course in Mechanics, Oxford Science Publications, Oxford 1991
2. Philip Dyke, Roger Whiteworth, Guide to Mechanics, MacMillan Press, London 1992
3. Herbert Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W07	C1	Lec 1 to Lec 15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_U05, K1MBM_U07	C2,	Classis 1 to 19	N2, N3
PEK_K01, PEK_K02, PEK_K03	K1MBM_K03, K1MBM_K04	C3	Classis 1 to 19	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe zwyczajne**
Name in English: **Ordinary differential equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031011 (MMM031311)**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses	X				
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student is familiar with the differential and integral calculus of function of one variable and other branches of mathematics used in this calculus, particularly linear algebra.
2. Student is able to calculate derivatives of functions of one variable, indefinite and definite integrals using methods by parts and by substitution.
3. Student is able to calculate determinants, eigenvalues and eigenvectors of matrix.

SUBJECT OBJECTIVES

C1. To gain basic knowledge of first-order and second-order ordinary differential equations, and systems of differential equations.
C2. To learn how to choose the appropriate method of solving ordinary differential equations and systems of differential equations.
C3. To develop and consolidate the ability to access information and its analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has theoretical knowledge of differential equations and knows methods of their solving.
PEK_W02 - Student has knowledge about methods of solving of systems of differential equations.
PEK_W03 - Student has knowledge about applying differential equations as the mathematical model for a physical phenomenon.

II. Relating to skills:
PEK_U01 - Student is able to formulate theorems and definitions of differential equations in oral and written, friendly manner,
PEK_U02 - Student is able to solve first-order and second-order differential equations.
PEK_U03 - Student is able to solve systems of differential equations.

III. Relating to social competences:
PEK_K01 - Student understands the necessity of systematical work on all tasks and can estimate the time needed for solving the exercise.
PEK_K02 - Student knows the scope of his/her knowledge and abilities, is able to identify lack of knowledge and complete it using the literature.
PEK_K03 - Student acts ethically and understands the importance of intellectual honesty,

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	First-order differential equations: the basic definitions. Issues from various fields leading to differential equations. First-order differential equations: the equations with separated variables and homogeneous equations.	2
Lec2	First-order linear homogeneous and heterogeneous differential equations. Method of variation of constant.	2
Lec3	Orthogonal curves. Second-order equations. Reducible second-order equations.	1
Lec4	Second-order linear homogeneous differential equations. Wronskian. Second-order linear homogeneous differential equations with constant coefficients.	2
Lec5	Second-order linear heterogeneous differential equations with constant coefficients. Method of variation of constants. Method of undetermined coefficients.	2
Lec6	Systems of differential equations. Method of elimination. Homogeneous linear system of equations with constant coefficients.	2
Lec7	Heterogeneous linear system of equations with constant coefficients. Method of variation of constants.	2
Lec8	Final test.	2
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Reminder on differential and integral calculus. Solving first-order differential equations with separated variables and homogeneous equations.	2

Cl2	Solving first-order linear homogeneous and heterogeneous differential equations.	2
Cl3	Solving reducible second-order differential equations.	2
Cl4	Solving second-order linear homogeneous differential equations with constant coefficients.	1
Cl5	Solving second-order linear heterogeneous differential equations with constant coefficients with method of undetermined coefficients.	2
Cl6	Solving second-order linear heterogeneous differential equations with constant coefficients with method of variation of constants.	2
Cl7	Solving heterogeneous linear systems of equations with constant coefficients.	2
Cl8	Final test (in case of evaluation on base of short tests, 2 hours are necessary to perform them during semester).	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture
N2. calculation exercises
N3. tutorials
N4. work on preparing for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	final test
P = 2/3*F1(wykład/lecture) + 1/3*F1(ćwiczenia/classes), gdzie obie oceny F1>2,0 (both marks F1 > 2.0)		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01- PEK_U03 PEK_K01-PEK_K03	short tests or final test
P = (brak)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. M. D. Greenberg, Ordinary differential equations, John Wiley & Sons, 2012.
2. R. Carlson, Linear ordinary differential equations, Society for Industrial and Applied Mathematics, Philadelphia 1997.
3. R. E. O'Malley, Thinking about ordinary differential equations, Cambridge University Press, 1997.
4. A. Jeffrey, Linear algebra and ordinary differential equations, CRC Press, 1993.
5. G. Birkhoff, G. C. Rota, Ordinary differential equations, John Wiley & Sons, 1989.
6. R. M. M. Mattheij, J. Molenaar, Ordinary differential equations in theory and practice, John Wiley and Sons, 1996.
7. R. K. Miller, A. N. Michel, Ordinary differential equations, Academic Press, 1982.

SECONDARY LITERATURE
1. J. H. Hubbard, B. H. West, Differential equations: a dynamical systems approach, Cambridge University Press, Cambridge 2003.
2. N. Finizio, G. Ladas, Ordinary differential equations with modern applications, Wadsworth Publ. Co., 1989.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ordinary differential equations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K01-PEK_K03	K1MBM_K03, K1MBM_K04	C3	Cl1 - Cl7	N3, N4
PEK_U01_PEK_U03,	K1MBM_U08	C2	Cl1 - Cl7	N2, N4
PEK_W01, PEK_W02, PEK_W03	K1MBM_W01	C1	Lec1 - Lec7	N1, N3

SUBJECT SUPERVISOR

dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka podstawy programowania (Matlab)**
Name in English: **Computer science – basics of programming (Matlab)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031013 (MMM031313)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure of a computer and its components, as well as on operating systems and principles of algorithm structure.
2. Knowledge of mathematics, covering basic problems of algebra and analysis.
3. Ability to use basic IT tools of CAE class.

SUBJECT OBJECTIVES

C1. Getting acquainted with high-level programming in Matlab, intended for engineering and scientific calculations.
C2. Getting acquainted with integration of calculations, visualisation (2D and 3D graphics) and programming in Matlab environment.
C3. Getting acquainted with principles of modelling technical systems using the Simulink module.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Ability to formulate a proceeding algorithm for mathematic calculations in the fields of algebra and analysis, covering, among others, matrix, differential and integral calculi, as well as problems related to solving systems of algebraic equations.
PEK_U02 - Ability to utilize possibilities of 2D and 3D graphics to visualize data and calculation results.
PEK_U03 - Ability to build a simple model of an object and to start simulation in the Matlab/Simulink system.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to acquire knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	General characteristics of Matlab system (graphic interface, environment maintaining, organization of work, system syntax) – exemplary applications.	2
Proj2	Operations on files and folders, saving and executing basic mathematical operations (evaluating function values).	2
Proj3	Vector and matrix calculi (basic matrix and table operations, identifying elements, generating vectors and matrices).	2
Proj4	Two-dimensional graphics in Matlab system – graphics generating functions, description of charts, window management.	2
Proj5	Three-dimensional graphics in Matlab system – graphics generating functions, description of charts, window management, animation 3D.	2
Proj6	Basics of programming in Matlab system (operators; conditional, iteration and switch statements).	2
Proj7	Basics of programming in Matlab system (compound statements; scripts and functions, creating M-files).	2
Proj8	Numerical methods: interpolation and approximation of functions.	2
Proj9	Function analysis (limits, derivatives, extrema).	2
Proj10	Solving equations and systems of equations – methods of solving.	2
Proj11	Numerical integration – characteristics of integration methods.	2
Proj12	Simulink – introduction to modelling technical objects (terminology, principles of building models and starting-up simulations).	2
Proj13	Building a simulation model based on the Simulink module library – analysis of influence of initial conditions and simulation parameters on calculation results.	2
Proj14	Building a model for a selected technical object – analysis of influence of initial conditions and simulation parameters on calculation results.	2
Proj15	Crediting the project.	2

	Total hours: 30

TEACHING TOOLS USED

N1. Auxiliary materials in form of instructions and multimedia presentations helpful at executing individual subjects.
N2. Tasks for checking knowledge within individual subjects.
N3. Self study - preparation for project class.
N4. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Assessment of preparation for executing subsequent project subjects, checking gained knowledge on the ground of test tasks.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Prepared instructions and aids to individual subjects (unpublished).
Mrozek B., Mrozek Z.: Matlab and Simulink. Editorial Office Helion Warsaw, 2004 (in Polish).
Brzózka J., Dorobczyński L.: Matlab. Environment of scientific-technical calculations. Editorial Office Helion PWN, 2005 (in Polish).
Zalewski A., Cegieła R.: Matlab – Numerical calculations and their application. Editorial Office Nakom. Poznan, 1998 (in Polish).
Reichel W., Stachurski M.: Matlab for students – exercises, problems, solutions. Editorial Office WITKOM. Warsaw, 2009 (in Polish).

SECONDARY LITERATURE
Pratap R.: Matlab 7 for scientists and engineers. Editorial Office MIKOM, 2007 (in Polish).
Regel W.: Symbolic and numerical calculations in Matlab program. Editorial Office MIKOM, 2004 (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer science – basics of programming (Matlab)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K1MBM_U05, K1MBM_U18	C1 - C3	Pr1 - Pr14	N1 - N4
PEK_K01 - PEK_K03	K1MBM_K04	C1 - C3	Pr1 - Pr14	N3, N4

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska 3D**
Name in English: **3D Engineering Graphics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031014 (MMM031314)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in range of technical drawing based on 3D models

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Students should be able to build 3D models of machine parts
PEK_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEK_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:
PEK_K01 - Student gains the skills to take responsibility for their work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - Advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	Basic solid modeling - Advanced operations on 2D sketches - function relationships of parameters, solid modeling with rotation, solid editing - shell models	2
Proj5	Basic solid modeling - solid modeling with rotation, one and multibody modeling	2
Proj6	Advanced solid operations - sweep, loft, split, scroll	2
Proj7	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj8	The project of assembly: preparing to create an assembly- parts assembling, bonds and relationships in the assembly	2
Proj9	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj10	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj11	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults, loads analysis	2
Proj12	The project of assembly: loads analysis, reactions and forces at the nodes, the presentation of the model	2
Proj13	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings	2
Proj14	The project of assembly: 2D technical drawings of assembly - assembly drawings	2

Proj15	Completion of the course: work during classes	2
		Total hours: 30

TEACHING TOOLS USED

N1. project presentation
N2. problem discussion
N3. self study - preparation for project class
N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01	test, participate in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
[2]Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE
[1]http://autodesk-inventor-pl.typepad.com/
[2]http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
3D Engineering Graphics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PPEK_U01, PEK_U02	K1MBM_U21	C1, C2	Pr1 - Pr12	N1, N2, N3, N4

, PEK_U03	K1MBM_U21	C3	Pr13, Pr14	N3, N4
PEK_K01	K1MBM_K04	C2	Pr8, Pr11	N2

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika płynów**
Name in English: **Fluid Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031015 (MMM031315)**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses	X				
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a structured knowledge of mathematics, including algebra and analysis.
2. Student has a structured knowledge of physics, mechanics.
3. Student has a structured knowledge of basis of machine design.

SUBJECT OBJECTIVES

C1. Understanding the basic laws of mechanics in relation to flows of liquids and gases
C2. Gaining ability to use basic laws of fluid mechanics in the construction and design of the machines
C3. Gaining ability to use basic laws of fluid mechanics in the machinery operation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define basic laws of fluid mechanics.
PEK_W02 - Student is able to explain the principles of machines operation and the phenomena utilized in their construction.
PEK_W03 - Student is able to Indicate the relationship between the fundamental laws of fluid mechanics and principles of operation of machines equipment.

II. Relating to skills:
PEK_U01 - Student is able to analyse the process of the phenomena associated with the flows in the machines operation.
PEK_U02 - Structured knowledge of machine design theory.
PEK_U03 - Student is able to combine law of fluid mechanics with the problems of machine design and operation.

III. Relating to social competences:
PEK_K01 - Student understands the legal aspects and effects of engineering activities.
PEK_K02 - Student understands and is aware of the non-technical aspects and impacts of engineering activities in machine design.
PEK_K03 - Student is aware of the necessity of individual and group activities that go beyond the engineering operation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of liquids and gases, forces and stresses in fluids,basic concepts of field theory.	2
Lec2	Newtonian and non-Newtonian fluids, fluid motion analysis method, streamlines , potential and rotational flow.	2
Lec3	The basic equations of fluid mechanics, the continuity equation, the conservation of momentum equation for the ideal and real fluids (Euler equation and Navier-Stokes equations).	2
Lec4	Hydrostatic equations, communicating vessels, the pressure forces of the liquid on the walls.	2
Lec5	Buoyancy and stability of floating bodies.	2
Lec6	Euler equation integrals - Bernoulli's equation, examples of applications: measurements of velocity, the flow of liquid through the holes.	2
Lec7	The equations of momentum and moment of momentum equation, hydrodynamic reaction, principles of turbo-machinery, pumps and turbines.	2
Lec8	Real fluids, laminar and turbulent flow, the Bernoulli's equation for real fluids.	1
Lec9	The flow similitude, the dimensionless numbers in fluid Dynamics, examples of applications.	2
Lec10	Examples of solutions of N-S equations , flows in the axially-symmetric pipes , major losses and their calculation, the effect of roughness.	2
Lec11	Hydrodynamic theory of lubrication in bearings, flows through the narrow gaps.	2
Lec12	Flow in pipes, pipelines characteristics, the unsteady phenomena - water hammer.	2

Lec13	The theory of the boundary layer, laminar and turbulent layer, the phenomenon of flow separation.	1
Lec14	Flow around bodies, drag forces, aerofoil theory, the hydrodynamic characteristics of profiles. Methods of calculation of forces on aerofoil.	2
Lec15	Numerical methods in fluid mechanics, examples of use in the analysis of flows.	2
Lec16	Final Test	2
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	The solution of the basic fluid properties problems.	1
Cl2	Exercises illustrating the application of the Euler equation and Pascal's law.	2
Cl3	Calculation of pressure forces on the walls.	2
Cl4	Application of the Bernoulli's equation and the continuity equation for calculating ideal fluid flow.	2
Cl5	Calculation of buoyancy and stability of floating bodies.	2
Cl6	Application of the conservation of momentum equation and moment of momentum equation to calculate the hydrodynamic forces.	2
Cl7	Calculation of the pressure loss in closed in pipelines. Determination of pipeline characteristics.	2
Cl8	Final Test	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = 0.5*F1+0.5*FC		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01,PEK_K02,PEK_K03	Test
P = F1=FC		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Prosnak W.J.,: Mechanika płynów. Tom I. PWN, Warszawa 1970.Bukowski J., Kijkowski P.; Kurs mechaniki płynów, PWN, 1980.Orzechowski Z., Prywer J., Zarzycki R.: Mechanika płynów w inżynierii środowiska. PWN, Warszawa 1998.Jeżowiecka-Kabsch K., Szewczyk H.: Mechanika płynów. Oficyna Wydawnicza PWr, Wrocław 2001.

SECONDARY LITERATURE

Burka S.E., Nałęcz T.J.: Mechanika płynów w przykładach. PWN, Warszawa 1994.Zieliński A.: Wybrane zagadnienia z mechaniki płynów. Oficyna Wydawnicza PWr, Wrocław 2011.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fluid Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W06	C1	Lec1-Lec15	N1
PEK_W02	K1MBM_W08	C2, C3	Lec5, Lec5, Lec12, Lec15	N1, N2
PEK_W03	K1MBM_W02	C2, C3	Lec1-Lec1	N1, N2
PEK_U01	K1MBM_U09	C2, C3	Cl1-Cl7	N3
PEK_U02	K1MBM_U06	C2, C3	Cl2,Cl6, Cl7	N3
PEK_U03	K1MBM_U05	C2, C3	Cl2, Cl4-Cl7	N3
PEK_K01, PEK_K02, PEK_K03	K1MBM_K08	C1-C3	Cl1-Cl7	N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jan Kulczyk tel.: 71 320-25-70 email: Jan.Kulczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ochrona własności intelektualnej**
Name in English: **Protecting intellectual property**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031016 (MMM031316)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge in the field of innovation
2. Basic knowledge in the area of accounting and finance
3. General knowledge of business law and marketing.

SUBJECT OBJECTIVES

C1. The aim of the course is to learn the basic message of a functioning legal system, intellectual property protection, and various forms of property: copyright, patents, utility models, and industrial, etc.
C2. The acquisition of basic skills notification of descriptions of inventions and utility models, and industrial, etc.
C3. Ability to use patent information.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of patent information
PEK_W02 - Is able to assess the patentability
PEK_W03 - Has knowledge of plagiarism

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basic idea of intellectual property protection. Research, science, knowledge, discovery, invention, innovation and innovativeness, reserved eniepatentowe, patterns of Productivity, industrial designs, integrated circuit topography	2
Lec2	The test procedure of patent and utility model.	2
Lec3	Rating patentability. Description of the application of the invention	2
Lec4	Patent information: sources and collections of patent documentation and literature, access to information and databases of Patent Office.	2
Lec5	Trademarks and their legal protection. The copyright of literary and artistic works.	2
Lec6	Intellectual property protection software. Organizations involved in the collective management of copyright	2
Lec7	Intellectual property databases and domains	2
Lec8	Plagiarism and engineering thesis- comparison.	1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	colloquium

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Autor: Pyr¿a R., tytuł: Poradnik wynalazcy , wydawnictwo: Urzad Patentowy RP, rok:2008Autor: Golat A.M., tytuł: Własność intelektualna i przemysłowa, wydawnictwo: C.H. Becke,rok: 2005Autor: Deren A.M., tytuł: Własność intelektualna i przemysłowa, wydawnictwo: Kompendium wiedzy. Ofic. Wyd. PWSzZ Nysa, rok: 2007Autor: Staszko W. (red.), tytuł: Ochrona patentowa, wydawnictwo: Wyd. Uniwersytetu Śląskiego, rok: 1983Autor: Sieniów T., Włodarczyk W., tytuł: Własności intelektualne w społeczeństwie informacyjnym, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2001Autor: Adamczak A., Gedłek M., tytuł: Znaki towarowe w działalności małych i średnich przedsiębiorstw, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2009Autor: Adamczak A., Dobosz E., Gedłek M., tytuł: Wzory przemysłowe w działalności małych i średnich przedsiębiorstw, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2009

SECONDARY LITERATURE

Autor: Gajos M., tytuł: Opis patentowy jako źródło informacji, wydawnictwo: Wyd. Uniwersytetu Śląskiego, rok: 2000Autor: Lowe P., tytuł: Zarzadzanie technologia. Możliwości poznawcze i szanse, wydawnictwo: Wyd. Śląskie, rok: 1999Autor: Jeziorow J., tytuł: Wrocławski "Kodeks dobrych praktyk w zakresie korzystania z wyników pracy intelektualnej., wydawnictwo: Urząd Marszałkowski Województwa Dolnośląskiego, rok: 2010Autor: Golat R., tytuł: Prawo autorskie. Poradnik dla twórców., wydawnictwo: Dom Wydawniczy ABC., rok: 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Protecting intellectual property

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W28	C1, C2, C3	Lec1 - Lec8	N1

SUBJECT SUPERVISOR

dr inż. Zygmunt Domagała tel.: 71 320-27-85 email: Zygmunt.Domagala@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo II**
Name in English: **Materials Science II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031017 (MMM031317)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Positive credit of Materials Science I lecture course
2. Positive credit of Materials Science I laboratory practice

SUBJECT OBJECTIVES

C1. Knowledge of division rules, classification and notatation for non-alloyed steels, alloyed steels , casts and their application
C2. Knowledge of heat treatment and termo-chemical teratment basement and their influence on steel properties
C3. Knowledge of types and non-iron metals properties

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know the rules of division, classification and notatation for non-alloyed steels, alloyed steels, casts and their application
PEK_W02 - Know the basement of termo and termo-chemical treatments and their influence on steel properties
PEK_W03 - Know the types and properties of non-iron metal alloys

II. Relating to skills:
PEK_U01 - Be able to divide, classification and notation of non-alloyed steels, alloyed steels , casts and their application
PEK_U02 - Be able to determine the types of heat and termo-chemical treatment application and theit influence on steel properties
PEK_U03 - Be able to determine the types and properties of non-iron metal alloys

III. Relating to social competences:
PEK_K01 - Information retrieval and their critical analyse
PEK_K02 - Observance of custom and rules binding at academic environment

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Cast irons. Grafitisation. Modification of cast irons	2
Lec2	Types of graphite and metall matrix of cast irons. Classification and natation rules of cast irons.	2
Lec3	Phase transformation in steels during heating	2
Lec4	Phase transformation in steels during cooling	2
Lec5	Basic types of annealing. Hardening and tempering of steel	2
Lec6	TTT diagrams. Hardenability. Supersaturation and ageing	2
Lec7	Surface treatment of steel, surface hardening, carburizing and nitriding	2
Lec8	Influence of alloying elements on the steel phase transformation	2
Lec9	General classification and notation rules for non-alloed steels	2
Lec10	Structures, properties and notation rules for alloed steels	2
Lec11	Alloyed structural steels. Weldability	2
Lec12	Alloyed tool steels.	2
Lec13	Steels with special properties: corrosion resistant steels, creep and heat resistant steels, maraging steels and wear resistant steels	2
Lec14	Copper and copper alloys	2
Lec15	Aluminium and light metal alloys	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Microstructures of steels and cast steels on the basement of Fe-Fe3C system	2
Lab2	Cast irons microstructures and properties	2

Lab3	Influence of the heat tratment on the steels microstructure and properties	2
Lab4	Mmicrostructures and properties of the tool steels	2
Lab5	Microstructures of stells with special properties	2
Lab6	Microstructures and properties of aluminium and copper alloys	2
Lab7	Summary and supplerment of laboratory practice	2
Lab8	Credit of laboratory practice	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. laboratory experiment
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Writen-oral examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K02	Introduction test, oral answers, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M.F.Ashby, D.R. Jones - Engineerig Materials

SECONDARY LITERATURE

M. F. Ashby- Materials Selection in Mechanical Design, vol 1 and 2

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01- PEK_W02	K1MBM_W12	C1-C2	Lec 1 - lec 13	N1-N4
PEK_W03	K1MBM_W12	C3	Lec 14 - Lec 15	N1-N4
PEK_U01- PEK_U03	K1MBM_U16	C1-C3	Lab 1 - Lab 6	N3-N5
PEK_K01- PEK_K02	K1MBM_K09	C1-C3	Lab 1 - Lab 8	N2, N3, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Włodzimierz Dudziński tel.: 320-37-80 email: wlodzimierz.dudzinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika II**
Name in English: **Mechanics II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031018 (MMM031318)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. mathematical analysis (differentiation, integration), linear algebra, trigonometry
2. differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of the principles of classical dynamics for typical mechanical systems (discrete systems: .massl particle, system of masses particles with holonomic constrains, rigid body).
C2. Resolving some technical problems of structure and mechanical systems under dynamic loads.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with
a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define key concepts in the dynamics of mechanical systems (momentum, angular momentum, force of inertia, work, kinetic and potential energy)
PEK_W02 - He knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance)
PEK_W03 - He knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert's principle). He is familiar with the term of conservative system and with energy conservation law. He knows the dynamics equations of rotational motion and plane motion of a rigid body. Dynamics of the rigid body rotation about a fixed point

II. Relating to skills:
PEK_U01 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion and in the rotation about a fixed point. He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using the Newton's second principle.
PEK_U02 - It can calculate the frequency of free vibration for systems with one degree of freedom of the linear viscous damping and without damping. He can derive the equations of motion and calculate its parameters (angular velocity and acceleration) for rigid body loaded by torque and moves rotation.
PEK_U03 - He can determine the reaction force constraints under dynamic loads. It can calculate the kinetic and potential energy for complex mechanical systems. He is able to apply the energy conservation law to determine the differential equations of conservative system.

III. Relating to social competences:
PEK_K01 - He can search information and is able to review it critically.
PEK_K02 - He can objectively evaluate the arguments as well as rationally explain and justify the own point of view.
PEK_K03 - He can observe customs and rules of academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. The basic principles of classical mechanics. Kinematics and dynamics. Models of discrete and continuous dynamical systems in mechanics.	2
Lec2	A brief reminder of the kinematics of the material from the previous semester. Addendum: Kinematics of the rigid body rotation about a fixed point.	2
Lec3	The Newton's second law (applicable in the dynamics of the free and constrained point).	2
Lec4	The vibrations of the one-mass single degree of freedom system with the linear viscous damping and without damping. Complex notation. Free vibrations.	2
Lec5	Harmonically forced vibration, frequency characteristics, resonance. Dynamic and kinematic excitations.	2
Lec6	The forces of inertia and d'Alembert's principle. Momentum, and momentum principle. Angular momentum and angular momentum principle.	2
Lec7	The definition of work. Elementary work. The kinetic and potential energy. The principle of work and kinetic energy equivalence.	2
Lec8	The principle of conservation of energy. Conservative systems. Examples of applications.	2

Lec9	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems.	2
Lec10	The principle of the center of mass motion and the principle of momentum in multi-mass systems.	2
Lec11	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation.	2
Lec12	Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness.	2
Lec13	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces.	2
Lec14	Angular momentum in the plane motion of a rigid body and dynamics of plane motion. The kinetic energy of rigid body in a general motion. The König's theorem.	2
Lec15	Determination of the differential equations of motion and natural frequency of the dynamical conservative systems based on the energy conservation law.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Practical problems of kinematics of particle, rotational motion and plane motion of rigid body.	2
Cl2	Practical problems of kinematics of relative motion of particle.	2
Cl3	Solving examples of tasks of Kinematics of rigid body rotation about a fixed point.	2
Cl4	Solving examples of tasks with dynamic free massl particle using The Newton's second law (rectilinear and curvilinear motion)	2
Cl5	The Newton's second law (applicable in the dynamics of the constrained massl particle).	2
Cl6	Test 1: Kinematics of massl particle and rigid body. The Newton's second law application in the derivation of the equations of motion of massl particle.	2
Cl7	Examples of tasks from free vibrations of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations)	2
Cl8	Examples of tasks from forced vibration of simple mechanical systems with one degree of freedom.	2
Cl9	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy)	2
Cl10	Examples of the tasks of the dynamics and rotational motion of the rigid body using momentum principle, angular momentum principle and mass center movement rule.	2
Cl11	Dynamic force responses in the supports of rotated body.	2
Cl12	Equations of motion for rigid body in plane movement.	2
Cl13	The kinetic energy of a rigid body in a general motion. The König's theorem. Determination of the differential equations of motion of the dynamical conservative systems based on the energy conservation law.	2
Cl14	Test 2: Dynamics of the particles system and rigid body, vibrations of mechanical systems with one degree of freedom.	2

Cl15	Passing talks, last chance tests.	2
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides.
N2. Calculation exercises.
N3. Tutorials.
N4. Self study - self studies and preparation for examination.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	oral-writing exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02,PEK_U03	test 1, oral answers
F2	PEK_K01,PEK_K02, PEK_K03,	test 2, oral answers
P = (F1+F2):2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 1, Statics, John Wiley & Sons, Inc., New York, 1998
2. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 2, Dynamics, John Wiley & Sons, Inc., New York, 1998

SECONDARY LITERATURE

1. Mary Lunn, A First Course in Mechanics, Oxford Science Publications, Oxford 1991
2. Philip Dyke, Roger Whiteworth, Guide to Mechanics, MacMillan Press, London 1992
3. Herbert Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W07	C1	Lec1 to Lec15	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_U05, K1MBM_U08	C2	Cl1 to Cl15	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K1MBM_K01, K1MBM_K03, K1MBM_K04	C3	Cl1 to Cl15	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ergonomia i BHP**
Name in English: **Ergonomics and safety**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031019 (MMM031319)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases, estimate of professional risk on work positions	2
Lec3	Ergonomics as interdisciplinary science	2
Lec4	Labor biomechanics - science about threats for employee health discovering, being result of executable work	2
Lec5	Dangerous and harmful agents in work environment - mechanical agents and electric power	2
Lec6	Dangerous and harmful agents in work environment - noise, vibrations and lighting	2
Lec7	Dangerous and harmful agents in work environment - chemical and biological agents	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE
D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ergonomics and safety
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W27	C1	Lec1, Lec2	N1, N2, N3, N4
PEK_W02	K1MBM_W30	C2	Lec3	N1, N2, N3, N4
PEK_W03	K1MBM_W26	C3	Lec4, Lec5, Lec6, Lec7	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-odlewnictwo**
Name in English: **Manufactures techniques - casting**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031020 (MMM031320)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge about the metallurgical process of metal ores and receiving ferrous alloys and non-ferrous metals; Has a basic knowledge about the types of engineering materials - their properties, applications and principles of their selection; Has a basic knowledge about the structure of metals and alloys as well as the principles of their classification and labeling;
2. Can determine the characteristics of the materials microstructure, identify occurring in material phases; Also is able to differentiate: the microstructure of ferrous alloys (in terms of carbon content), non-ferrous alloys and the effect of the heat treatment;
3. Can read and interpret the figures and diagrams used in the technical documentation;

SUBJECT OBJECTIVES

C1. The acquisition of general knowledge about the basic techniques of foundry manufacturing methods;
C2. Acquiring the selection skills and a critical analysis of chosen casting technology and basic parameters of that process;
C3. Acquisition and consolidation of social skills like the ability of working in a group to solve the problems effectively; The acquisition of sense of responsibility and respect for traditions existing in academia and society;

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a basic knowledge of the manual and machine manufacturing technologies of foundry molds and cores
PEK_W02 - Has a knowledge of the basic methods of melting and treatment of metallurgical alloys.
PEK_W03 - Has a basic knowledge about designing the casting products and the processes for their production with principles of technology of their selection dependent on the type of casting and the type of alloy.

II. Relating to skills:
PEK_U01 - Can analyze and design the process of production casting equipment to a simple product.
PEK_U02 - Can choose the right technology for casting and define the basic parameters of that process.
PEK_U03 - Can choose the right method of treatment of the casting alloy and define its basic parameters.

III. Relating to social competences:
PEK_K01 - Can search for information and critically analyze them, rationally explain them and justify the own point of view using the knowledge of foundry branch.
PEK_K02 - Recognizes the importance of team cooperation on ways to choose a strategy to optimally solve assigned to a group problems.
PEK_K03 - Understands the need to respect the traditions and rules in academia and society.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Discussion about the specific shape of the statethe from liquid metal, fundamental concepts and algorithms for casting production.	2
Lec2	Principles for design and construction of casting equipment.	3
Lec3	Materials and equipment used for the preparation of the molding and core sands and the methods of their manufacturing and testing their properties.	3
Lec4	Methods for manual manufacturing of foundry molds and cores.	2
Lec5	Automatic manufacturing of foundry molds and cores.	3
Lec6	Production of molds and cores from selfsetting molding sands.	3
Lec7	Production of molds and cores from thermosetting molding sands.	2
Lec8	Manufacturing the castings using a precise technique of lost models.	2
Lec9	Knocking out and the cleaning of castings.	1
Lec10	Manufacturing the castings in metal molds.	3
Lec11	Melting casting alloys.	3
Lec12	Obróbka metalurgiczna stopów odlewniczych i cieplna odlewów. Sprawdzian wiadomości.	3
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Organizational issues. Research the materials and molding sands.	2
Lab2	Construction of casting models and core boxes.	2

Lab3	Manual production of foundry molds and cores.	2
Lab4	Automatic production of foundry molds and cores.	2
Lab5	Production of molds and cores from self-and thermosetting molding sands.	2
Lab6	Manufacturing the castings in metal molds.	2
Lab7	Testing the properties of casting alloys. Completion of the course.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
N4. tutorials
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03,PEK_K01-PEK_K03	short exam
F2	PEK_U01 - PEK_U03,PEK_K01-PEK_K03	oral exam
F3	PEK_U01 - PEK_U03,PEK_K01-PEK_K03	laboratory reports
P = średnia z wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000; 2. Tabor A. Odlewnictwo wyd. „Akapit” Kraków 1996; 3. Murza-Mucha P., Techniki wytwarzania – Odlewnictwo. PWN, Warszawa 1978;4. Granat K. Laboratorium z odlewnictwa, skrypt PWr, Wrocław 2007; 5. Jaworski R. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr, Wrocław 1981;6. Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skr. P. Warsz. Warszawa 1981;

SECONDARY LITERATURE

1. Lewandowski J. L.; Tworzywa na formy odlewnicze, wyd.: „Akapit” Kraków 1997;2. Błaszkowski K. Technologia formy i rdzenia, Warszawa 1990;3. Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufactures techniques - casting
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W21	C1, C2	lec1, lec3-10	N1-N5
PEK_W02	K1MBM_W21	C1, C2	lec11,12	N1-N5
PEK_W03	K1MBM_W21	C2	lec2	N1, N2, N4
PEK_U01, PEK_U02	K1MBM_U27	C1	La1-La6	N2-N5
PEK_U03	K1MBM_U27	C2	La7	N2-N5
PEK_K01, PEK_K03	K1MBM_K01, K1MBM_K06	C3	La1-La7	N2-N5
PEK_K02	K1MBM_K04	C3	La7	N2-N5

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów I**
Name in English: **STRENGTH OF MATERIALS I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031021 (MMM031321)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2	2			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of statics and fundamentals of mechanics – forces, reactions, constraints, Newton’s laws. More specifically the familiarity with the following concepts is required: moment of a force at a point, balance/reduction of an arbitrary spatial force system, definitions of internal forces in a member, vector algebra and mass geometry. The ability to calculate the following quantities: internal force in a member, moment of static and moment of inertia of composite figures and simple solids, the parallel and rotary transformation of the coordinate system.

SUBJECT OBJECTIVES

C1. Technical problem solving based on mechanics.
C2. Performing strength analyses of machine components.
C3. Teamwork and following academic principles.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows: foundations of tensor analysis and its applications in the solid mechanics,
PEK_W02 - limitations of solutions of geometrically linear structures, when to superimpose displacements, what is the stability of the compressed member and what load leads to its loss,
PEK_W03 - the most useful failure criteria hypotheses and their applications,

II. Relating to skills:
PEK_U01 - Student has practical skills in: performing the parallel and rotational transformation as well as calculating the eigenvalues of the stress, strain or moment of inertia tensors,
PEK_U02 - calculating of the stress and displacement in a member with a compact or a thin-walled cross-section loaded with tension–compression, torsion, shear or bending force as well as stress in welded, riveted, bolted joints.
PEK_U03 - designing a member resistant to buckling in the elastic and elastic-plastic regions.

III. Relating to social competences:
PEK_K01 - Social competencies: independent research and critical evaluation of the found sources,
PEK_K02 - objective evaluation of arguments, rational explanation and justification of the student's viewpoint using knowledge of the strength of materials,
PEK_K03 - conforming to the academic principles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic notions. Experimental foundations of the discipline. Strength design of straight members in tension and compression.	2
Lec2	Stress theory.	2
Lec3	Theory of strain. Engineering measurements of strain.	2
Lec4	Physical relationships between stress and strain.	2
Lec5	Torsion of circular shafts.	2
Lec6	Torsion of members of arbitrary cross-section. Thin-walled members.	2
Lec7	Shearing of joints.	2
Lec8	Symmetric bending of straight members. Internal forces and stresses.	2
Lec9	General case of bending. Unsymmetrical bending. Shearing centre.	2
Lec10	Displacements in beams. Deflection line of a beam.	2
Lec11	Buckling of members.	2
Lec12	Strain energy, spherical and deviatoric parts of tensor, shear energy.	2
Lec13	Failure criteria and combined modes of loading.	2
Lec14	Energy methods for determining displacements in statically determinate and indeterminate member systems.	2
Lec15	Stress concentration. Permissible stress. Factor of safety.	2
		Total hours: 30

Form of classes – Classes	Number of hours

Cl1	Strength design of straight members in tension and compression. Effect of temperature.	2
Cl2	Statically indeterminate cases in stretching/compressing.	2
Cl3	Plane stress. Mohr’s circle.	2
Cl4	Engineering strain measurement.	2
Cl5	Shafts in torsion – strength and stiffness.	2
Cl6	Thin-walled members in torsion – strength and stiffness.	2
Cl7	Written test.	2
Cl8	Bending. Stress field.	2
Cl9	General case of bending.	2
Cl10	Displacements in beams. Deflection line of a beam.	2
Cl11	Unsymmetrical bending. Shearing centre.	2
Cl12	Buckling of compressed members.	2
Cl13	Applications of failure criteria hypotheses.	2
Cl14	Castigliano and Menabre-Castigliano theorem.	2
Cl15	Written test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. lectures supported with audiovisual aids when necessary.
N2. calculating classes
N3. homework
N4. self study and preparation for the exam.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written and oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03; PEK_K01, PEK_K02, PEK_K03;	Oral examination, written test 1, written test 2.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
(Basic reading)

SECONDARY LITERATURE
(Additional reading)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
STRENGTH OF MATERIALS I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W09	C1	L1 - L15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_U19	C2	C1 - C15	N2, N3
PEK_K01, PEK_K02, PEK_K03	K1MBM_K01, K1MBM_K03	C3	C1 - C15	N2 do N4

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Śródka tel.: 713204070 email: wieslaw.srodka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji maszyn I**
Name in English: **Fundamentals of Machine Design I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031022 (MMM031322)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	30	
Number of hours of total student workload (CNPS)	90		60	60	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	3		2	2	
including number of ECTS points for practical (P) classes			2	2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4	1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic understanding of the types of engineering materials, their structure, properties and properties, processing, applications and selection rules. 2 It has a basic knowledge of mechanics, strength of materials and manufacturing techniques. 3 He has knowledge of the methods of mapping geometric formations on the plane and the principles of saving design of machine elements and the performance of their schemes.
2. Skills: 1 Able to read and interpret drawings and diagrams used in the technical ability to perform the technical documentation. 2 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 3 It can be used in the process of constructing knowledge gained on subjects: Metallurgy, Mechanics, Strength of materials, Engineering Graphics.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2. Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the process of design and engineering.
C2. Gaining knowledge of the construction, operation and use of the major machine components (connections) and the rules for their selection and construction.
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is to construct a simple device with screw drive (for example, a screw press, bearing puller, scissor lift, car jack, etc.) while using the knowledge of the connections, used in mechanical engineering (screw, bolt, dowel, keyways, spline, serrated, snap-fitting, welded and spring).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge in the design, principles of design, design features, and knows the algorithm design and construction.
PEK_W02 - It has a basic knowledge of connections in the construction of machines, their design and strength calculations and applications.
PEK_W03 - He has knowledge of the factors affecting the fatigue strength of machine elements and how they are taken into account in the design calculations.

II. Relating to skills:
PEK_U01 - Able to independently formulate and solve simple technical tasks.
PEK_U02 - He can choose and calculate the basic connection used in mechanical engineering.
PEK_U03 - He can choose the optimal (in light of the criteria used) machine parts and know their limitations.

III. Relating to social competences:
PEK_K01 - Can search information and carry out their critical analysis.
PEK_K02 - Able to work independently and in a team.
PEK_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Defined notions of technical product and design. Design features, principles of design. Rationale for the existence of a product.	2
Lec2	Design and construction - differences. Description of the process of design - examples.	2
Lec3	Algorithmical and heuristic methods of generating of conceptions (method of elementary questions, morphology boards and boxes, biological analogy, brainstorming, 635 method, Delphic method).	2
Lec4	Criteria of conception rating. Methods of selection of the best conception: method of balancing positive and negative features, weighting of criteria method, etc.. Examples.	2
Lec5	Stress, fatigue, fatigue strength and method of its determination. Smith's and Haighe's graphes.	2

Lec6	Stress raisers and possible impacts on strength calculations. Processes resulting in the increased fatigue life of machine elements. β - fatigue stress concentration factor.	2
Lec7	Methods for increasing the fatigue strength. Allowable stress k - means for their appointment. Factor of safety and actual safety factor.	2
Lec8	The actual safety factor in the case of complex stress state. Stages of strength calculations for machine elements loaded forces variables. Calculation example (the roller gear).	2
Lec9	Joints in mechanical engineering, classification and characteristics. Bolted connections, thread specifications. Determination of the forces and moments on the thread.	2
Lec10	Efficiency and self-locking of a power screw. The minimum height of the nut in the screw.	2
Lec11	The notion of preload. Method for the calculation of bolted connections with preload. Calculations of thread forms.	2
Lec12	Shaft-hub connections: keys, splines, serrated joints. Dowel connections. Main features and calculation rules.	2
Lec13	Welded and pin connections. Specifications, principles of design and calculations.	2
Lec14	Pressed connections. Analytical bases of geometry selection, elements fit.	2
Lec15	Steel elastic connectors. Fundamentals of strength calculations of selected types of springs. Forming of cylindrical coil springs.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Health and Safety Training. Recognizing of standard machine elements.	1
Lab2	Determination of static stiffness, energy dissipated and acquired in elastic-damping elements.	2
Lab3	Determination of the frictional characteristics of the cross slide bearing.	2
Lab4	Determining of resistance to motion of angular bearing.	2
Lab5	Theoretical and practical identification of phenomenon of the resonance in shaft with one non-balanced mass.	2
Lab6	Research of the pressed connections.	2
Lab7	Investigation of belt transmission with V-belt – elastic slip and efficiency.	2
Lab8	Estimation of efficiency of power screw.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed device.	3
Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	5
Proj3	Calculations and analysis of designed elements (power screw, bearings, bolts, etc..).	12
Proj4	Performance of assembly drawing designed device and working drawings of elements selected by lecturer.	10
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. laboratory experiment N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	exam, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Quizzes, oral response, the report of the laboratory
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	defense of project, quizzes, evaluation of computational design review, review of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Podstawy konstrukcji maszyn; Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999. 2. Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT. 3. Beitz G.; Nauka konstruowania . Warszawa, WNT 1984. 4. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982. 5. Roloff / Matek, Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

SECONDARY LITERATURE

1. A. Dziama; Metodyka konstruowania maszyn, PWN, Warszawa, 1985. 2. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT.1966. 3 .Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982. 4. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer-Verlag 1985. 5. Niezgodzinski M., Niezgodziński T.; Wzory, wykresy i tablice wytrzymałościowe Warszawa, PWN 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machine Design I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W18	C1	Lec1 - Lec5	N1, N2, N3, N5
PEK_W02	K1MBM_W18	C2	Lec8 - Lec14	N1-N5
PEK_W03	K1MBM_W18	C2, C3	Lec6 - Lec7	N1, N2, N3, N5
PEK_U01 - PEK_U03	K1MBM_U14, K1MBM_U18, K1MBM_U21	C1 - C3	Proj1- Proj4, Lab1 - Lab8	N2-N5
PEK_K01- PEK_K03	K1MBM_K10	C1 - C3	Proj1- Proj4, Lab2 - Lab8	N2-N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Stanisław Krawiec tel.: 71 320-40-56 email: Stanislaw.Krawiec@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria mechanizmów i manipulatorów**
Name in English: **Theory of Mechanisms and Manipulators**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031023 (MMM031323)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of fundamental laws in statics, kinematics and dynamics
3. Skill in fuction analysis, derivatives, basic matrix and vector operations

SUBJECT OBJECTIVES

C1. Acquire knowledge in topology, kinematics and dynamics of mechanisms and manipulators
C2. Acquire and understanding of basic mechanisms and manipulators
C3. Getting skills in determining kinematic and dynamic parameters

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Understands theoretical fundamentals of mechanism and robot topology
PEK_W02 - Has the knowledge of kinematic and dynamic analysis methods
PEK_W03 - Is able to commentate results of analysis, evaluate their correctness

II. Relating to skills:
PEK_U01 - Is able to evaluate topological carrectness of kinematic systems
PEK_U02 - Is able to determine kinematic and dynamic properties
PEK_U03 - Is able to create models of simple planar mechanisms and manipulators

III. Relating to social competences:
PEK_K01 - Has a conviction of responsibility for the work done

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms, movable properties, redundant constraints	3
Lec2	Kinematics of mechanisms - graphic-analytical methods	3
Lec3	Analytical methods in kinematics (vectors, projections, time derivatives)	2
Lec4	Planetary gear trains	2
Lec5	Manipulators' properties. Planar serial and parallel systems	2
Lec6	Kinematics of planar manipulators, jacobian	2
Lec7	Matrix description of spatial systems	2
Lec8	Denavit-Hartenberg notation	2
Lec9	Introduction to mechanisms' dynamics	2
Lec10	Kinetostatic analysis	3
Lec11	Friction in joints, efficiency	3
Lec12	Dynamic motion analysis	2
Lec13	Fluctuation o machine motion, flyweels	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction to modelling mechanisms in SAM (Simulation and Analysis of Mechanisms) – presentation of examplesi	2
Proj2	Mechanisms' topology: rules of drawing digrams, topology analysis - joint classification, mobility (test, project)	2
Proj3	Rules of creating models in SAM system, creating simple models, model motion simulation, presentation of analysis results	2
Proj4	Dimensional modelling of mechanisms, drivers' definition, massis, external loads	2
Proj5	Kinematic analysis - position analysis (project)	2

Proj6	Kinematic analysis - velocity and acceleration determination - vector methods (test, project)	2
Proj7	Kinematic analysis - velocity and acceleration determination using SAM (project)	2
Proj8	Kinematic analysis using analytical methods: loop equation, vectors, projections, time derivatives (project)	2
Proj9	Planar manipulators - kinematic analysis using matrix notation	2
Proj10	Modelling manipulators in SAM: forward and inverse tasks (project)	2
Proj11	Anaysis of planetary transmissions, angular velocity ratio determination (test, project)	2
Proj12	Modelling of planetary transmissions and gear linkage mechanisms using SAM (project)	2
Proj13	Joint force and external equilibrium determination (test, project)	2
Proj14	Determination of joint forces including friction (test, project)	2
Proj15	Dynamic force analysis using SAM	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. self study - preparation for project class
N3. individual project
N4. tutorials
N5. preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written examination
P = Ocena z egzaminu		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project defence

F2	PEK_U01, PEK_U02, PEK_U03 PEK_K01	test
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002; Miller S.: Theory of machines and mechanisms. Analysis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1996; Gronowicz A. i inni: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE

Olędzki A.: Fundamentals of machines and mechanisms theory (in Polish). WNT 1987; Morecki A., Oderfeld J.: Theory of machines and mechanisms (in Polish). PWN 1987; Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory of Mechanisms and Manipulators
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W17	C1, C2, C3	Lec1-Lec13	N1 - N5
PEK_U01, PEK_U02, PEK_U03	K1MBM_U11	C2, C3	Proj1-Proj15	N2, N3, N4
PEK_K01	K1MBM_K04	C3	Proj1-Proj15	N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Antoni Gronowicz tel.: 71 320-27-10 email: antoni.gronowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031024 (MMM031324)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the complex functions and differential equations.

SUBJECT OBJECTIVES

C1. Getting knowledge about the basic description methods of automatic systems.
C2. Getting knowledge about the basic analysis methods of automatic systems.
C3. Getting knowledge about the basic synthesis methods of automatic systems.
C4. Learning to design control systems.
C5. The practical skills to build and run basic automation systems.
C6. Skills to evaluate the performance of control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of basic methods for describing automation systems.
PEK_W02 - Knowledge of basic methods to analyze automation systems.
PEK_W03 - Knowledge of methods to synthesize automation systems.

II. Relating to skills:
PEK_U01 - Can define the mathematical description of the automation system.
PEK_U02 - Able to analyze the function of the automation system.
PEK_U03 - Can design automation system.

III. Relating to social competences:
PEK_K01 - Can broaden their knowledge by using additional aids.
PEK_K02 - Can think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic terms, the structure of control systems and their classification.	2
Lec2	Description of linear automation systems: differential equations, transfer function, time characteristics.	2
Lec3	Description of linear automation systems: the frequency response, the frequency characteristics.	2
Lec4	Dynamic objects: proportional, inertial, differential.	2
Lec5	Dynamic objects: Integral, oscillating, delay.	2
Lec6	Stability. Theorem of stability, properties of stable and unstable systems.	2
Lec7	Description of discrete systems. The differential equation, transfer function, frequency responce, time characteristics.	2
Lec8	Automatic control. Requirements. Static control. astatic control.	2
Lec9	Controllers: PI, PD, PID	2
Lec10	Nonlinear systems. Methods of description and analysis.	2
Lec11	Discrete automatic control.	2
Lec12	Boolean algebra.	2
Lec13	Logic combinational systems.	2
Lec14	Logic sequential systems.	2
Lec15	Test. Credit.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Static characteristics of automatic objects.	2
Lab2	Dynamic characteristics of automatic objects.	2
Lab3	Frequency characteristics of automatic objects.	2

Lab4	Examination of automatic control systems.	2
Lab5	Simulation tests of automatic objects in Matlab-Simulink system.	2
Lab6	On-off control.	2
Lab7	Programming languages of PLC controllers.	2
Lab8	Mathematical fundamentals of digital automation systems.	2
Lab9	Elements and contactor-relay systems.	2
Lab10	Logic combinational systems.	2
Lab11	Synthesis of logic sequential systems.	2
Lab12	Modeling and programming of sequential processes.	2
Lab13	Modeling and programming of concurrent processes.	2
Lab14	Modeling and programming of complex processes.	2
Lab15	Industrial communication networks.	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - self studies and preparation for examination
N2. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	Exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01,PEK_K02	Average grade
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Automatic Control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W01, K1MBM_W16	C1-C3	Lec1-Lec15	N1
PEK_U01 - PEK_U03 PEK_K01 - PEK_K02	K1MBM_K05, K1MBM_U05	C4-C6	Lab1-Lab15	N2

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Naplocha tel.: 27-22 email: krzysztof.naplocha@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-przeróbka plastyczna**
Name in English: **Manufacturing techniques-plastic working.**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031025 (MMM031325)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basic mechanical properties of engineering materials.
2. Have a basic knowledge of physics and mathematics.
3. Have skills in measurement methods, techniques for measuring and evaluating the results of the measurement.

SUBJECT OBJECTIVES

C1. Understanding the different manufacturing technologies by processing plastic products. Method used to investigate the effect of shaping the properties of the manufactured products.
C2. Understanding the phenomena limiting plastic forming processes.
C3. Knowledge of modern technologies for shaping plastic.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic technologies and material plastic forming process parameters.
PEK_W02 - Able to properly define the problem in the field of plastic forming and properly be characterized.
PEK_W03 - Can choose the right technology plastic forming and defining the basic parameters of the process.

II. Relating to skills:
PEK_U01 - Can search for information on plastic forming and execute their critical analysis.
PEK_U02 - Can use the theoretical knowledge gained in forming the lecture and apply it in practice.
PEK_U03 - Able to perform selected laboratory tests and correct to assess their performance.

III. Relating to social competences:
PEK_K01 - Can think and act in a creative way.
PEK_K02 - Acquires the ability to work as a team.
PEK_K03 - Understands the impact of engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	History of plastic processing.	1
Lec2	Effect of strain on the structure and properties of the material.	2
Lec3	Effect of plastic forming process on the properties of the product.	3
Lec4	Sheet metal forming processes. Analysis of cutting and bending processes.	3
Lec5	Course of process of formation of articles about non - the developable surface.	3
Lec6	Processes of forming lumps. Analysis of the process of rolling plates and profiles.	3
Lec7	The conduct and analysis of the extrusion process..	3
Lec8	The course and forging process analysis.	2
Lec9	Manufacture of metal in the drawing process.	2
Lec10	Manufacture of metal in the metal powder metallurgy.	2
Lec11	Metal Forming Tools.	2
Lec12	Overview of modern technologies for shaping plastic.	3
Lec13	Final test	1
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Cold deformation and annealing of metals.	2
Lab2	Cupping test sheets.	2
Lab3	Rolled metal sheets and profiles.	2
Lab4	Squeezing metallurgical and machine parts.	2
Lab5	Manufacture of metal in the process of drawing.	2
Lab6	Expression - cut, bending and pressing.	3

Lab7	Free forging and matrix.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷ PEK_W03	Colloquium.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03 PEK_K01÷PEK_K03	quizzes, laboratory report, participate in discussions problem
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
The Gronostajski J., Plastic processing of metals, Wroclaw 1974Morawiecki M., Sadok L., Wosiek the E., Theoretical bases of technological processes of plastic alteration, Wyd. Silesia, Katowice 1981
http://www.metalplast.pwr.wroc.pl/instrukcje.html

SECONDARY LITERATURE
The Romanowski P., Guide of plastic processing on hold, the Publishing house Scientifically - Technical, Warsaw 1976. the Erbel the S., Kuczyński the K., Marciniak the Z., plastic Processing of, PWN, Warsaw 1981.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing techniques-plastic working.
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01÷ PEK_W03	K1MBM_W21	C1÷ C3	Lec1÷ Lec7	N1
PEK_U01÷PEK_U03	K1MBM_U29	C1÷ C3	Lab1÷ Lab7	N2, N3, N4
PEK_K02÷ PEK_K03	K1MBM_K04	C1÷ C3	Lab1÷ Lab7	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Andrzej Dolny tel.: 21-74 email: andrzej.dolny@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-spawalnictwo**
Name in English: **Manufacturing techniques - welding**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031026 (MMM031326)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1.Has a basic knowledge concerning metallurgical processes of treatment of ores, production of steel and non-ferrous metals, has a basic knowledge about mechanical properties of engineer materials, organized knowledge about types of metallic engineer materials, its composition, properties, applications and rules of its right choice.
2. 2.Has a detailed knowledge about structures of steel and cast iron, rules of its classification and description, has a basic knowledge about thermal and thermo-mechanical treatment, knowledge about alloyed steels and non-ferrous metals and its alloys, has the theoretical knowledge about electric circuits.
3. 3.Can analyze macrostructures of materials, technological imperfections, can estimate features of microstructure of metals, can identify phases using the balance curves, can distinguish microstructures according to amount of carbon in steel, influence of thermal treatment, can analyze electric circuits, understands technical drawings, can prepare technical documentation

SUBJECT OBJECTIVES

C1. Getting of basic knowledge about joining of metals with use of welding methods.
C2. Getting of skills of the right choice of joining and basic parameters of the process.
C3. Obtaining and keeping of social competences concerning ability to cooperate in the student's group with a goal to solve problems effective way. Responsible, honest and serious approach to new duties, respecting customs of academic society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows types of joints, welding positions, description of joints, reasons of cracking of joints
PEK_W02 - Knows basic methods of welding and parameters of the process
PEK_W03 - Has the knowledge concerning metallurgy of welding processes, brazing/soldering, pressure joining and thermal cutting

II. Relating to skills:
PEK_U01 - Can define basic parameters of welding, describe basic properties of welding equipment and make a right choice of consumables
PEK_U02 - Can define basic parameters of brazing/soldering and resistance welding, describe basic properties of welding equipment and make a right choice of consumables
PEK_U03 - Can define basic parameters of thermal cutting, analyze influence of cutting on properties of the cutting surface and precision of following of the shape

III. Relating to social competences:
PEK_K01 - Shows ability necessary to cooperate in a team with a goal to improve methods of right strategy of optimal solving of problems
PEK_K02 - Is able to assess properly ratios, explain and justify his own point of view with use of a knowledge concerning basic matters of material science.
PEK_K03 - Respects customs and rules of academic society

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization of the lecture, Safety in welding, Types of welds and joints, welding positions	2
Lec2	Basics of metallurgy of welding processes	2
Lec3	Fuel gas welding of steel, cast iron and non-ferrous metals	2
Lec4	Basic information about arc welding	2
Lec5	Shielded manual metal arc welding	2
Lec6	Gas shielded tungsten arc welding	2
Lec7	Gas shielded metal arc welding GMAW	2
Lec8	Submerged arc welding and electroslag welding	2
Lec9	Welding with use of concentrated energy sources	2

Lec10	Brazing and soldering. Braze welding	2
Lec11	Thermal oxygen, plasma and laser cutting. Water cutting	2
Lec12	Resistance pressure joining, Friction welding	2
Lec13	Hardfacing and thermal spraying	2
Lec14	Stresses and deformations in welding. Thermal treatment of welded joints	2
Lec15	Acceptance tests of welded structure. Quality systems in welding	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Organization of the lab. Safety in welding. Fuel gas welding of steel	2
Lab2	Brazing and soldering of steel, copper and aluminum	2
Lab3	Resistance pressure joining Friction welding	2
Lab4	Shielded manual metal arc welding	2
Lab5	Gas shielded tungsten and metal arc welding	2
Lab6	Stresses and deformations in welding. Submerged arc welding	2
Lab7	Thermal oxygen and plasma cutting. Robotic welding	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	verball anwers, short tests
P = średnia z F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Ambroziak, A. (ed.). Manufacturing techniques. Welding. Laboratory. Wrocław University of Technology, 2011, http://Www.Dbc.Wroc.Pl/

SECONDARY LITERATURE

1. Pilarczyk, J. (eds.): Advisory Engineer. Welding. Vol I and II, WNT Warszawa, 2003, 2005
2. Klimpel A: Welding, Resistance Welding and Cutting Metals., WNT, Warsaw, 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing techniques - welding
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W21	C1, C3	Le1 - Le15	N1, N5
PEK_U01 - PEK_U03	K1MBM_U28	C1, C2, C3	Lab1 - Lab7	N2, N3, N4
PEK_K01 - PEK_K03	K1MBM_K04	C3	Lab1 - Lab7	N2 - N5

SUBJECT SUPERVISOR

dr inż. Piotr Białucki tel.: 42-71 email: piotr.bialucki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Tworzywa sztuczne**
Name in English: **Polymers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031027 (MMM031327)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The Student has got a basic knowledge in the field of materials science and chemistry.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of construction, preparation, modification and properties of polymeric materials.
C2. Acquisition of basic knowledge about the technology used for plastics processing.
C3. Getting skill about selection of polymeric materials in certain applications.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic groups of polymers, their structure, properties.
PEK_W02 - The student knows the technology used for the processing of polymeric materials,
PEK_W03 - The student knows the basic applications of polymeric materials.

II. Relating to skills:
PEK_U01 - Is able to identify polymeric materials.
PEK_U02 - Can indicate the processing technology for producing a selected product from the plastic material,
PEK_U03 - Place the selected polymeric materials for specific applications.

III. Relating to social competences:
PEK_K01 - Searches of information and its critical analysis,
PEK_K02 - Team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group
PEK_K03 - Compliance with the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basics, nomenclature. Classification and distribution of polymeric materials.	2
Lec2	Preparation of polymers and plastics. Polymerization processes and the production of plastic materials	2
Lec3	Structure of the polymers and the resulting properties.	2
Lec4	Models mechanical behavior of polymers.	2
Lec5	Rheology and behavior of materials during processing.	2
Lec6	Transformation of plastics, the impact of environmental conditions on the behavior of polymeric materials.	2
Lec7	The basic group of polymeric materials and their specific properties.	2
Lec8	Methods for modification of polymeric materials and their impact on the property.	2
Lec9	Preparation of polymer composites.	2
Lec10	Overview of polymeric construction materials - Properties and application of thermoplastic materials.	2
Lec11	Overview of polymeric construction materials - Properties and application of chemically-and thermosetting plastics and elastomers.	2
Lec12	Primary processing technologies plastics - injection molding	2
Lec13	Technologies primary processing of polymeric materials - extrusion	2
Lec14	Technologies secondary processing of polymeric materials - thermoforming	2
Lec15	Manufacturing technologies of chemicallysetted polymers	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Polymeric materials and methods for their identification	2

Lab2	Technologies of plastics parts joning	2
Lab3	Primary processing technology - injecting molding	2
Lab4	Secondary processing technologies - Vacuum thermoforming and blow molding	2
Lab5	Friction and wear test of polymeric materials	2
Lab6	Research sagging body wall - analytical methods and experimental	2
Lab7	Thermosetting plastics processing technologies - casting and pressing	2
Lab8	Tools for processing of plastics	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	test
F2	PEK_W03	test
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	quiz,
F2	PEK_U02	quiz, oral answer
F3	PEK_U03	quiz, oral answer
F4	PEK_K01, PEK_K02, PEK_K03	oral answer, report
P = (F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Robert Sikora, Przetwórstwo tworzyw wielkocząsteczkowych, Warszawa : "Żak", 1993;Wojciech Kucharczyk, Wojciech Żurowski, Przetwórstwo tworzyw sztucznych dla mechaników, Radom : Politechnika Radomska. Wydawnictwo, cop. 2005; Izabella Hyla, Tworzywa sztuczne : własności, przetwórstwo, zastosowanie, Gliwice : Wydawnictwo Politechniki Śląskiej, 2000.

SECONDARY LITERATURE

Piotr Jasiulek, Łączenie tworzyw sztucznych metodami spawania zgrzewania, klejenia i laminowania, Krosno, Wydaw. i Handel Książkami "KaBe", 2004;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Polymers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03,	K1MBM_W13	C1	Lec1-Lec15	N1, N2-N3
PEK_U01-PEK_U03	K1MBM_U29	C2	Lab1-Lab8	N2-N4
PEK_K01-PEK_K03	K1MBM_K09	C3	Lab1-Lab8	N2-N4

SUBJECT SUPERVISOR

dr inż. Roman Wróblewski tel.: 320-21-70 email: r.m.wroblewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów II**
Name in English: **STRENGTH OF MATERIALS II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031028 (MMM031328)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of fundamentals of solid mechanics: tensor analysis, static laws, concepts of displacement, strain and stress, dependencies between these quantities in an elastic medium, the ability to calculate displacements and stress in a member.

SUBJECT OBJECTIVES

C1. Technical problem solving based on mechanics.
C2. Performing strength analyses of machine components.
C3. Teamwork and following academic principles.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows: how to determine stress and displacement in rotating disks, pipes and thick-walled tanks,
PEK_W02 - the theory of thin-walled axisymmetric shells loaded with pressure,
PEK_W03 - the basics of fatigue of material and fatigue of simple construction elements,

II. Relating to skills:
PEK_U01 - Student has practical skills in: performing basic strength tests,
PEK_U02 - measuring the plain state of strain using tensometers (strain gauges),
PEK_U03 - determining the basic elasticity constants: Young modulus, Poisson ratio and Kirchhoff modulus.

III. Relating to social competences:
PEK_K01 - Social competencies: independent research and critical evaluation of the found sources,
PEK_K02 - objective evaluation of arguments, rational explanation and justification of the student’s viewpoint using knowledge of the strength of materials,
PEK_K03 - conforming to the academic principles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Eccentric compression of slender members.	2
Lec2	Bending of a curved member.	2
Lec3	Models of material damage.	2
Lec4	Single- and multi-layer thick-walled cylinders.	2
Lec5	Rotating disks.	2
Lec6	Differential equation of thin plate.	2
Lec7	Symmetrically loaded circular plates. Rectangular plates.	2
Lec8	Axially symmetric shells.	2
Lec9	Impact loads in members.	2
Lec10	Time and temperature dependent loads – fatigue, creep, relaxation.	2
Lec11	Material fatigue – basic calculations.	2
Lec12	Finite Element Method (FEM) – introduction, shape functions.	2
Lec13	FEM – member and shell elements.	2
Lec14	Examples of applications of FEM.	2
Lec15	Written test	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction.	3
Lab2	Tensile test in metals and plastics.	2
Lab3	Strain gauge analysis.	2

Lab4	Determination of fatigue limit.	2
Lab5	Combined loading in members (torsion + bending).	2
Lab6	Buckling of slender members. Compression test.	2
Lab7	Symmetric and unsymmetric bending. Summary of laboratories and examination.	2
		Total hours: 15

TEACHING TOOLS USED

N1. Lectures supported with audiovisual aids when necessary.
N2. Self study and exam preparation.
N3. Laboratory experiment
N4. Report preparation
N5. Individual preparation for laboratories.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Exam, written test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 do PEK_U03, PEK_K01 do PEK_K03.	Written examination, written report.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
(basic reading)

SECONDARY LITERATURE
(additional reading)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
STRENGTH OF MATERIALS II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 do PEK_W03	K1MBM_W09	C1, C2	L1 - L15	N1, N2
PEK_U01 do PEK_U03	K1MBM_U20	C1, C2	La1 - La7	N3 -N5
PEK_K01 do PEK_K03	K1MBM_K01, K1MBM_K03	C3	La1 - La7	N2- N5

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Śródka tel.: 713204070 email: wieslaw.srodka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Hydrostatyczne układy napędowe**
Name in English: **Hydrostatic drive systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031029 (MMM031329)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student posses basic knowledge of fluid mechanics.
2. Student can solve diferential equations of mathematical models of hydraulis components and systems.
3. Student possess basic knowledge of classic mechanics.

SUBJECT OBJECTIVES

C1. Students acquaintance withbasic lows of hydrostatic drive systems.
C2. Students acquaintance with hydraulic components and their working principle.
C3. Students acquaintance with configuration of simple hydrostatic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student should be able to define requirements for hydraulic fluids of hydrostatic drive systems.
PEK_W02 - In the result of lesson student should be able to describe working pinciple of basic components of hydrostatic system.
PEK_W03 - In the result of lesson student should be able to characterize of working of basic hydrostatic drive systems.

II. Relating to skills:
PEK_U01 - In the result of lesson student should be able to analyse operation of hydrostatic components and systems.
PEK_U02 - In the result of lesson student should be able to calculate basics parameters of hydrostatic drive system.
PEK_U03 - In the result of lesson student should be able to interpret basic characteristic of hydrostatic components and systems.

III. Relating to social competences:
PEK_K01 - In the result of lesson student should possess ability of information analysis with diferent complex level.
PEK_K02 - In the result of lesson student should possess ability of objective argument evaluate, efficient explanation and justification own opinion with help of knowledge of hydrostatic drive systems.
PEK_K03 - In the result of lesson student should possess ability of follow the rules valid in academic environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements.	1
Lec2	Basic symbols of hydraulic and pneumatics components.	1
Lec3	Hydraulic fluids - their properties.	2
Lec4	Contaminations - sources, reasons and results - filtration.	1
Lec5	Positive displacement pumps - systematics, characteristics, efficiencies.	2
Lec6	Valves - systematics, types, functions.	4
Lec7	Hydraulic and volumetrics losses in displacement machines and in the system.	2
Lec8	Efficiency: hydraulic, volumetric and overall.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory range presentation, check form, requirements.	2
Lab2	Experimental determination properties of working fluid - bulk modulus.	2
Lab3	Experimental determination resistance character in hydraulic pipes - linear resistance.	2
Lab4	Local resistences in hydraulic systems. Orifice as a local resistance - cavitation effect.	2
Lab5	Experimental determination pump characteristic.	2

Lab6	Static characteritics of conventional directional control valve.	2
Lab7	Description of transient states in hydraulic systems - experimental determination of basic dynamic factors.	2
Lab8	Check.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. laboratory experiment
N4. report preparation
N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K03	test, report, oral response
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Kollek W.: Gear pumps (in polish). Zakład Narodowy im. Ossolińskich, Wrocław 1996.
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Osiecki A.: Machines hydrostatic drive (in polish). WNT, Warszawa 1996.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.

SECONDARY LITERATURE

Szydelski Z.: Hydraulic drive and control in vehicles and heavy duty machines. WNT 1980.
Kollek W.: Basics of hydraulic drive theory. NOT, Wrocław 1978.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrostatic drive systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W08	C1	Lec1,Lec2, Lec3	N1,N2
PEK_W02	K1MBM_W08	C2	Lec4,Lec5, Lec6	N1,N2
PEK_W03	K1MBM_W08, K1MBM_W20	C3	Lec7,Lec8	N1,N2
PEK_U01	K1MBM_U09	C1,C2	Lab1,Lab2, Lab4,Lab5, Lab6	N3,N4,N5
PEK_U02	K1MBM_U09, K1MBM_U24	C3	Lab3,Lab4, Lab7	N3,N4,N5
PEK_U03 PEK_K01 - PEK_K03	K1MBM_K09, K1MBM_U24, K1MBM_U25	C1,C3	Lab8,Lab2	N3,N4,N5

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji maszyn II**
Name in English: **Fundamentals of Machine Design II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031031 (MMM031331)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic knowledge of metallurgy, construction materials, mechanics, strength of materials and manufacturing techniques, engineering graphics. 2 It has a basic knowledge of Fundamentals od Machine Design I (process design and engineering, connections used in mechanical engineering) and perform the technical documentation using AutoCAD.
2. Skills: 1 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 2 It can be used in the process of constructing knowledge gained on subjects: metallurgy, mechanics, strength of materials, Engineering Graphics, Fundamentals of Machine Design I.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2 Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the design of machine shafts (structural calculations, the selection of geometric features, resonance, mounting elements on the shaft) and the holder shafts - bearings (bearings characteristics, selection criteria, rules for bearing and fit).
C2. Gaining knowledge of the construction, operation, selection, design calculations and operation of the couplings and conveyor units and changing the rotation (mechanical transmission belts, chains and gears).
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is the optimal design of the drive unit driven machine (eg conveyor, ball mill, crusher, rotary kiln, etc.) The process of constructing a computer-aided both in the selection of design features (using the computer programs for the calculation of constructed elements) as well as at the stage of their graphical application (AutoCAD).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the algorithm design calculations machine shafts and shafts supporting elements.
PEK_W02 - It has an extended knowledge in the construction of clutches, their applications and the selection and calculation.
PEK_W03 - It has a basic knowledge of construction, operation, principles of selection and design calculations of the conveyor units and changing the rotation (mechanical gears: belt, chain and gear).

II. Relating to skills:
PEK_U01 - Able to independently formulate and solve simple technical tasks.
PEK_U02 - He can choose and calculate the shafts, bearings, couplings, mechanical.
PEK_U03 - It can construct an optimal (in light of the criteria used) drive any machine work.

III. Relating to social competences:
PEK_K01 - Can search information and carry out their critical analysis.
PEK_K02 - Able to work independently and in a team.
PEK_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Shafts and axes – characteristics. Theoretical bases selection of constructional features of shafts. Fundamentals of shafts and axes forming. Methods for the axial location of machine elements on a shaft.	2
Lec2	Design calculations of the shafts (preliminary, checkout). The phenomenon of resonance. Calculations of shafting for resonance in bending mode.	2
Lec3	Main features of rolling and sliding friction. Classification of bearings, main features of rolling contact and sliding bearings. Procedure and criteria for the selection of roller contact bearings.	2
Lec4	Bearing arrangement. Fits, lubrication and sealing in application for roller bearings.	2

Lec5	Classification of coupling and clutches. Main features of couplings. Selection and calculation rules.	2
Lec6	Main features of clutches. Engagement process, Work and friction losses, heat balance, service life. Equivalent friction radius.	2
Lec7	Belt transmissions, classification, general characteristic and selection criteria. Friction coupling of the belt with the wheel. Elastic slip, actual transmission ratio, load transfer coefficient.	2
Lec8	Force distribution, tensioning devices in belt. Required tension force and ways of regulation.	2
Lec9	Efficiency of belt transmission and belt durability. Characteristics material for belts. The design of pulleys (material, main dimensions). Design calculations of V-belt transmissions.	2
Lec10	Chain transmissions – characteristic and calculation.	2
Lec11	Gear transmissions. Classification and main features. Fundamental rule of engagement. Cycloid and involute profiles.	2
Lec12	Basic rack tooth profile. Standardization of involute wheels. Basic notions. Geometry of spur gears. Generation methods.	2
Lec13	Boundary tooth number, mesh correction, addendum modification.	2
Lec14	Tooth loading model for bending and contact pressure. Service factor. Distribution of forces in spur and helical gearing.	2
Lec15	ISO recommended methods for the calculation of gear transmission, a summary.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed drive system (operation principles, location data, quantitative data, operation conditions).	2
Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	4
Proj3	Assumption of acceptance criteria for each of the sub-assemblies of the unit. Selection of the best solution using a dedicated software.	12
Proj4	Implementation stage of the design process: assembly and selected working drawings. Drafting technique - CAD.	12
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - preparation for project class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	exam, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	defense of project, quizzes, evaluation of computational design review, review of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Podstawy konstrukcji maszyn. Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999. 2.Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom II i III, Warszawa, WNT. 3. Dziama A. i inni; Przekładnie zębate. Warszawa, PWN 1995. 4. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom III i IV. W-a, WNT 1996. 5. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982. 6. Krawiec S.; Obliczenia konstrukcyjne przekładni pasowych i zębatych wspomagane mikrokomputerem, skrypt PWr.,Wrocław, 1992. 7. Capanidis D, Krawiec S. Wieleba W.; Materiały pomocnicze do ćwiczeń projektowych z PKM wspomaganych komputerowo, IKEM PWr., 1993. 8. Roloff/Matek; Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

SECONDARY LITERATURE

1.Jaśkiewicz Z., Wąsiewski A.; Przekładnie walcowe. Warszawa, WKŁ 1992. 2. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer- Verlag 1985. 3. Niemann G., Winter H.; Maschinenelemente. Band III. Berlin, Springer- Verlag 1983. 4. Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machine Design II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W18	C1	Lec1-Lec4	N1, N3, N5
PEK_W02	K1MBM_W18, K1MBM_W25	C2	Lec5, Lec6	N1, N3, N5
PEK_W03	K1MBM_W18, K1MBM_W19, K1MBM_W25	C2	Lec7-Lec15	N1, N3, N5
PEK_U01 - PEK_U03	K1MBM_U02, K1MBM_U07, K1MBM_U21, K1MBM_U34	C3	Proj1-Proj4	N2-N5
PEK_K01 - PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K05, K1MBM_K11	C1-C3	Proj1-Proj4	N2-N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Stanisław Krawiec tel.: 71 320-40-56 email: Stanislaw.Krawiec@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy napędowe pojazdów**
Name in English: **Driving Systems of Vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031032 (MMM031332)**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. positive marks of mechanics, mathematical analysis and construction of foundations.
2. basic knowledge of working various systems or machines devices.
3. Basic ability to work in groups.

SUBJECT OBJECTIVES

C1. The aim of the course is to broaden the knowledge of the construction vehicle propulsion systems and their components. The student gets acquainted with the methods of developing and preparing the characteristics of individual components of propulsion systems, traction characteristics and primary energy sources.
C2. The aim of the course is to acquire practical knowledge of the methods of calculation and selection of individual drive components and determine how to prevent undesirable phenomena such as the circulating power, etc. He knows the need for further professional development.
C3. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology. Student is responsible for own work and group work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - primary energy sources can be selected and the characteristics are known; can and described the power flow through the various elements of the powertrain, hydrostatic, hydrodynamic and mechanical, powertrain components are selected on the basis of calculations and characteristics.
PEK_W02 - can point out the use of power systems and improve them to suit your needs based on the development of technology;
PEK_W03 - is able to describe and explain the principles of operation of the various components of propulsion systems, indicate the potential for adverse effects and identify methods for their elimination.

II. Relating to skills:
PEK_U01 - can also using foreign literature to interpret the results obtained in the laboratory experiments and the use of catalogs;
PEK_U02 - is able to analyze and develop the results in order to obtain the characteristics or parameters measured in the propulsion system of vehicles and machinery at different settings of the control system;
PEK_U03 - is able to offer own ideas and own propulsion control systems performing similar functions.

III. Relating to social competences:
PEK_K01 - is capable and understands the need for continuous updating of skills and acquire new kwowledge;
PEK_K02 - is responsible for the decisions both in terms of environmental and mechanical engineering activities;
PEK_K03 - is able to work in a team and solve the tasks assigned to the various positions and is responsible for the group to achieve its intended purpose.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Systematic drive systems (systems single source, multi-source, serial, parallel, hybrid) - application examples. The basic functions performed by the powertrain (transmission, transformation, distribution, accumulation and energy recuperation) - Case studies.	2
Lec2	The characteristics of conventional primary and secondary sources of energy - control principle. Non-conventional sources of energy (eg, fuel, etc.) - examples of applications and development trends.	2
Lec3	Strenuous-intensity characteristics of power consumers - examples of typical load in the form of linear, area, cycle, spectrum charges etc.	2
Lec4	Propulsion systems of the "rigid" and "flexible" kinematic coupling. The issue of non-compliance kinematic and power circulating in the propulsion system - basic physical, technical implications, sposobyeliminacji-examples.	2
Lec5	Basic structure of the propulsion system selection and selection problem of primary energy sources: a) typical mechanical drive system b) typical drive system converter.	2
Lec6	Basic structure of the propulsion system selection and selection problem of primary energy sources: c) a typical hydrostatic system. Drive systems with stepper motors and servo-electric principle.	2
Lec7	Issues of transients in the propulsion system under the elastic ties, starting characteristics of conventional and programmable - minimizing the negative effects of dynamic.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Experimental studies hydrostatic drive earth working vehicle.	2
Lab2	Experimental studies on hybrid caterpillar driving system.	2
Lab3	Experimental determination of the characteristics of the selected receiver of energy and the choice of the optimum driveline capstans.	2
Lab4	Comparison of the boot process of asynchronous motor in the driving system	2
Lab5	Study of the effect of elastic stiffness in a driving system on its dynamic toughness.	2
Lab6	Determination of the characteristics of the external combustion engine ignition.	2
Lab7	The study of motion parameters of the propulsion system of an internal combustion engine and "flexible" kinematic coupling.	2
Lab8	Experimental research of wheel loader extended arm working system.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	written-oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K03	short test, the report of the exercises, oral answer
P = pozytywne oceny z wszystkich ćwiczeń laboratoryjnych		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Szumanowski A. , tytuł: Układy napędowe z akumulacja energii, PWN, rok: 19902. Pieczonka K. , tytuł: Maszyny urabiające, Politechnika Wrocławska, rok: 19883. Szydelski Z. , tytuł: Napęd i sterowanie hydrauliczne, WKŁ, rok: 19994. Kaczmarek T., tytuł: Napęd elektryczny robotów, Wydawnictwo Politechniki Poznańskiej, rok: 19965. Wróbel T. , tytuł: Silniki krokowe, Wydawnictwo Naukowo-Techniczne, rok: 19936. Kosmol J., tytuł: Serwonapędy obrabiarek sterowanych numerycznie, Wydawnictwo Naukowo-Techniczne,rok: 1998

SECONDARY LITERATURE

1. Dębicki M., tytuł: Teoria samochodu, WNT , rok: 19692. Szumanowski A. , tytuł: Czas energii, WKiŁ, rok: 19883. Mitschke M. , tytuł: Dynamika samochodu. Napęd i hamowanie., WKiŁ, rok: 19874. Michałowski K. Ocioszyński J., tytuł: Pojazdy samochodowe o napędzie elektrycznym i hybrydowym, WKiŁ, rok: 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Driving Systems of Vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W20	C1, C2, C3	Lec1-Lec7	N1, N3
PEK_W02	K1MBM_W25	C1, C2, C3	Lec3-Lec7	N1, N3
PEK_W03	K1MBM_W17	C1, C2, C3	Lec1-Lec7	N1, N3
PEK_U01	K1MBM_U01	C3	Lab1-Lab7	N2
PEK_U02	K1MBM_U24	C3	Lab1-Lab7	N2
PEK_U03	K1MBM_U25	C3	Lab1-Lab7	N2
PEK_K01	K1MBM_K07	C1, C2	Lab1-Lab7	N3
PEK_K02	K1MBM_K02	C1, C2	Lab1-Lab7	N3
PEK_K03	K1MBM_K04	C3	Lab1-Lab7	N2

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031033 (MMM031333)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.
PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2

Lec2	Measurement, measurement types, method and measurement principle.	2
Lec3	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec4	Dimensions, tolerance of linear dimensions nad fits.	3
Lec5	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	3
Lec6	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec7	Tolerance and machine parts measurement.	3
Lec8	Tolerating and measurements of machines parts manufactured in the process of: casting, plastic forming, welding, plastics processing.	3
Lec9	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec10	Mehods and means of mechanization and automation of measurements.	2
Lec11	Analysis of dimension. Fundamentals of statistical control of dimensions.	2
Lec12	Fundamentals of coordinate measurement techniques.	2
		Total hours: 28
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Errors of measurement and assasement methods of measurement uncerteinaty.	2
Lab3	Measurements of linear dimensions.	2
Lab4	Measurements of angular dimensions.	2
Lab5	Direct and indirect measurements of cones.	2
Lab6	Identification and measurement of threads.	2
Lab7	Project of a tests.	2
Lab8	Assessment of the geometrical structure of the surface.	2
Lab9	Identification and measurement of cylindrical gears.	2
Lab10	Measurements of selected shape deviations.	2
Lab11	Measurements of selected displacement.	2
Lab12	Cams measurement.	2
Lab13	Measurements of machine parts with pneumatic measurement equipment.	2
Lab14	Verification of measuring instruments	2
Lab15	Coordinate masurements of machine parts.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE
[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007. [2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009. [3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004. [4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008. [5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1MBM_W15	C1; C2; C3; C4; C5; C6	Wy1-Wy13	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1MBM_U12, K1MBM_U40	C1; C2; C3; C4; C5; C6	La1 - La15	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1MBM_K04, K1MBM_K05, K1MBM_K06	C1; C2; C3; C4; C5; C6	La1 - La15	N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszyny technologiczne CNC i roboty**
Name in English: **Technological CNC machines and robots**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031036**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	15	
Number of hours of total student workload (CNPS)	60		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about design & manufacturing process, structure and operation of machine components and assemblies, as well as principles of their selection and designing.
2. Well-grounded knowledge about basic manufacturing techniques and role of technological machines.
3. Ability to design a manufacturing process in the field of chipless forming and machining.

SUBJECT OBJECTIVES

C1. Getting acquainted with engineering of basic CNC manufacturing machines and robots, in particular with their control, drive and measurement systems.
C2. Getting acquainted with programming principles of CNC machines according to ISO standard and with principles of building and implementing driver software, as well as with methods supporting a programmer's work.
C3. Getting acquainted with principles and possibilities of using automated single- and multimachine systems for executing specific machining tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of engineering and operation principles of modern CNC manufacturing machines, in particular principles of their operation control.
PEK_W02 - Knowledge of selection principles of CNC manufacturing machines intended for specific machining tasks.
PEK_W03 - Knowledge of programming principles of CNC machines.

II. Relating to skills:
PEK_U01 - Ability to evaluate CNC manufacturing machines with respect to their suitability for specific machining tasks.
PEK_U02 - Ability to elaborate a program structure for basic CNC machines, as well as to use standard subprograms and cycles.
PEK_U03 - Ability to select and preset machining parameters, select tools and verify correctness of the developed programs.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to gain knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	General characteristics of manufacturing machines and their classification. Geometrical, kinematic and dynamic structures of the machines. Technical and operational parameters. Basic requirements.	2
Lec2	Parts, mechanisms and components of CNC manufacturing machines: bodies, spindle and guiding assemblies, tooling and workpiece systems.	2
Lec3	Main drive and feeding systems of modern manufacturing machines (basic requirements, exemplary solutions). Measurement, diagnostics and supervision systems.	4
Lec4	Basics of automatic control of manufacturing machines. Classification of control systems (NC, CNC, DNC, AC and PLC systems).	2
Lec5	Introduction to programming numerically controlled machines – geometrical basics of CNC control, coordinate systems, driver structure, interpolation. Ways of computer-aided programming – machining simulators.	2
Lec6	Review of groups of CNC machines: lathes, milling machines, grinding machines (technical & usable features and purpose of the machines).	2
Lec7	Review of groups of CNC machines: machining centres, autonomous machining stations (technical & usable features and purpose of the machines).	2
Lec8	CNC machines for electrochemical and laser machining (technical & usable features and purpose of the machines).	2
Lec9	Selected structures of CNC machines for chipless machining (technical & usable features and purpose of the machines).	2

Lec10	Industrial robots and manipulators (structure, classification and application fields). Structure and purpose of coordinate measuring machines.	2
Lec11	Multimachine, robotized manufacturing systems, production centres and lines (organizational structures and application fields). Computer-integrated manufacturing systems (CIM).	2
Lec12	Machines and devices for additive manufacturing and reverse engineering techniques – exemplary applications.	2
Lec13	Trends in development of CNC manufacturing machines (machines for HSC and HPC machining, hexapods, intelligent and hybrid machine tools).	2
Lec14	Credit colloquium.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	The use of the manipulator in processes of thermal spraying.	2
Lab2	The use of robots in sheet and spot welding processes.	2
Lab3	Control of machines in sheet metal forming processes.	2
Lab4	The use of Coordinate Measuring Machine (CMM).	2
Lab5	Automation of technological processes using PLC controllers (FESTO system).	2
Lab6	Machines to implement additive technology (Rapid Prototyping).	2
Lab7	Reverse Engineering equipment.	2
Lab8	Crediting the course.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Selection of a machine tool, preparation of a workpiece, selection of tools and machining parameters.	2
Proj2	Determination of characteristic points of a contour and location of a workpiece in the machine-tool workspace.	2
Proj3	Elaboration of a driver software to control the manufacturing process on a CNC machine – linear and circular interpolation.	2
Proj4	Elaboration of a driver software to control the manufacturing process on a CNC machine – establishing corrective functions; programming movements with correction of tool dimensions.	2
Proj5	Elaboration of a driver software to control the manufacturing process on a CNC machine – subprograms technique, incremental programming, programming movements in a loop.	2
Proj6	Elaboration of a driver software to control the manufacturing process on a CNC machine – use of machining cycles at programming.	2
Proj7	Elaboration of a driver software to control the manufacturing process on a CNC machine – completion of the project and its verification.	2
Proj8	Summary of the work – presentation of the project and its assessment.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. own work – preparation for crediting the lecture N3. self study - preparation for project class and laboratory N4. presentation of the project, crediting the lab subjects N5. consultancies

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Credit colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Class admission test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Assessment of the project preparation
F2	PEK_U01 - PEK_U03	Defence of the project
P = 0.5(F1+F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warsaw, 2000 (in Polish)
Kosmol J.: Automation of machine tools and machining. WNT Warsaw, 2000 (in Polish)
Honczarenko J.: Numerically controlled machine tools. WNT Warsaw, 2009 (in Polish)
Programming of CNC machine tools. Editorial Office REA. Warsaw, 1999 (in Polish)
Nikiel G.: Programming of CNC machine tools on the example of control system Sinumerik 810D/840D. ATH Bielsko-Biała, 2004 (available in internet) (in Polish)
Habrat W.: Operation and programming of CNC machine tools. Operator's handbook. KaBe, Krosno, 2007 (in Polish)
Kosmol J., Słupik H.: Programming of numerically controlled machine tools. Silesian University of Technology, Gliwice, 2001 (in Polish).

SECONDARY LITERATURE
Engineer's handbook. Machining. Vol. 1, 2, 3. WNT Warsaw, 1992 – 1994 (in Polish)
Instruction manual of Sinumerik control system programming (available in internet) (in Polish)
Dudik K., Górski E.: Lathe operator's handbook. WNT Warsaw, 2000 (in Polish)
Dudik K., Górski E.: Milling machine operator's handbook. WNT Warsaw, 2003 (in Polish)
Catalogues of tools used at CNC machine tools (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technological CNC machines and robots
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W35	C1 - C3	Wy1 - Wy13	N1, N2, N5
PEK_U01 - PEK_U03	K1MBM_U17	C1 - C3	Pr1 - Pr8; Lab1 -Lab8	N3, N4
PEK_K01 - PEK_K03	K1MBM_K04	C1 - C3	Pr1 - Pr8; Lab1 -Lab8	N2 - N5

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie w produkcji**
Name in English: **Management in production**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031038 (MMM031340)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows and understands the nature of the management process and the basic functions of management.
2. Understands the basic concepts and basic economic rights and economic phenomena and their effects.
3. Posesses a basic knowledge of manufacturing processes.

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of the production and manufacturing processes
C2. Knowledge of methods and techniques for managing different types of manufacturing processes
C3. The acquisition of skills in planning, organizing and controlling of production processes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Distinguishes and characterizes by different types of production systems.
PEK_W02 - Can define the concepts of production and technological processes.
PEK_W03 - Has knowledge of the methods and techniques of production systems management.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristics of manufacturing organizations	1
Lec2	Characteristics of production systems	2
Lec3	Manufacturing system, its organization and components	2
Lec4	Classification of production processes	1
Lec5	Types and forms of production	2
Lec6	Methods of manufacturing control systems (pull, push and squeeze)	4
Lec7	Methods of organization of production systems	4
Lec8	Characteristics of bottlenecks in manufacturing processes	4
Lec9	Methods of manufacturing inventory management	4
Lec10	Principles of planning and scheduling	6
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Chlebus E.: "Techniki komputerowe CAx w inżynierii produkcji", Wydawnictwa Naukowo-Techniczne, Warszawa 2000,
2. Durlik I.: "nżynieria zarządzania : Cz. 1 i Cz.2", Wydawnictwo Placet, Warszawa 2007,
3. Liwowski B.: "Podstawowe zagadnienia zarządzania produkcją", Oficyna Ekonomiczna, Kraków 2006

SECONDARY LITERATURE
1. Rogowski A..: "Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie", Wydawnictwa Fachowe CeDeWu, Warszawa 2010, 2. Burchart-Korol D.: "Zarządzanie produkcją i usługami", Wydawnictwo Politechniki Śląskiej, Gliwice 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management in production
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W24	C1, C2, C3	Lec1 - Lec10	N1

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Budowa pojazdów samochodowych**
Name in English: **Construction of vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031101 (MMM031351)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	120				
Form of crediting	Examination				
Group of courses					
Number of ECTS points	4				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	2.4				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of machine design
2. The ability to associate and use knowledge

SUBJECT OBJECTIVES

C1. Knowing the main units and systems of motor vehicles
C2. Understanding the basic principles of the selection of types of teams and systems in motor vehicle
C3. Knowledge and understanding of the workings of teams and systems in motor vehicle

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has a basic knowledge of the construction and operation of major components or vehicle general automotive parts and mechanisms of a motor vehicle
PEK_W02 - It has a basic knowledge of the names of individual components and systems vehicle.
PEK_W03 - Versed in the current state and recent trends in vehicle development car

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic information about the ingredients of the road transport system	2
Lec2	Classification of vehicles. Approval. elements identification	2
Lec3	Fundamentals of traffic engineering. resistance to motion	2
Lec4	The choice of power source. Power on wheels and engine characteristics	2
Lec5	Construction of automotive powertrain vehicles	3
Lec6	Construction chassis vehicles. Bearing and suspension system	3
Lec7	Wheels. tires	2
Lec8	The construction of the steering	2
Lec9	Construction of the brake system	2
Lec10	Automation of systems of a motor vehicle	2
Lec11	The criteria for assessing the safety car	2
Lec12	Compatible vehicles	1
Lec13	Outdoor Lighting Vehicle	2
Lec14	CAN / BUS	1
Lec15	Features built-ins of vehicles with special	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. case study
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	exam
F2	PEK_W02	exam
F3	PEK_W03	exam
P = F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Reimpell J., Betzler J.: Chassis cars. Basic construction. Optics Warsaw 2001

PAWrzecioniarz, W.Ambroszko, A.Górniak - Energy Efficient Design of powetrain and body, Wrocław University of Technology, 2011

SECONDARY LITERATURE

L. Prochowski: Mechanical Movement. Publisher of Science and Technology, Warsaw, 2005.

M. Zając: Transmission systems for trucks and buses. WKiŁ Warsaw 2003

Automobile Engineering Handbook. publishing REA

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Construction of vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_KM_W04, K1MBM_W18	C1-C3	WY1-WY15	N1- N3

SUBJECT SUPERVISOR

dr inż. Wojciech Ambroszko tel.: 71 347-79-18 email: wojciech.ambroszko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy tribologii**
Name in English: **Fundamentals of Tribology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031102 (MMM031352)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 He has ordered knowledge about the types of engineering materials - metal, ceramic, polymer and composite materials.2. It has a basic knowledge of the construction, operation and use of the main components and machine assemblies.3. It has a basic knowledge of physics, chemistry, statistics.
2. Skills: 1. It can analyze the macroscopic fractures, microstructure of materials, technological drawbacks of origin, is able to determine the characteristics of the microstructure of metallic materials.2. He can choose the material on a given machine element and can explore its basic properties.
3. Competencies: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineer.2. Is aware of the importance of behavior in a professional manner and have a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. Familiar with the processes of friction, wear and lubrication of moving nodes and methods for machine control these processes in terms of minimizing their effects (special attention will be paid to the construction and technological methods of increasing the reliability and durability of sliding pairs, as well as the problem of lubrication and lubricant selection as an effective prevention of friction and wear).
C2. Understanding the impact of selected parameters of friction vector, ie, pressure, velocity slip material cooperating associations and grease on the tribological characteristics of sliding pairs. Get to know the influence of the structure of the material to abrasion and impact bushing stiffness for load distribution in the bearing friction.
C3. Show students that they can effectively counteract the negative effects of friction in the moving solid contact with real objects illustrate some of the issues discussed theoretically in the lecture.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the processes of friction, wear and lubrication of moving nodes machine.
PEK_W02 - Know the basic types of lubricants and their applications.
PEK_W03 - He knows the design and technological methods of increasing the reliability and durability of sliding pairs.

II. Relating to skills:
PEK_U01 - It can choose materials for sliding nodes and understand relationships and dependencies between the material used and its durability.
PEK_U02 - It can perform basic tests of materials used in the nodes of friction, interpret them and implement in the final node machines.
PEK_U03 - He can use the theoretical knowledge acquired friction and lubrication of the lecture and apply it in practice.

III. Relating to social competences:
PEK_K01 - It can search for information and critically analyze them.
PEK_K02 - Properly define and resolve dilemmas, adheres to the principle of professional ethics.
PEK_K03 - Able to work independently and as a team, and properly assess their own tasks and priorities of the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program and requirements. Brief history of tribology. Elastic contact of smooth bodies. The real contact of solids. The problem of the surface layer.	2
Lec2	Friction processes, their distribution and characteristics. Sliding and rolling friction. Theories of friction.	2
Lec3	Wear processes, their distribution and characteristics. Effect of pressure and sliding velocity on the friction and wear.	2
Lec4	Characteristics of materials (metal and others) on the sliding nodes and the rules for their selection. Simple and reversed pair of friction.	2

Lec5	Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2
Lec6	Grease as a construction material. Objectives lubrication. The way of obtaining o fluid friction. Distribution of lubricants. Lubricating oils and their properties.	2
Lec7	Greases, their distribution and characteristics.Their characteristics.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Determining of properties of slide bearing materials.	2
Lab2	Determining of coefficient of static friction.	2
Lab3	Research of lubricity of greases using a four ball tester.	2
Lab4	Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	Analysis of the impact bushing stiffness for load distribution in the sliding bearing.	2
Lab6	Analysis of the impact on the structure of the material on abrasive wear (Tester T-07).	2
Lab7	Research of the frictions into screw gear.	2
Lab8	Study materials for the seizure.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. laboratory experiment
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Lawrowski Z.; Tribologia, Tarcie, zużywanie i smarowanie. W-a, PWN, 1993.2.Garkunov D. N.; Trybotechnika. Moskva, Mašinostroenie, 1999.3.Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.4.Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990.5. Embedded detailed instructions posted on the website: www.ikem.pwr.wroc.pl/pkmit

SECONDARY LITERATURE

1.Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag, 2000.2.Lawrowski Z.; Technika smarowania. W-a, PWN, 1987.3.Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Tribology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W11, K1MBM_W18, K1MBM_W26	C1	Lec1, Lec2, Lec3	N1, N2, N5
PEK_W02	K1MBM_W18, K1MBM_W25	C1	Lec6, Lec7	N1, N2, N5
PEK_W03	K1MBM_W21, K1MBM_W22, K1MBM_W26	C1	Lec4, Lec5	N1, N2, N5
PEK_U01 - PEK_U03	K1MBM_U01, K1MBM_U04, K1MBM_U06, K1MBM_U15, K1MBM_U20	C2, C3	Lab1 - Lab8	N3, N4, N5
PEK_K01- PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K04	C3	Lab1-Lab7	N2, N3, N4

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napęd hydrauliczny**
Name in English: **Hydraulic drive**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031104 (MMM031354)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	15	
Number of hours of total student workload (CNPS)	60		60	30	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student posses basic knowledge of fluid mechanics.
2. Student can solve diferential equations of mathematical models of hydraulis components and systems.
3. Student possess basic knowledge of hydrostatic drive systems.

SUBJECT OBJECTIVES

C1. Students acquaintance with simple and advanced hydraulic components.
C2. Students acquaintance with hydraulic drive systems.
C3. Students acquaintance with control and regulation methods selected parameters of hydraulic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student has knowledge for description of basic hydraulic systems in vehicles and heavy duty machines.
PEK_W02 - In the result of lesson student has knowledge for design of hydraulic drive systems.
PEK_W03 - In the result of lesson student has knowledge for description hydraulic components for control or regulation selected parameters.

II. Relating to skills:
PEK_U01 - In the result of lesson student is able to design hydraulic system with control system - make suitable calculations and on their basis student is able to select suitable hydraulic components with proper dimensions and properties.
PEK_U02 - In the result of lesson student is able to make measurements of hydraulic components and systems and describe results and formulate proper conclusions.
PEK_U03 - In the result of lesson student is able to build and start and analyse working hydraulic and electrohydraulic drive system.

III. Relating to social competences:
PEK_K01 - Student can cooperate in group during hydraulic and electrohydraulic system building and report preparation.
PEK_K02 - Student can plan measurements and project preparation.
PEK_K03 - Student correctly identyfi and solve problems with hydraulic and electrohydraulic system during its building. Student formulate appropriate conclusions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements, list of references.	1
Lec2	Hydraulic systems properties.	2
Lec3	Speed regulation of hydraulic motor during fast and working movement.	2
Lec4	Hybrid hydraulic systems.	2
Lec5	Cavitation effect, calculaction of sucking line of hydraulic pump.	2
Lec6	Hydraulic brake systems.	2
Lec7	Hydraulic ABS system	2
Lec8	Hydraulic systems of travel mechanism.	2
Lec9	Steering servomechanisms.	2
Lec10	Multipumps systems.	2
Lec11	Synchronisation of hydraulic actuators movement.	2
Lec12	Hydropneumatic suspension, vibration dampers.	2
Lec13	Load-sensing hydraulic systems.	3
Lec14	Thermal balance of hydraulic systems.	2
Lec15	Design of hydraulic drive.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction - laboratory topics presentation, check form, requirements. Laboratory regulations and industry safety.	2
Lab2	Sequence control of hydraulic motors.	2
Lab3	Serial and papralel connection of hydraulic actuators.	2
Lab4	Control of hydraulic system with proportional reliefe valve.	2
Lab5	Hydraulic systems with check valves and flow regulator.	2
Lab6	Methods of safety increasing in hydraulic systems - controlled check valve.	2
Lab7	Functions of hydraulic accumulator.	2
Lab8	Functions and applications of relief valve with unloading.	2
Lab9	Load-sensing system tests.	2
Lab10	Regulation with constant power in hydraulic system.	2
Lab11	Volumetric control.	2
Lab12	Comparison tests of speed control and regulation systems for hydraulic actuator.	2
Lab13	Methods of power losses reduction in hydraulic systems.	2
Lab14	Tests of dynamics processes in hydraulic systems.	2
Lab15	Check.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction to project.	2
Proj2	Generating of system structure.	2
Proj3	Preparation of basic calculations.	2
Proj4	Selection of typical components.	2
Proj5	Preparation of static characteristic of the system.	3
Proj6	Description of system operation and selected components specification.	2
Proj7	Project presentation and check.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for project class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02 PEK_U03	oral response for practical veryfication of design and buliding of systems.
F2	PEK_U02	report
F3	PEK_U03	student's activity note
P = (2F1+F2+F3)/4		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01-PEK_K03	project check
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Kollek W.: Gear pumps (in polish). Zakład Narodowy im. Ossilońskich, Wrocław 1996.
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Osiecki A.: Hydrostatic drive of machines (in polish). WNT, Warszawa 1996.
Garbacik A., Szewczyk K.: Hydraulic drive and control. Basics of systems designing (in polish). Skrypt Politechniki Krakowskiej, Kraków 1998.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984

SECONDARY LITERATURE

Jędrzykiewicz Z.: Design of hydrostatic systems. Basics (in polish). Skrypt 1313. AGH Kraków 1992.
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydraulic drive
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_KM_W03, K1MBM_W14, K1MBM_W20	C2 C3	Lec1 Lec4 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N1
PEK_W02	K1MBM_KM_W03, K1MBM_W08, K1MBM_W14, K1MBM_W20	C1 C2	Lec1 Lec2 Lec5 Lec14 Lec15	N1 N3
PEK_W03	K1MBM_W16, K1MBM_W20	C1 C2 C3	Lec1 Lec3 Lec6 Lec7 Lec9 Lec11 Lec13	N1
PEK_U01	K1MBM_KM_U03, K1MBM_U23, K1MBM_U25	C1 C2 C3	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Lab13	N1 N3
PEK_U02	K1MBM_U12, K1MBM_U24	C1 C2 C3	Lab4 Lab9 Lab10 Lab11 Lab12 Lab14	N2 N4
PEK_U03	K1MBM_U09, K1MBM_U23, K1MBM_U24	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab12 Lab13	N2 N4
PEK_K01	K1MBM_K04, K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N2 N4
PEK_K02	K1MBM_K04, K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N2 N3 N4
PEK_K03	K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N2 N3 N4

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie spajania**
Name in English: **Joining technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. - The student knows the types of welds, welding positions, joints marking, causes of welded joints cracking
- The student knows the basic welding methods and parameters of the welding processes
- The student has knowledge of the fundamentals and applications of soldering, brazing, resistance welding and thermal cutting
2. - The student is able to select the right technology (method) of joining (bonding) and define basic parameters of the process;
- The student is able to select the right technology (method) of thermal cutting and define basic parameters of the process;
- The student is able to design a simple bonding process of the product

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the different types of welded structures
C2. Acquiring the ability to develop bonding technology
C3. Searching for information and its critical analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the performance of various welded structures
PEK_W02 - Knows welding, resistance welding, soldering, brazing and adhesive bonding technologies of different metals and alloys
PEK_W03 - Has knowledge of use of welding, resistance welding, soldering, brazing and adhesive bonding

II. Relating to skills:
PEK_U01 - Is able to select the right bonding technology
PEK_U02 - Is able to select the appropriate parameters of welding, soldering, brazing, resistance welding and adhesive bonding
PEK_U03 - Is able to design bonding process of different types of structures

III. Relating to social competences:
PEK_K01 - searching for information and its critical analysis
PEK_K02 - team cooperation on improving methods for the selection of a strategy to optimally solve assigned problems
PEK_K03 - objective evaluation of arguments, rational explanations and justifications of own point of view, using knowledge of welding technology

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to economics of welding processes	2
Lec2	Technological parameters of manual metal arc welding	2
Lec3	Technological parameters of TIG welding	2
Lec4	Technological parameters of submerged arc welding	2
Lec5	Technological parameters MAG/MIG welding	2
Lec6	Welding of unalloyed and low-alloy steel	2
Lec7	Welding of high-alloy steel	2
Lec8	Welding of copper and cast iron alloys	2
Lec9	Aluminum and its alloys welded constructions	2
Lec10	Welding of pressure vessels	2
Lec11	Advanced soldering and brazing technologies	2
Lec12	Selected aspects of resistance welding	2
Lec13	Structural adhesives, properties and applications	2
Lec14	Adhesive technology of engineering materials	2
Lec15	Laser welding	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Selection of MMA welding parameters	3
Lab2	Selection of MIG, MAG, TIG welding parameters	2

Lab3	Determination of pre-heating temperature of welded steels	2
Lab4	Selection of filler materials for welding high-alloy steels	2
Lab5	Influence of welding parameters on the process of resistance weld forming. Evaluation of resistance welded joints.	2
Lab6	Advanced soldering and brazing technologies	2
Lab7	Adhesive bonding of basic engineering materials	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01- PEK_W03; PEK_K03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01- PEK_U03 PEK_K01 - PEK_K03	short test, laboratory report
P = Średnia z F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Joining technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_W21	C1-C3		N1 - N5
PEK_U01-PEK_U03	K1MBM_U28	C1-C3		N1 - N5
PEK_K01-PEK_K03	K1MBM_K02	C1-C3		N1 - N5
PEK_W01-PEK_W03	K1MBM_TSW_W03	C1-C3		N1 - N5

SUBJECT SUPERVISOR

dr inż. Tomasz Piwowarczyk tel.: 4255 email: tomasz.piwowarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowa symulacja procesów kształtowania plastycznego**
Name in English: **Computer simulation of plastic forming processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031203**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic understanding of the processes and machinery for plastic forming
2. It has a basic understanding of the foundations of the theory of finite element methods
3. It has a basic understanding of the strength of materials, mechanics and the theory of machines and mechanisms

SUBJECT OBJECTIVES

C1. To gain insight into the field of modern engineering tools for analysis and optimization of plastic forming processes
C2. To gain basic knowledge and skills to build mathematical models of forming processes
C3. To know the influence of the process parameters on the forming forces

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows the construction of mathematical models of plastic forming processes
PEK_W02 - It has a basic knowledge of the possible applications of the finite element method to the process analysis and optimization of forming processes
PEK_W03 - It knows the basic relationships between material properties and parameters of forming process

II. Relating to skills:
PEK_U01 - It gain the skills necessary to build mathematical models of plastic forming processes
PEK_U02 - Is able to perform the calculation and initial optimization of the plastic forming process
PEK_U03 - Is able to identify which of the process parameters significantly affect the forming forces

III. Relating to social competences:
PEK_K01 - It acquires beliefs about the responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Plastic forming - types of processes, the basic process parameters.	2
Lec2	The model of the process, geometry transfer, calculation model building.	2
Lec3	Fundamentals of plastic deformation.	3
Lec4	Models of materials, stress-strain curves, yield criterion	2
Lec5	Modelling of bulk metal forming processes - extrusion, drawing.	2
Lec6	Modelling of bulk metal forming processes - rolling,forging.	2
Lec7	Modelling of sheet metal forming.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction to computer simulation of the plastic forming processes in the computing environment.	2
Proj2	Modelling of selected examples of plastic forming processes.	2
Proj3	Analysis and determination of the influence of process parameters on the forming forces (friction, temperature, speed).	2
Proj4	Preparation of design assumptions for the selected item shaped by forming processes.	2
Proj5	Description of the process geometry and its export to the FEM program.	2
Proj6	Building the model in the FEM program.	2
Proj7	Making calculations for the various process parameters and/or the geometry of the process.	3
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem exercises
N3. self study - preparation for project class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project rating
F2	PEK_U01, PEK_U02, PEK_U03	test
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Joseph R. Davis: Metals handbook. Vol. 14, Forming and forging ASM International Handbook Committee.
Altan, Taylan; Tekkaya, A. Erman: Sheet Metal Forming - Processes and Applications, ASM International.
Hosford, William F.; Caddell, Robert M.: Metal Forming - Mechanics and Metallurgy, Cambridge University Press

SECONDARY LITERATURE

Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003
Morawiecki M., Sadok L., Wosiek E.: Przeróbka plastyczna- podstawy teoretyczne. Wydawnictwo Śląsk 1986
Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer simulation of plastic forming processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_TSW_W05	C1, C2, C3	Wy1-Wy7	N1,N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_TSW_U05	C1, C2, C3	Pr1-Pr7	N2,N3
PEK_K01	K1MBM_K04	C3	Pr3	N2

SUBJECT SUPERVISOR

dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Narzędzia skrawające**
Name in English: **Cutting tools**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031204**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of manufacturing in machining
2. He has skills in measurement methods, techniques for measuring and evaluating the results of measurement
3. Can obtain information from literature, databases and other sources, and to draw conclusions and formulate and justify opinions

SUBJECT OBJECTIVES

C1. Expanding knowledge of cutting tools, cutting edge geometry, tools materials and coatings used on the cutting edge.
C2. Knowing the rules of proper tool selection, due to working conditions, treatment efficiency and manufacturing costs.
C3. Gaining knowledge of wear and regeneration blunted cutting tools.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to correctly classify cutting tools, know their structure and geometry in different frames of reference.
PEK_W02 - Student can choose the modern technological processes cutting tools due to the efficiency and cost of production.
PEK_W03 - The student is able to explain the physical and chemical phenomena occurring at the cutting edge during machining.

II. Relating to skills:
PEK_U01 - Students can choose the tool materials due to optimal cutting for various workpiece materials.
PEK_U02 - Student can determine what is the influence of cutting edge geometry on the effects of machining technology.
PEK_U03 - Students should be able to use the computer programs used for the selection of tools set machining conditions.

III. Relating to social competences:
PEK_K01 - Is aware of the importance of behavior in a professional way, well-defined and resolve dilemmas.
PEK_K02 - Recognize the effects of the impact of technology on the environment and related social responsibility of science and technology.
PEK_K03 - Is aware of the necessity of individual and group activities that go beyond the activities of engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role of tools and equipment in the production of machine parts	2
Lec2	Tool materials and their selection	2
Lec3	The geometry of the cutting edge. Reference systems and dimensioning of the blade. The role and importance of the angles of the blades in the cutting process.	2
Lec4	Components of tools - construction and their functions	2
Lec5	Characteristics and application of tools	2
Lec6	Cutters and cutter heads. Thread Tools and gears	2
Lec7	Modular and multifunction tool	2
Lec8	Colloquium	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Measurement and tool setting in flexible production system	2
Lab2	The measurement tool components.	2
Lab3	Turning with inserts WIPER type.	2
Lab4	Cutting tool geometry on technological effect of machining.	2
Lab5	Drilling with gundrills.	2
Lab6	Machinability determination for choosen tools.	2

Lab7	The choice of cutting tools with the use of computer programs	2
Lab8	Grading	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	report on laboratory exercises
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Autor: Piotr Cichosz, tytuł: Narzędzia skrawające, wydawnictwo: WNT , rok: 2006
Autor: Mieczysław Feld, tytuł: Uchwyty obróbkowe, wydawnictwo: WNT, rok: 2002

SECONDARY LITERATURE

Autor: Henryk Żebrowski, tytuł: Przyrządy i uchwyty obróbkowe, , wydawnictwo: Oficyna Wyd. PWr., rok: 1983

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Cutting tools
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_TSW_W01, K1MBM_W22	C1, C3	Lec1 - Lec8	N1 ,N4, N5
PEK_U01, PEK_U02, PEK_U03	K1MBM_TSW_U01, K1MBM_U26, K1MBM_U31	C1, C2, C3	La1 - La8	N2, N3, N5
PEK_K01, PEK_K02, PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K07	C1	La5 - La7	N1, N5

SUBJECT SUPERVISOR

dr inż. Marek Kołodziej tel.: 41-81 email: marek.kolodziej@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Proseminarium dyplomowe**
Name in English: **Thesis proseminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031208**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					15
Number of hours of total student workload (CNPS)					30
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic engineering knowledge in the field of manufacturing technology, process equipment and materials science.
2. Ability to acquire the information from different sources also in foreign languages.
3. Can formulate and justify its views, participate in the discussion in the field of science and technology, prepare and discuss own presentation.

SUBJECT OBJECTIVES

C1. Acquire the abilities of developing the editorial and substantive skills in editing master thesis.
C2. Acquiring the abilities to develop research results and to formulate conclusions and to present own work.
C3. Preparing students for the final master exam. The replay of selected information from the field of studies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can in a transparent and communicative way prepare and give a presentation, discuss the plan to achieve the master thesis.
PEK_U02 - Can easily carry on a discussion on master thesis and on topics related to field of study.
PEK_U03 - Can develop and discuss the topics on the diploma examination and answer to questions.

III. Relating to social competences:

PEK_K01 - Has a sense of responsibility for its own work and its impact on the functioning of the company.
PEK_K02 - Understands necessity of critical discussion of results of the done teamwork.
PEK_K03 - Understands the need for lifelong learning and development the professional and social skills.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Presentation of the program, the purpose and scope of activities. Overview of the principles of writing master thesis. Distribution of questions to self-develop in the field of the final exam. Determination of the order of master's thesis presentations.	2
Sem2	Discussion of the diploma examination questions by the students in the group A	2
Sem3	Discussion of the diploma examination questions by the students in the group B	2
Sem4	Discussion of the diploma examination questions by the students in the group C	2
Sem5	Presentation of theses implementation plan - I group. Discussion.	2
Sem6	Presentation of theses implementation plan - II group. Discussion.	2
Sem7	Presentation of theses implementation plan - III group. Discussion.	2
Sem8	A summary of the seminar. Discussion. Pass.	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Rating the presentations, discussion and active participation skills.
F2	PEK_U03	Rating of the prepared questions for the final exam
P = (0,7F1 + 0,3F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Baranowski B.; Metody twórczego rozwiązywania problemów inżynierskich. Wielkopolska Korporacja Techniczna NOT, Poznań 1999

SECONDARY LITERATURE

Wiszniewski A.; Sztuka pisania. Videograf II, Katowice 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Thesis proseminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K1MBM_TSW_U01, K1MBM_TSW_U02, K1MBM_TSW_U03, K1MBM_TSW_U05, K1MBM_U01, K1MBM_U12	C1, C2	S1, S5 - S8	N1, N2
PEK_U03	K1MBM_U01, K1MBM_U04	C3	S1, S5 - S8	N1, N3
PEK_01 - PEK_K03	K1MBM_K01, K1MBM_K04, K1MBM_K06, K1MBM_K09	C1, C2	S1, S5 - S8	N1 - N3

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie laserowe w wytwarzaniu**
Name in English: **Laser Technology in Manufacturing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of optics and optical systems impact on the light beam
2. Basic knowledge of electromagnetic radiation's interaction with matter
3. Knowledge of the heat treatment's issues and its impact on the changes taking place in the material

SUBJECT OBJECTIVES

C1. Acquiring knowledge of the construction and the laser processing operation's
C2. Acquiring the ability to select the appropriate laser system to the task in
C3. Independent acquisition of information and its use to solve engineering problems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the principles of operation and construction of high-power lasers
PEK_W02 - He knows the laser beam forming systems and the interaction of radiation with matter
PEK_W03 - He is familiar with the scope of lasers in manufacturing

II. Relating to skills:
PEK_U01 - He can choose the right laser system for a given treatment process
PEK_U02 - Acting in an appropriate way with the specialized laser equipment
PEK_U03 - Depending on the desired process he is able to select the appropriate beam forming system

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basics of high-power lasers	2
Lec2	Measurements of the laser beam	2
Lec3	Laser beam forming systems and laser safety	2
Lec4	Impact of the laser beam with matter	2
Lec5	Cutting with laser beam	2
Lec6	Use of laser to welding	2
Lec7	Laserl cladding and micromachining	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Overview of laser radiation generators	2
Lab2	Monitoring of the laser beam	2
Lab3	Laser cutting	2
Lab4	Welding using the laser beam	2
Lab5	Laserl cladding	2
Lab6	Use of laser scanning head for machining	2
Lab7	Engraving and laser micromachining	2
Lab8	Evaluation	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
N4. Evaluation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03,	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03,	short exam
P = średnia F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

J. Kusiński: ”Lasery i ich zastosowanie w inżynierii materiałowej”, Wydawnictwo Naukowe Akapit, 2000; A. Klimpel: "Technologie laserowe w spawalnictwie" Wydawnictwo Politechniki Śląskiej, 2011.

SECONDARY LITERATURE

E. Kannatey-Asibu: “Principles of Laser Materials Processing”, Wiley, 2009.
J.C. Ion: „Laser Processing of Engineering Materials”, Elsevier, 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser Technology in Manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01- PEK_W03	K1MBM_TSW_W03, K1MBM_W21	C1,C2	Lec1-Lec7	N1- N3, N5
PEK_U01- PEK_U03	K1MBM_TSW_U03, K1MBM_U26, K1MBM_U28	C2, C3	Lab1-Lab7	N2- N5

SUBJECT SUPERVISOR

dr inż. Tomasz Baraniecki tel.: 26-62 email: tomasz.baraniecki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń wytwórczych**
Name in English: **Operation maintenance of manufacturing machines and devices**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031212**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure and operation of machine components and assemblies, as well as principles of their selecting and designing.
2. Basic knowledge about operation, reliability and safety of machines.
3. Well-grounded knowledge about basic manufacturing techniques and role of manufacturing machines.

SUBJECT OBJECTIVES

C1. Getting acquainted with principles of the Total Productive Maintenance (TPM) concept.
C2. Getting acquainted with basic TPM tools and methods allowing to increase efficiency of machine stock maintenance. Getting acquainted with principles of determining indices describing progress at implementing the TPM methodology.
C3. Getting acquainted with possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personnel.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of scope and principles of selecting a maintenance strategy of manufacturing machines and devices.
PEK_W02 - Knowledge of basic TPM tools and indices.
PEK_W03 - Knowledge of basic features and possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personnel.

II. Relating to skills:
PEK_U01 - Ability to use the acquired knowledge to formulate tasks aimed at improving a maintenance system of manufacturing machines and devices.
PEK_U02 - Ability to determine indices determining progress at implementing the TPM methodology.
PEK_U03 - Ability to use modern IT tools for computer-aided managing the maintenance processes.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to gain knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic problems related to maintenance of manufacturing machines and devices: service requirements, cause and effect analysis of machine failure, role and significance (benefits) of maintenance organization and planning.	2
Lec2	History and development of the TPM concept (characteristics of basic TMP pillars).	2
Lec3	Characteristics of basic TPM tools – exemplary applications.	2
Lec4	Maintenance strategies – idea of systematic and system-related attitude to maintenance problems.	2
Lec5	Measures and indices determining efficiency of implementing the TPM methodology.	2
Lec6	CMMS-class computer systems supporting maintenance management (requirements and functions of selected systems, system selection criteria).	2
Lec7	Implementing the TPM methodology to industrial practice (role and organization of Maintenance Department). Exemplary solutions of implementing a TPM program.	2
Lec8	Crediting the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides.
N2. Own work – preparation for crediting the lecture.
N3. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Credit colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Legutko S.: Basics of operation of machines and devices. Editorial Office WSiP. Warsaw, 2007 (in Polish).
Słowiński B.: Engineering of machine operation. Editorial Office of Koszalin University of Technology. Koszalin, 2011 (in Polish).
Kaźmierczak J.: Operation of technical systems. Editorial Office of Silesian University of Technology. Gliwice, 2000 (in Polish).

SECONDARY LITERATURE
Hebda M.: Elements of the theory of technical systems operation. Editorial Office MCNEMT. Radom, 1990 (in Polish).
Żółtowski B.: Basics of machine diagnostics. Editorial Office ATR Bydgoszcz, 1996(in Polish).
Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warsaw, 2000 (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of manufacturing machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W18, K1MBM_W26	C1 - C3	Wy1 - Wy7	N1 - N3
PEK_U01 - PEK_U03	K1MBM_U32	C1 -C3	Wy8	N2

PEK_K01 - PEK_K03	K1MBM_K04	C1 - C3	Wy1 - Wy8	N1 - N3

SUBJECT SUPERVISOR
dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia w procesach wytwarzania**
Name in English: **Metrology in manufacturing techniques**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031220**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics.
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C2. Gaining the ability to analyze the results of measurements, measurement errors and expressing measurement uncertainty in dependence of production lot scale.
C3. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C4. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to identify and define the quantity of the measuring machine parts. He knows and is able to determine the arrangements for ensuring the measurement integrity.
PEK_W02 - Can name the elements of the measurement system and define its functional characteristics. He knows the characteristic values measured in different types of machines.
PEK_W03 - He knows the principles governing the creation of tools, components and measuring systems in dependence of production lot scale.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use literature related to the assessment of the geometry of the product. Can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can create documents for the implementation of the measurements on the test bench.
PEK_U03 - Can use industrial measuring equipment management systems.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, measurement itegrity.	2
Lec2	Elements of measurenment systems and their properties.	2
Lec3	The method of determining the measurement uncertainty.	2
Lec4	Distribution of the variability of dimensions for typical processes.	3
Lec5	Toleration of machines in various technological processes.	3
Lec6	Designing of measuring devices's heads .	2
Lec7	Design and control tests for checking the geometry of the product.	2
Lec8	Integration of measuring stands.	2
Lec9	Mechanization and automation of measurement processes.	2
Lec10	Methods of measurement systems analysis.	2
Lec11	Methods and tools for monitoring measurement equipment.	2
Lec12	Elements of statistical control of manufacturing processes.	2
Lec13	Organization and documentation of the process control of machines.	2
Lec14	Analysis of tolerance and interchangeability of parts.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	1
Lab2	Checking selected metrological characteristics of measuring instruments.	2
Lab3	Selection of equipment for specific measurement tasks.	2
Lab4	Analysis of the measurement system.	2
Lab5	Measurement with pneumatic methods	2
Lab6	Analysis of the measurement system.	2
Lab7	Measurement in the integrated measurement environment.	2
Lab8	Analysis and implementation of the CMM measurement tasks.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. report preparation
N3. self study - preparation for laboratory class
N4. tutorials
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03; PEK_K01; PEK_K02; PEK_K03;	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.

SECONDARY LITERATURE
[1] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.
[2] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)
[3] Humienny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004
[4] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.
[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.
[6] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.
[7] Zelczak A.:" Pneumatyczne pomiary długości". WKŁ, Warszawa 2006.
[8] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology in manufacturing techniques
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1MBM_W15	C1; C2; C3; C4	Wy1 - Wy14	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1MBM_TSW_U01, K1MBM_U01, K1MBM_U12	C1; C2; C3; C4	La1 - La8	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1MBM_K04, K1MBM_K05	C1; C2; C3; C4	Wy1 - Wy14; La1 - La8	N1; N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badanie jakości wyrobów**
Name in English: **Research of qualities of products**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031221**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should has a basic knowledge about the basic mechanical properties of engineering materials; has ordered knowledge about the types of metallic engineering materials - their structure, properties, applications and principles of selection; has detailed knowledge about the structures of steel and cast iron, the principles of classification and labeling; has a basic knowledge about heat and thermo-chemical treatment, has a knowledge about alloy steels and non-ferrous metals and alloys.Has a theoretical knowledge about circuitry.
2. Can analyze the macroscopic fractures, microstructure of materials, technological defects; is able to determine the characteristics of the microstructure of metallic materials; is able to identify the phases on the basis of equilibrium diagrams; can distinguish between the microstructure in terms of carbon content in steel, the influence of heat treatment; can analyze circuits, can read and interpret the drawings and diagrams used in technical documentation
3. Has a basic knowledge of the manufacturing processes of products from the liquid metal, the plastic molding, welding and machining techniques.
Has a basic knowledge of metrology of geometrical quantities.

SUBJECT OBJECTIVES

C1. To familiarize students with methods of product quality assesment manufactured from the liquid metal, through the plastic molding, welding techniques and machining.
C2. Acquisition of knowledge about the basic methods of quality assesment of castings, forgings, stampings, rolled products, drawn, welded products, welded and brazed, glued, screwed, sintered products form metal powders, products manufactured by machining, heat-treated products and products made of plastics.
C3. The acquisition and consolidation of social skills including emotional intelligence involving the ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in the acting; observance of customs in academia environment and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic methods of quality assessment of castings and products made by methods of plastic working.
PEK_W02 - Knows the basic quality assessment methods of products made by prosesses like welding, glueing, screwing and sintered products from metal powders.
PEK_W03 - Knows the basic quality assessments methods of products manufactured by machining, heat treatement and plastic products.

II. Relating to skills:
PEK_U01 - Can choose the appropriate method for the quality assessment of products manufactured by castings and by methods of
plasting working and specify a quality class of product .
PEK_U02 - Can choose the appropriate method for the quality assessment of products produced in the process of welding and specify a quality class of product .
PEK_U03 - Can choose the appropriate method for the quality assessment of products manufactured by machining and plastic products and specify a quality class of product .

III. Relating to social competences:
PEK_K01 - Searching for the information and critical analysis,
PEK_K02 - Objective evaluation of arguments to justify, the rational translation and his own point of view using the knowledge about the casting, plastic forming and welding, machining and plastics
PEK_K03 - Observance with the customs and rules of the academic environment,

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts and terminology in systems to ensure product quality.	2
Lec2	The techniques used for quality control of products.	2
Lec3	Aspects of the application of non-destructive testing for quality control of products.	2
Lec4	Geometric measurements of the products.	2
Lec5	The methods and principles for quality assessment of the castings.	2

Lec6	Methods of quality assessment of rolled, drawn and extruded products.	2
Lec7	Methods of quality assessment of forged products	2
Lec8	Testing and quality control methods of welded products	2
Lec9	Testing and quality control methods of welded and brazed products	2
Lec10	Testing and quality control methods of glued and screwed products	2
Lec11	Methods of quality assessment of sintered products.	2
Lec12	Methods of quality assessment of products after the thermo-chemical treatment.	2
Lec13	Methods of quality assessment of plastic products	2
Lec14	Methods of quality assessment of products made by machining	2
Lec15	Coordinate measuring techniques in the assessment of product quality.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Quality control of non-destructive testing methods.	2
Lab2	The study of selected parameters of cast products and the assessment of their quality.	2
Lab3	The study of selected parameters of product manufactured by plastic processing technologies and the assessment of their quality.	2
Lab4	The study of selected parameters of product manufactured by welding processes and the assessment of their quality.	2
Lab5	The study of selected parameters of plastic product and the assessment of their quality.	2
Lab6	The study of selected parameters of product manufactured by machining and the assessment of their quality.	2
Lab7	Computed tomography in product quality control.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03, PEK_K01 - PEK_K03	Written - oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	oral examination, short test
P = = średnia z wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Praca zbiorowa. Zarządzanie jakością, T4. Metody oceny jakości wyrobów technicznych. Politechnika Krakowska. 2000r.

Łabanowski J. Ocena jakości wyrobów hutniczych. Wyd. PWSZ w Elblągu. 2008r.

SECONDARY LITERATURE

Zymonik Janusz i Zofia. Systemy jakości w wytwarzaniu maszyn. SIMPRESS, Wrocław, 1997r.

Mirski Z., Technologia i badanie materiałów inżynierskich : laboratorium. Oficyna Wydawnicza Politechniki Wrocławskiej, 2010r.

Subject standards PN-EN ISO.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Research of qualities of products
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W15	C1, C2	Lec1 - Lec7	N1, N4, N5
PEK_W02	K1MBM_W15	C1, C2	Lec1 - Lec4, Lec8 - Lec11	N1, N4, N5
PEK_W03	K1MBM_TSW_W04, K1MBM_W15	C1, C2	Lec1 - Lec4, Lec12 - Lec15	N1, N4, N5

PEK_U01	K1MBM_TSW_U04, K1MBM_U12	C1, C2, C3	Lab1 - Lab3, Lab5	N2, N3
PEK_U02	K1MBM_U12	C1, C2, C3	Lab1, Lab4, Lab5	N2, N3
PEK_U03	K1MBM_U12	C1, C2, C3	Lab1, Lab5, Lab6, Lab7	N2, N3
PEK_K01 - PEK_K03	K1MBM_K04	C3	Lec1 - Lec15, Lab1 - Lab7	N4, N5

SUBJECT SUPERVISOR

dr inż. Wiesław Derlukiewicz tel.: 27-38 email: wieslaw.derlukiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English: **MASTER THESIS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031250**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				450	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				15	
including number of ECTS points for practical (P) classes				15	
including number of ECTS points for direct teacher-student contact (BK) classes				15.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of manufacturing techniques and production systems documented by positive marks in all subjects in within the specialty of Technologies and Manufacturing Systems
2. Can apply their knowledge. Carry out experimental research, seek an information from the literature. Speak a foreign language at the level which let to express self-opinions and write master's thesis in the field of production techniques and production systems. Can analyze the results of the research and specify the conclusions.
3. Is aware of the importance of non-technical aspects and impacts of engineering, to respect the principles of ethics and social role of technical college graduate.

SUBJECT OBJECTIVES

C1. Based on the acquired knowledge while studying, preparation of master thesis by the solution of research problem in the field of the specialty of Technologies and Manufacturing Systems.
C2. Writing a master thesis and presentation of its achievements in relation to current information in literature.
C3. Acquisition and consolidation of independent work skills, determination of the priorities to tackle the task and awareness of responsibility for own work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a necessary knowledge of realization the engineering tasks, their description, documentation and presentation.
PEK_W02 - Has a basic knowledge of the organization and implementation of master thesis, on issues related to the specialty of Technologies and Manufacturing Systems.
PEK_W03 - Has a basic knowledge in methodology of presenting the results of done work and background skills needed for the communicating in engineering teamwork.

II. Relating to skills:
PEK_U01 - Can critically analyze and evaluate existing manufacturing processes, production systems and technological machines. Can work independently to realize the degree of master's thesis, using research techniques and methods known during studies.
PEK_U02 - Can acquire concrete information from the literature also in foreign languages. Can to interpret and critically evaluate the research results.
PEK_U03 - Knows how to edit a master's thesis complying with prevailing requirements of method and style of writing. Can present it orally to a wider audience using multimedia capabilities, including the occurrence to the diploma committee.

III. Relating to social competences:
PEK_K01 - As a graduate student is aware of being the next leader, who knows how to organize the work and determine the self-priorities for the others, can manage a team of people as well as work together in the group taking the different roles.
PEK_K02 - Is gaining characteristics of a person working alone, according to the principles of ethics with an awareness of the responsibility for their own work.
PEK_K03 - Acquires attention to style and form of expression of own views in native and a foreign languages, especially in English, understands the need of continuing education and developing professional skills throughout their live.

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. case study
N2. self study - self studies and preparation for examination
N3. multimedia presentation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Working in the semester, preparing master's thesis as a work.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Literature of the master's thesis topic agreed with the promoter.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MASTER THESIS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W25, K1MBM_W30	C1 - C3		N1, N2, N4
PEK_U01 - PEK_U03	K1MBM_U41, K1MBM_U42, K1MBM_U45	C1, C2		N1 - N4
PEK_K01 - PEK_K03	K1MBM_K01, K1MBM_K04, K1MBM_K05, K1MBM_K06, K1MBM_K09	C1 - C3		N1 - N4

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska - geometria wykreślna**
Name in English: **Engineering graphics - descriptive geometry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10	20			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry
2. Student has ability to use of the drawing utensils
3. Student has ability to draw basic geometric structures, such as division of a line's segment into n equal parts, plotting a regular hexagon

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane, as the basis for design recording (technical drawing)
C2. Acquiring the ability to solve tasks requiring the use of a projection by Monge, including measuring tasks (descriptive determining of the distances, angles, actual size).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge of the geometric structures mapping onto drawing's plane using Monge method and has elementary knowledge in the field of axonometry.
PEK_W02 - Student can indicate an appropriate algorithm of the mapping for solution of the position and the relationship between of the geometric structures in the space.
PEK_W03 - Student has mastered the basics of geometric structures restitution based on the Monge's projections.

II. Relating to skills:
PEK_U01 - Student can practically apply the principles of the Monge projection method to map the elements and geometric structures (including solids) on the drawing plane.
PEK_U02 - Student can set the actual sizes characterized the measuring tasks of the descriptive geometry.
PEK_U03 - Student is able to interpret the drawing, made by the method of Monge, showing the position of the geometric structure in the space.

III. Relating to social competences:
PEK_K01 - Student is able to work independently and solve problems involving Monge projection method.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions and principles of the parallel, rectangular projection by Monge, the mapping of basic geometric elements (point, line, plane).	2
Lec2	The edges and breakdown points. Transformation of the position (rotation, revolved section) and the reference system. Solids - definitions.	2
Lec3	Cross body (with projecting plane) as the set of the common points of the solid and cutting plane, breakdown points of the solid by a straight line, cutting of the solid by set of the cutting planes.	2
Lec4	The penetration of the solids - transmission lines definition, the use of auxiliary cutting planes and reference system transformation.Projections in the three orthogonal planes.	2
Lec5	Completing the missing solid projection- use of the axonometric projection. Final test (1 hr.).	2
		Total hours: 10

Form of classes – Classes		Number of hours
Cl1	Information on the drawing utensils and principles of the geometric structures drawing. Projection of a point and a straight line, the mapping of a plane using her traces; identification of the basic elements localization in the space using two orthogonal projection planes.	2
Cl2	Belonging of the basic geometric elements, completion of the missing projection. Edge as a common element of two planes.	2
Cl3	Breakdown point as a common point of a line and plane. The edge between flat figures. Identification and construction of parallel and perpendicular relationship of basic geometric elements. Identification of the relationship of parallelism and squareness of basic geometric elements.	2

Cl4	Rotation and revolved section of basic geometric elements (line's segment, plane rotation) - used in measuring tasks (determination of the real size of a line's segment,an angle of a plane figure).	2
Cl5	Reference system transformation application in measuring tasks and localization identification. The mapping of elementary solids in the Monge projection, the points and straight lines belonging to the solid walls identification.	2
Cl6	Determination of the cross sections of polyhedra and solids of revolution cutted by projection planes. Cutting a solid with assembly of the cutting planes.	2
Cl7	Determination of the transmission line of polyhedra. Solids of revolution transmission line determination.	2
Cl8	Mapping the solid on three orthogonal projection planes. Modifying the solid by projecting plane against one of a projection plane.	2
Cl9	Mapping the solid with axonometric projection. Determination of the missing projection of the solid modified by cutting planes. Relationsip between Monge projections and axonometric view.	2
Cl10	Final test	2
		Total hours: 20

TEACHING TOOLS USED

N1. problem lecture
N2. problem exercises
N3. self study - preparation for project class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_U02, PEK_U03	Final test, good rating is needed (min. 3.0)
F2	PEK_K01	evaluation of n (sheets) projects preparation, n = min. 3 - max. 6, good rating of each project is needed, F2 = (P1 + ... Pn) / n
P = F1*3/4+F2*1/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania),[2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998,[3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001,[4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005

SECONDARY LITERATURE

[1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania),[2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997,[3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997,[4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering graphics - descriptive geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W14	C1	Lec1-Lec5	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_U14	C2	Cl1-Cl9	N2, N3, N4
PEK_K01	K1MBM_K05	C1, C2	Cl1-Cl9	N2-N4

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia materiałów**
Name in English: **Materials chemistry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. high school level

SUBJECT OBJECTIVES

C1. Introduction with chemistry sections usable over study of related courses (meterial scicnce, metallurgy, polymers)
C2. Introduction with basic chemical knowledge enabling of chemical rules and physicochemical properties of technical materials particularly metals, alloys and polymers

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student should have basic chemical knowledge associated with structure of matter, states of matter.
PEK_W02 - The student should have basic inorganic knowledge associated with the structure of metals, alloys, electron conductivity as well as basic organic knowledge associated with fuels and polymers
PEK_W03 - The student should have basic knowledge associated wit physicochemical characterization techniques of construction materials

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The structure of matter, elements, periodic table, compounds	2
Lec2	Chemical bonds, molecules	2
Lec3	The states of matter	2
Lec4	Metals and alloys, solid state band theory, electrochemistry, corrosion	2
Lec5	Basic crystallography, unit cell, symmetry elements, crystallographic defect	2
Lec6	Ceramic materials	2
Lec7	Selected topics of organic chemistry	2
Lec8	Polymers chemistry	2
Lec9	Selected methods of solid materials characterizations	2
Lec10	Qualifying class -test	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Chemical Principles, Atkins Peter William, Jones Loretta, Palgrave Macmillan

SECONDARY LITERATURE
Chemistry, Michell J. Sienlo and Robert A. Plane, both of Cornell University, Ithaca, New York.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials chemistry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W03, K1MBM_W06, K1MBM_W11, K1MBM_W13	C1, C2, C3	Lec1- Lec9	N1-N4

SUBJECT SUPERVISOR

dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologia materiałów inżynierskich**
Name in English: **Engineering Materials Technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032005**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge concerning physics and mathematics. Ability to use basic measuring equipment like slide caliper.
2. Ability to analyze information included in laboratory instructions
3. Ability to work in a team

SUBJECT OBJECTIVES

C1. Familiarization with metallurgical processes of ore conversion, production of steel and non-ferrous metals.
C2. Familiarization with basic methods of testing of mechanical properties of steel and non-ferrous metals and principles of forming of items with use of powder metallurgy.
C3. Obtaining and reinforcement of social competences connected with a teamwork with a goal to solve problems effectively.
C4. Familiarization with knowledge about basic mechanical properties of engineer materials like tensile strength, compressive strength, impact strength, hardness by participation in testing of given materials.
C5. Familiarization with methods of conducting of non-destructive testing like visual inspection, dye-penetrant examination, magnetic particle testing, radiographic and ultra-sonic testing by participation in testing given parts.
C6. Familiarization with technological tests and forming of items with use of powder metallurgy by participation in an experiment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of conducted lecture the student should be able to define the basic physical properties of engineering materials, to quote and to describe the ways of processing of ores the metals, to characterize the metallurgical processes of receiving the metals and the alloys of metals.
PEK_W02 - As a result of conducted laboratory the student should be able to define the mechanical properties of metals and the alloys, to describe the method of tests destructive and non-destructive, to characterize the method of carrying out the technological tests.
PEK_W03 - As a result of conducted classes the student should be able to distinguish basic engineering materials, to characterize their physical and mechanical properties, to identify method investigations of properties of engineering materials.

II. Relating to skills:
PEK_U01 - As a result of the lecture the student should be able to analyze processes metallurgical obtaining metal, compare the properties of engineering materials
PEK_U02 - As a result of laboratory classes student should be able to carry out in a limited range the basic test of tensile strength, compressive strength, impact tests, hardness tests and technological tests
PEK_U03 - As a result of the course the student should be able to obtain information from the literature, have the ability to self-learning, carry out measurements, determine the value and to evaluate certainty basic mechanical properties.

III. Relating to social competences:
PEK_K01 - Demonstrates skills needed in teamwork on improving methods of choice of a strategy to optimally solve problems assigned group.
PEK_K02 - Is able objectively evaluate the arguments rationally explain and justify his own point of view using the knowledge of the basics of engineering materials.
PEK_K03 - Respects the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization of groups. General information about properties of engineer materials. Refractory materials and fuels in pyrometallurgy.	2

Lec2	Metallurgy of iron. Ore treatment, blast furnace process, production of steel.	2
Lec3	Metallurgy of copper. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of copper and its alloys	2
Lec4	Metallurgy of zinc. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of zinc and its alloys. Metallurgy of aluminum. Treatment of ores, production of aluminum oxide and refining of aluminum.	2
Lec5	Production of high melting metals with use of powder metallurgy and methods of production of parts with use of metallic powders.	2
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Organization of groups, safety. Tensile test of metals	2
Lab2	General information about metals and alloys. Technological tests	2
Lab3	Compression test and impact test	2
Lab4	Hardness measurement	2
Lab5	Non-destructive testing	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01-PEK_U03, PEK_K01-PEK_K03	oral answers, short tests
P = średnia z F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Z. Mirski. Technology and engineering materials testing, laboratory. Wrocław University of Technology Publishing House, 2010.
2. Krynicki L., L. Sozański. Technology of metals. Publisher University of Technology, 1994.

SECONDARY LITERATURE

Supplementary materials for exercises No. 1-5. W10 library (building B4, III floor)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering Materials Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W03	K1MBM_W10	C1, C2	Le1 - Le5	N1, N5
PEK_W02, PEK_W03	K1MBM_W10	C4, C5, C6	Le1 - Le5	N1, N5
PEK_U01, PEK_U03	K1MBM_U20	C4, C5, C6	Lab1 - Lab5	N2, N3, N4
PEK_U02, PEK_U03	K1MBM_U20	C4, C5, C6	Lab1 - Lab5	N2, N3, N4
PEK_K01, PEK_K03	K1MBM_K04	C3	Lab1 - Lab5	N2, N3, N4
PEK_K02, PEK_K03	K1MBM_K04	C3	Lab1 - Lab5	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Piotr Białucki tel.: 42-71 email: piotr.bialucki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Statystyka inżynierska**
Name in English: **Statistics for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032007**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of mathematics confirmed positive marks on the upper secondary school leaving certificate

SUBJECT OBJECTIVES

C1. Gaining basic knowledge of probability and mathematical statistics takes into account the aspects of application and the acquisition of skills exploration figures in the field of construction and operation of equipment, organization and management, as well as optimize the design, technology and systems.
C2. Acquiring skills development (reduction) of data using statistical software (STATISTICA, MatLab, Gretl, R) and the possibility of a spreadsheet (Excel).
C3. The acquisition and consolidation of social skills including emotional intelligence involving the ability to work in a group of students with a view to effectively solve problems with regard to accountability, integrity and fairness in the proceedings.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - knows the basic descriptive statistics pertaining to the results of measurements in engineering and knows the principle of grouping data and compilation of the distribution
PEK_W02 - knows the basic theoretical distributions of discrete and continuous features and has a basic knowledge of the principles of estimating confidence intervals for the average value and the dispersion characteristics
PEK_W03 - has knowledge of the methods for parametric and non-parametric statistical hypotheses about the average value, the equality of the two values of the average of the value of homogeneity of variance and multiple variance

II. Relating to skills:
PEK_U01 - able to perform data reduction for a suitable choice of the statistics that describe the average value, the dispersion and the shape of the distribution as well as how the raw data to create a frequency distribution, and illustrate a set of data using a histogram, the empirical distribution function and graph frameset
PEK_U02 - able to fit the empirical data and theoretical distribution on the basis of estimated quantile values for selected probabilities, and estimate the probability for selected quantiles and can correctly choose the type of statistical test and perform testing hypotheses about the average and distribution of features
PEK_U03 - can analyze dependencies in a multi-dimensional characteristics of categorical data table and can perform regression analysis and correlation of two and more variables, estimate the parameters characterizing the strength and shape of the relationship

III. Relating to social competences:
PEK_K01 - acquisition and consolidation of competence to understand the need for self-study, including the ability to improve attention and focus on what's important and to develop the ability to independently apply their knowledge and skills and to find the information and its critical analysis
PEK_K02 - team cooperation on improving methods for the selection of a strategy to optimally assigned to group problem solving
PEK_K03 - compliance with customs and rules in academia and independent and creative thinking

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Statistical methods of data analysis - the essence of statistical modeling. The descriptive analysis of the data: the forms of representation of statistical data, measures of association, variability, asymmetry and concentration. Development and presentation of statistical data. Grouping data - ranks simple and distribution. Histogram and empirical cumulative distribution.	2
Lec2	Random variables and their distributions. Numerical characteristics of the distribution. Selected discrete and continuous distributions. Elements of the theory of estimation - point estimate. Interval estimation of the mean value and variance. The confidence intervals. Parametric statistical hypotheses. Testing hypotheses about the average value, the equality of the two average values. Testing hypotheses about the rate structure and the structure of the equality of two ratios. Testing hypotheses about the variance and equality of two variances.	2
Lec3	Nonparametric hypothesis testing. Conformance Test chi-square, Kolmogorov-Smirnov test. Test of independence Pearson chi-square. Based measures based on chi-square. The odds ratio. Nonparametric tests: test Wald-Wolfowitz runs test, Wilcoxon rank-Mann-Whitney test.	2

Lec4	Correlation and regression analysis. The method of least squares. Pearson correlation coefficients and Spearman. Linear regression function. Multivariate regression analysis and correlation. The estimation of linear multiple regression function. The significance test for multiple regression coefficients. Estimation of the multiple correlation coefficient. The coefficient of determination.	2
Lec5	Univariate analysis of variance and post-hoc test: Tukey, Duncan and least significant difference. Kruskal-Wallis test and post-hoc test of Dunn. Methods of analysis of the dynamics of the phenomena - time series. Time series smoothing methods. Analysis of periodic fluctuations. Presentation of selected computer programs supporting statistical analysis STATISTICA, R, Gretl.	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Organizational matters. Introduction to using a spreadsheet. Math and statistics Excel. Generate a vector of continuous variables with normal distribution. Descriptive statistics - calculating measures of location, variability, asymmetry and concentration. Construction series distribution. A graphical representation of the data set - the histogram and the empirical distribution function and the graph ramkowy.	2
Proj2	Basic distributions encountered in mathematical statistics: a normal distribution, Student, chi-square, F Snedecor. Probability density function and cumulative distribution. Point and interval estimation of the expected value, the rate structure (fraction), variance and standard deviation.	2
Proj3	Testing of statistical hypotheses. Parametric tests of significance for the expected value and the variance of the general population. The test for two variances for two medium and two indicators of the structure. Student's test for paired test, homogeneity of variance Bartlett's many, many medium homogeneity test (ANOVA).	2
Proj4	Non-parametric tests of significance - compatibility test Pearson's chi-square test, Kolmogorov sensor compatibility,. Chi-square test of independence - kontyngencyjne boards. Mann-Whitney test. Median test and Wilcoxon signed-ranks test. Rank sum test Kruskal-Wallis test to assess the relationship between the two zmiennymiDwuwymiarowa regression analysis and correlation. A scatterplot. Strength of the association correlation - correlation coefficient estimation, test of significance for the correlation coefficient, parameter estimation of linear regression function, a test of significance for the regression coefficient (slope of the regression line), the confidence interval for the regression coefficient.	2
Proj5	Multivariate analysis of correlation and regression. Estimation of the multiple regression function. The significance test for multiple regression coefficients. Estimation of the coefficient of determination and multiple correlation. Curvilinear regression. Logistic regression. Maximum likelihood estimation. Interpretation of the results of logistic regression.	2
		Total hours: 10

TEACHING TOOLS USED

N1. informative lecture
N2. self study - preparation for project class
N3. calculation exercises
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_K01	small exam, evaluation of computing project
F2	PEK_U02,PEK_K02	small exam, evaluation of computing project
F3	PEK_U03,PEK_K03	small exam, evaluation of computational design, defense project
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Bobrowski D: Probability in technical applications. Warsaw 1986, WNT [2] R. Smith: Statistics for physicists. Warsaw 2002, PWN [3] Ostasiewicz W. (ed.): Statistical methods for data analysis. Wroclaw 1999, Publisher of Economics in Wroclaw [4] Zeliaś A., Pawelek, B., S. Wanat: Statistical Methods. The tasks and tests. Warsaw 2002, PWE

SECONDARY LITERATURE
[1] I. Bak, Markowicz I., Mojsiewicz M., K. Wawrzyniak: Statistics in tasks. Part I and II. Warsaw 2001. Publisher of Science and Technology [2] Cieciura M., Zacharski J.: Probabilistic methods in practical terms. Warsaw 2007, VIZJA PRESS & IT Sp. z oo [3] Dobosz M.: The computer-assisted statistical analysis of test results. Warsaw 2001, Academic Publishing House EXIT. [4] Frątczak E. Gach-Ciepiela Laws, Babiker H. event history analysis. Elements of the theory, some examples of applications. 2005 Warsaw School of Economics in Warsaw. [5] Puppet L: Fundamentals of engineering studies. Warsaw 2002, PWN. [6] Maliński M.: Computer-assisted mathematical statistics. Gliwice 2000, Silesian University of Technology Press

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Statistics for Engineers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W01	C1, C2	Lec1, Lec2, Lec3,	N1, N2, N3
PEK_W02	K1MBM_W01	C1, C2	Lec1, Lec3, Lec4,	N1, N2, N3
PEK_W03	K1MBM_W01	C1, C2, C3	Lec1, Lec4, Lec5,	N1, N2, N3, N4
PEK_U01	K1MBM_U04	C1, C2	Pr1, Pr2	N1, N2, N3
PEK_U02	K1MBM_U04	C1, C2	Pr2, Pr3, Pr4	N1, N2, N3
PEK_U03	K1MBM_U01, K1MBM_U05	C1, C2	Pr4, Pr5	N2, N3, N4
PEK_K01	K1MBM_K05	C3	Pr5	N4
PEK_K02	K1MBM_K04	C3	Pr1, Pr5	N4
PEK_K03	K1MBM_K05	C3	Pr1, Pr5	N4

SUBJECT SUPERVISOR

dr inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo I**
Name in English: **Materials Science I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032009**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic of physic at the high school level
2. Basic of chemistry at the high school level

SUBJECT OBJECTIVES

C1. Knowledge of interaction between structure, manufacturing and properties the basic groups of engineering materials
C2. Knowledge of basic rules of selection materials applied for constructional elements in machines building
C3. Knowledge of basic crystallography and cristalline structures properties
C4. Knowledge of structures and properties of iron-cementite system alloys
C5. Knowledge basic properties of unalloyed steels

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know basic types and properties of materials
PEK_W02 - Know influence of basic manufacturing technoilogies on the basic materials properties
PEK_W03 - Know basic types and properties of iron alloys structures

II. Relating to skills:
PEK_U01 - Able to assess the type of materials applied for engineering design
PEK_U02 - Can determine the structures of materials applied for engineering design
PEK_U03 - Can determine the basic properties of materials applied for engineering design

III. Relating to social competences:
PEK_K01 - Information retrieval and their critical analyse
PEK_K02 - Observance of custom and rules binding at academic environment

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification of engineering materials. Dependences between manufacturing process, structure and materials properties. Rules for materials selection at machines construction.	2
Lec2	Polymer, compositeand ceramic materials - classification, structures and properties	2
Lec3	Elements of crystallography. Build of real crystals. Defects of crystalline structures	2
Lec4	Equilibrium and equilibrium criteria. Internal energy. Entropy. Free energy.	2
Lec5	Phase transformations. Crystallisation. Allotropic and magnetic transformations.	2
Lec6	Alloys. Structure and types of alloys. Intermetallic phases.	2
Lec7	Characteristic of phases presented in alloys of metals	2
Lec8	Binary phase diagrams. Phase rule.	2
Lec9	Analyse of basic types of phase equilibrium diagrams.	2
Lec10	Iron-cementite equilibrium diagram. Diagram analysis.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Introduction.The aim and methods of materials investigation. Construction and operation of metallographic microscope. Macroscopic investigation of materials and investigation of technological defects.	2
Lab2	Binary equilibrium diagram analysis	2
Lab3	Microstructural investigation of mono- and multiphase alloys at etched and non-etched state.	2
Lab4	Diagram and microstructures of iron-cementite diagram analysis	2
Lab5	Summation and laboratory practice credit	2
		Total hours: 10

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - self studies and preparation for examination N3. self study - preparation for laboratory class N4. laboratory experiment N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03,	Oral-written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K02	Introduction test, oral answers, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. M.F.Ashby, D.R. Jones - Engineerig Materials

SECONDARY LITERATURE
M. F. Ashby- Materials Selection in Mechanical Design

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W02	K1MBM_W10, K1MBM_W11	C1 - C3	Lec 1 - Lec 7	N1 - N3
PEK_W03	K1MBM_W10, K1MBM_W11	C4 - C5	Lec 8 - Lec 10	N1 - N3
PEK_U01 - PEK_U03	K1MBM_U01, K1MBM_U02, K1MBM_U06	C1 - C2	Lab 1 - Lab 5	N3 - N5
PEK_K01 - PEK_K02	K1MBM_K09	C1 - C5	Lab 1 - Lab 5	N2, N3, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Włodzimierz Dudziński tel.: 320-37-80 email: wlodzimierz.dudzinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika I**
Name in English: **Mechanics I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	20			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematics I (differenting, integrating)
2. Algebra, Linear algebra, (Matrix, Determinants)
3. Euklides geometry & Trigonometry

SUBJECT OBJECTIVES

C1. Solving technical problems on the basis of mechanics rules
C2. Making statical strength analysis of machines elements.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with
a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define basic quantities in Mechanics (Force and momentum). He knows conditions of static equilibrium of forces system.
PEK_W02 - He knows the Centroid of Area, the center of Gravity of a Mass, Moments of inertia, Product of inertia, Parallel–axis theorem, Rotation transformation of Moments of inertia, Iinertia Tensor, inertia ellipsoid, the principal axes.
PEK_W03 - He is able to define key concepts in Kinematics, motion of particle, trajectory, one–dimensional model. Velocity and acceleration in natural coordinates. Rigid body, The Degrees of Freedom, Classification of motions, Velocity and acceleration in general motion.

II. Relating to skills:
PEK_U01 - He can solve typical engineering structures (Trusses, Beams & Frames) under statical loading. Conditions of static equilibrium of forces system. Plane forces system reduction.
PEK_U02 - He can calculate the Centroid of Area, the center of Gravity of a Mass, Moments of inertia, Product of inertia, He can use Parallel–axis theorem, Rotation transformation of Moments of inertia, Iinertia Tensor, inertia ellipsoid, the principal axes
PEK_U03 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion of a point. He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using the Newton's second principle.

III. Relating to social competences:
PEK_K01 - He can search information and is able to review it critically.
PEK_K02 - He can objectively evaluate the arguments as well as rationally explain and justify the own point of view.
PEK_K03 - He can observe customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Curriculum. Requirements. Literature.Theory of vectors algebra. Force and momentum. Principal vector and principal momentum of forces system. Statics. Conditions of static equilibrium of forces system.	2
Lec2	The change of momentum point. Concurrent forces system.Trusses. Method of Joints.	2
Lec3	Plane forces system. Reactions in the statically determinate systems (Beams, Trusses, Frames). Conditions of static equilibrium of forces system. Plane forces system reduction.	2
Lec4	Internal forces in Beams (analytical methods, diagrams).	2
Lec5	Internal forces in Frames (analytical methods, diagrams). Centroid of Area. The center of Gravity of a Mass.	2
Lec6	Moments of inertia. Product of inertia. Parallel–axis theorem. Rotation transformation of Moments of inertia, inertia tensor, inertia ellipsoid. The principal axes.	2
Lec7	Kinematics, motion of particle, trajectory, one–dimensional model. Velocity, acceleration. Velocity and acceleration in natural coordinates.	2

Lec8	Rigid body, The Degrees of Freedom, Classification of motions, Velocity and acceleration in general motion.	2
Lec9	Plane motion and rotation over permanent axis. Planar motion of rigid body, velocity, center of circulation.	2
Lec10	Centroids, acceleration in a planar motion of rigid body. Relative motion. Kinematics in a general motion of rigid body. The Coriolis' acceleration.	2
		Total hours: 20
Form of classes – Classes		Number of hours
Cl1	Vectors algebra. Trusses. Method of Joints. Analytical methods of trusses solving.	2
Cl2	Reactions in the statically determinate plane systems. Analytical methods. Reactions in the statically determinate space systems. Analytical methods. Analytical methods of trusses solving. The Ritter's methods.	2
Cl3	Internal forces in beams (analytical methods, diagrams).	2
Cl4	Internal forces in beams (analytical methods, diagrams). Beams with Joints. Internal forces in Frames (analytical methods, diagrams).	2
Cl5	Centroid of Area. The center of Gravity of discrete Multi-mass structures. Centroid of Area. The center of Gravity of continue-mass structures.	2
Cl6	Moments of inertia & inertia products. Parallel–axis theorem. Rotation transformation of Moments of inertia, inertia tensor, inertia ellipsoid. Principal axes.	2
Cl7	Kinematics of particle in orthogonal coordinates.	2
Cl8	Kinematics of rigid body. Plane motion and rotation over permanent axis.	2
Cl9	Velocity in a plane motion.	2
Cl10	Test	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. Homeworks

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03 ,	Test

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01-PEK_K03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. B. Gabryszewska, A. Pszonka: „Mechanika”, cz. I, Statyka, PWr, 19882. J. Zawadzki, W. Siuta: „Mechanika ogólna”, PWN, Warszawa 19713. J. Misiak : „Mechanika ogólna. Statyka i kinematyka”. Tom I, WNT, Warszawa 19934. M. Kulisiewicz, St. Piesiak: „Dynamika układów mechanicznych w zadaniachtechnicznych” część I : „Podstawy Kinematyki”, PWr, 20025. Cz. Witkowski, „Zbiór zadań z mechaniki”. Część I. „Kinematyka”. PWr. 19996. Z. Jaśniewicz, „Zbiór zadań ze statyki”, PWr. 1996

SECONDARY LITERATURE

1. J. Giergiel : „Mechanika ogólna”, WNT, Warszawa 19802. B. Skalmierski: „Mechanika” PWN, Warszawa 19773. J. Leyko : „Mechanika ogólna”, WNT, Warszawa 19804. S. Piasecki, J. Rżysko: „Mechanika” WNT, Warszawa 1977,5. W. Siuta: „Mechanika techniczna”, WNT, Warszawa 1968MACIERZ POWIĄZANIA EFEKTÓW KSZTAŁCENIA DL

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W07	C1,C2,C3	Lec1-Lec10	N1,N3
PEK_U01, PEK_U02, PEK_U03	K1MBM_U05, K1MBM_U07	C1, C2, C3	Cl1-Cl9	N2,N4

PEK_K01-PEK_K03	K1MBM_K03, K1MBM_K04	C3	Cl1-Cl9	N2 - N4

SUBJECT SUPERVISOR
dr inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe zwyczajne**
Name in English: **Ordinary differential equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032011**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10	10			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses	X				
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the differential and integral calculus of function of one variable and other branches of mathematics used in this calculus, particularly linear algebra.
2. Student is able to calculate derivatives of functions of one variable, indefinite and definite integrals using methods by parts and by substitution.
3. Student is able to calculate determinants, eigenvalues and eigenvectors of matrix.

SUBJECT OBJECTIVES

C1. To gain basic knowledge about first-order and second-order ordinary differential equations, and systems of differential equations.
C2. To learn how to choose the appropriate method of solving ordinary differential equations and systems of differential equations.
C3. To develop and consolidate the ability to access information and its analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has theoretical knowledge of differential equations and knows methods of their solving.
PEK_W02 - Student has knowledge of methods of solving of systems of differential equations.
PEK_W03 - Student has knowledge about applying differential equations as the mathematical model for a physical phenomenon.

II. Relating to skills:
PEK_U01 - Student is able to formulate theorems and definitions of differential equations in oral and written, friendly manner.
PEK_U02 - Student is able to solve first-order and second-order differential equations.
PEK_U03 - Student is able to solve systems of differential equations.

III. Relating to social competences:
PEK_K01 - Student understands the necessity of systematical work on all tasks and can estimate time needed for solving the exercise.
PEK_K02 - Student knows the scope of his/her knowledge and abilities, is able to identify lack of knowledge and complete it using the literature.
PEK_K03 - Student acts ethically and understands the importance of intellectual honesty.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	First-order differential equations: the basic definitions. Issues from various fields leading to differential equations. First-order differential equations: the equations with separated variables and homogeneous equations.	2
Lec2	First-order linear homogeneous and heterogeneous differential equations.	2
Lec3	Reducible second-order equations. Second-order linear homogeneous differential equations with constant coefficients.	2
Lec4	Second-order linear heterogeneous differential equations with constant coefficients. Method of undetermined coefficients. Homogeneous linear system of equations with constant coefficients. Method of elimination.	2
Lec5	Final test.	2
		Total hours: 10
Form of classes – Classes		Number of hours
Cl1	Solving first-order differential equations with separated variables and homogeneous equations.	2
Cl2	Solving first-order linear homogeneous and heterogeneous differential equations.	2
Cl3	Solving reducible second-order differential equation. Solving second-order linear homogeneous differential equations with constant coefficients.	2
Cl4	Solving second-order linear heterogeneous differential equations with constant coefficients with method of undetermined coefficients. Solving systems of equations by elimination.	2

Cl5	Final test (in case of evaluation on base of short tests, 2 hours are necessary to perform them during semester).	2
		Total hours: 10

TEACHING TOOLS USED
N1. traditional lecture N2. calculation exercises N3. tutorials N4. work on preparing for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W05	final test
P = 2/3*F1(wykład/lecture) + 1/3*F1(ćwiczenia/classes), gdzie obie oceny F1>2,0 (both marks F1 > 2.0)		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K03	short tests or final test
P = (brak)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M. D. Greenberg, Ordinary differential equations, John Wiley & Sons, 2012.
2. R. Carlson, Linear ordinary differential equations, Society for Industrial and Applied Mathematics, Philadelphia 1997.
3. R. E. O'Malley, Thinking about ordinary differential equations, Cambridge University Press, 1997.
4. A. Jeffrey, Linear algebra and ordinary differential equations, CRC Press, 1993.
5. G. Birkhoff, G. C. Rota, Ordinary differential equations, John Wiley & Sons, 1989.
6. R. M. M. Mattheij, J. Molenaar, Ordinary differential equations in theory and practice, John Wiley and Sons, 1996.
7. R. K. Miller, A. N. Michel, Ordinary differential equations, Academic Press, 1982.

SECONDARY LITERATURE

1. J. H. Hubbard, B. H. West, Differential equations: a dynamical systems approach, Cambridge University Press, Cambridge 2003.
2. N. Finizio, G. Ladas, Ordinary differential equations with modern applications, Wadsworth Publ. Co., 1989.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ordinary differential equations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_W01	C1	Lec1 - Lec4	N1
PEK_U02-PEK_U03	K1MBM_U08	C2, C3	Cl1 - Cl4	N2, N4
PEK_K01, PEK_K03	K1MBM_K03, K1MBM_K04	C1, C3	Cl1 - Cl4	N2, N3

SUBJECT SUPERVISOR

dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia w produkcji przemysłowej**
Name in English: **Ecology in industrial manufacturing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032012**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)					
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points					
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has systematized secondary school knowledge of biology, chemistry and physics; knows the principles of engineering drawing; can interpret the basic relationship between human activity and the behaviour of living organisms and the whole environment; understands the necessity of developing industry and implementing novel solution in the construction, operation and modernization of machines in accordance with the principles of sustainable development and the protection of natural resources and the environment.

SUBJECT OBJECTIVES

C1. The student is to learn about the structure and functioning of living nature, the effect of ecotoxins, and the greenhouse effect; to acquaint herself/himself with the hazards arising from the escalation of human industrial activity and with the legal regulations concerning environmental protection; to understand the environmental management systems, the ISO 14000 standard.
C2. The student is to acquaint herself/himself with the hazards involved in and the ways of acquiring energy from conventional and renewable sources and the principles of waste management – waste minimization and recycling, the LCA method.
C3. The student is to acquaint herself/himself with the principles of constructing, operating and modernizing machines, conducive to the protection of natural resources and the environment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows and understands the hazards arising from the greenhouse effect, the development of technology, energy acquisition and waste production and recycling.
PEK_W02 - The student understands the necessity of introducing environmental regulations; knows the environmental management systems; has knowledge relating to the implementation of ISO 14000.
PEK_W03 - The student knows and understands the hazards arising from the escalation of human activity; knows the principles and advantages of implementing the environment-friendly rules of constructing and operating machines.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, definitions, the importance of the problem, the requirements, literature, what everyone can do to protect the environment.	2
Lec2	The international conventions and the Polish laws relating to environmental protection; environmental management; environmental management systems, the current standards: BS, EMAS, ISO 14000	2
Lec3	The international conventions and the Polish laws relating to environmental protection; environmental management, environmental management systems.	2
Lec4	Environment-friendly methods and consequences of acquiring energy from conventional sources, and the current standard: BS, EMAS, ISO 14000 and other.	2
Lec5	Environment-friendly methods and consequences of acquiring energy from conventional sources, hazards, trends.	2
Lec6	Waste minimization, recycling, rational and eco-friendly methods of managing wastes; examples of recycling in selected branches of industry.	2
Lec7	Waste management, waste sources, waste processing, energy recovery, safe storage, waste management monitoring.	2
Lec8	Environment-friendly materials in machine operation – oils, lubricants, greases; biodegradability, toxicity, carcinogenicity and mutagenicity of lubricating media and consumable materials; polychlorinated biphenyls.	2
Lec9	New environment-friendly techniques in machine operation; sparing lubrication techniques, lubrication management in industry; seals and their effectiveness; the environmental aspects of the construction, use and modernization of machines; recyclability.	2
Lec10	Final test.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Written final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology in industrial manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W32	C1 - C3	Wy1 - Wy9	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Zbigniew Wasiak tel.: 27-81 email: zbigniew.wasiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka podstawy programowania (Matlab)**
Name in English: **Computer science – basics of programming (Matlab)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure of a computer and its components, as well as on operating systems and principles of algorithm structure.
2. Knowledge of mathematics, covering basic problems of algebra and analysis.
3. Ability to use basic IT tools of CAE class.

SUBJECT OBJECTIVES

C1. Getting acquainted with high-level programming in Matlab, intended for engineering and scientific calculations.
C2. Getting acquainted with integration of calculations, visualisation (2D and 3D graphics) and programming in Matlab environment.
C3. Getting acquainted with principles of modelling technical systems using the Simulink module.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Ability to formulate a proceeding algorithm for mathematic calculations in the fields of algebra and analysis, covering, among others, matrix, differential and integral calculi, as well as problems related to solving systems of algebraic equations.
PEK_U02 - Ability to utilize possibilities of 2D and 3D graphics to visualize data and calculation results.
PEK_U03 - Ability to build a simple model of an object and to start simulation in the Matlab/Simulink system.

III. Relating to social competences:

PEK_K01 - Ability to search-out and use professional literature recommended for the course and to acquire knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	General characteristics of Matlab system (graphic interface, environment maintaining, organization of work, system syntax) – exemplary applications. Operations on files and folders, saving and executing basic mathematical operations (evaluating function values).	2
Proj2	Vector and matrix calculi (basic matrix and table operations, identifying elements, generating vectors and matrices)	2
Proj3	Two-dimensional and three-dimensional graphics in Matlab system – graphics generating functions, description of charts, window management.	2
Proj4	Basics of programming in Matlab system (operators; conditional, iteration and switch statements, compound statements; scripts and functions, creating M-files).	2
Proj5	Numerical methods: interpolation and approximation of functions.	2
Proj6	Function analysis (limits, derivatives, extrema).	2
Proj7	Solving equations and systems of equations – methods of solving.	2
Proj8	Simulink – introduction to modelling technical objects (terminology, principles of building models and starting-up simulations).	2
Proj9	Building a simulation model based on the Simulink module library – analysis of influence of initial conditions and simulation parameters on calculation results.	2
Proj10	Crediting the project.	2
		Total hours: 20

TEACHING TOOLS USED

N1. Auxiliary materials in form of instructions and multimedia presentations helpful at executing individual subjects. N2. Tasks for checking knowledge within individual subjects. N3. Self study - preparation for project class. N4. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Assessment of preparation for executing subsequent project subjects, checking gained knowledge on the ground of test tasks.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Prepared instructions and aids to individual subjects (unpublished).
Mrozek B., Mrozek Z.: Matlab and Simulink. Editorial Office Helion Warsaw, 2004 (in Polish).
Brzózka J., Dorobczyński L.: Matlab. Environment of scientific-technical calculations. Editorial Office Helion PWN, 2005 (in Polish).
Zalewski A., Cegieła R.: Matlab – Numerical calculations and their application. Editorial Office Nakom. Poznan, 1998 (in Polish).
Reichel W., Stachurski M.: Matlab for students – exercises, problems, solutions. Editorial Office WITKOM. Warsaw, 2009 (in Polish).

SECONDARY LITERATURE
Pratap R.: Matlab 7 for scientists and engineers. Editorial Office MIKOM, 2007 (in Polish).
Regel W.: Symbolic and numerical calculations in Matlab program. Editorial Office MIKOM, 2004 (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer science – basics of programming (Matlab)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_U01 - PEK_U03	K1MBM_U05, K1MBM_U18	C1 - C3	Pr1 - Pr9	N1 - N4
PEK_K01 - PEK_K03	K1MBM_K04	C1 - C3	Pr1 - Pr9	N1 - N4

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska 3D**
Name in English: **3D Engineering Graphics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032014**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in range of technical drawing based on 3D models

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Students should be able to build 3D models of machine parts
PEK_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEK_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:
PEK_K01 - Student gains the skills to take responsibility for their work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - Advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	The project of assembly: the concept,solid modeling with rotation, one and multibody modeling	2
Proj5	The project of assembly: solid operations - sweep, loft, split, scroll	2
Proj6	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj7	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj8	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults.	2
Proj9	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings, assembly drawings	2
Proj10	Completion of the course: work during classes	2
		Total hours: 20

TEACHING TOOLS USED

N1. project presentation
N2. problem discussion
N3. self study - preparation for project class
N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	test, participate in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
[2]Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE
[1]http://autodesk-inventor-pl.typepad.com/
[2]http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
3D Engineering Graphics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K1MBM_U21	C1, C2	Pr1 - Pr8	N1, N2, N3, N4
PEK_U03	K1MBM_U21	C3	Pr9	N3, N4
PEK_K01	K1MBM_K04	C2	Pr6, Pr8	N2

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika płynów**
Name in English: **Fluid Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032015**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	10			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses	X				
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a structured knowledge of mathematics, including algebra and analysis.
2. Student has a structured knowledge of physics, mechanics.
3. Student has a structured knowledge of basis of machine design.

SUBJECT OBJECTIVES

C1. Understanding the basic laws of mechanics in relation to flows of liquids and gases.
C2. Gaining ability to use basic laws of fluid mechanics in the construction and design of the machines.
C3. Gaining ability to use basic laws of fluid mechanics in the machinery operation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define basic laws of fluid mechanics.
PEK_W02 - Student is able to explain the principles of machines operation and the phenomena utilized in their construction.
PEK_W03 - Student is able to Indicate the relationship between the fundamental laws of fluid mechanics and principles of operation of machines equipment.

II. Relating to skills:
PEK_U01 - Student is able to analyse the process of the phenomena associated with the flows in the machines operation.
PEK_U02 - Structured knowledge of machine design theory.
PEK_U03 - Student is able to combine law of fluid mechanics with the problems of machine design and operation.

III. Relating to social competences:
PEK_K01 - Student understands the legal aspects and effects of engineering activities.
PEK_K02 - Student understands and is aware of the non-technical aspects and impacts of engineering activities in machine design.
PEK_K03 - Student is aware of the necessity of individual and group activities that go beyond the engineering operation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of liquids and gases, forces and stresses in fluids. Newtonian and non-Newtonian fluids.	2
Lec2	Methods for fluid motion analysis, potential and rotational flow.	1
Lec3	The basic equations of fluid mechanics, the continuity equation, the conservation of momentum equation for the ideal and real fluids (Euler equation and Navier-Stokes equations).	2
Lec4	Hydrostatic equations, communicating vessels, the pressure forces of the liquid on the walls, buoyancy.	2
Lec5	Euler equation integrals - Bernoulli's equation, examples of applications: measurements of velocity, the flow of liquid through the holes, Venturi effect.	2
Lec6	The equations of momentum and moment of momentum equation, hydrodynamic reaction, principles of turbo-machinery.	2
Lec7	Classification of flows, laminar and turbulent flow, Bernoulli's equation for real fluids.	1
Lec8	The flow similitude , the dimensionless numbers in fluid Dynamics, examples of applications.	1
Lec9	Flow in axial-symmetric pipes - N-S equations, major losses, the principles of calculation of major looses, the effect of roughness, flows through the narrow gaps.	2
Lec10	Hydrodynamic theory of lubrication in bearings, flows through the narrow gaps.	1
Lec11	The theory of the boundary layer, laminar and turbulent layer, the phenomenon of flow separation.	1

Lec12	Flow around bodies, drag forces, hydrodynamic buoyancy, aerofoil theory, the hydrodynamic characteristics of profiles.	2
Lec13	Numerical methods in fluid mechanics.	1
		Total hours: 20
Form of classes – Classes		Number of hours
Cl1	The solution of the basic fluid properties problems.	1
Cl2	Exercises illustrating the application of the Euler equation and Pascal's law. Calculation of pressure forces on the walls.	2
Cl3	Application of the Bernoulli's equation and the continuity equation for calculating fluid flows and to measure flow velocity	2
Cl4	Calculation of the pressure loss in closed pipelines. Determination of pipeline characteristics	2
Cl5	Calculation of the flow through the narrow gaps	2
Cl6	Final Test	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Final Test
P = 0.5*F1+0.5*FC		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01,PEK_K02,PEK_K03	Final Test
P = F1=FC		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Bukowski J., Kijkowski P.: Kurs mechaniki płynów. PWN Warszawa 1980.
Jeżowiecka-Kabsch K., Szewczyk H.: Mechanika płynów. Oficyna Wydawnicza PWr, Wrocław 2001.
Troskolański A.T.: Hydromechanika, WNT, Warszawa 1967.

SECONDARY LITERATURE
Prosnak W.J.: Mechanika płynów. Tom I. PWN, Warszawa 1970.
Burka S.E., Nałęcz T.J.: Mechanika płynów w przykładach. PWN, Warszawa 1994.
Zieliński A.: Wybrane zagadnienia z mechaniki płynów. Oficyna Wydawnicza PWr, Wrocław 2011.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fluid Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_W02, K1MBM_W06, K1MBM_W08	C1	Lec1-Lec13	N1
PEK_U01 - PEK_U03	K1MBM_U05, K1MBM_U06, K1MBM_U09	C1	Cl1-Cl6	N2
PEK_K01 - PEK_K03	K1MBM_K08	C1	Cl1-Cl6	N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jan Kulczyk tel.: 71 320-25-70 email: Jan.Kulczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ochrona własności intelektualnej**
Name in English: **Protecting intellectual property**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032016**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge in the field of innovation.
2. Basic knowledge in the area of accounting and finance
3. General knowledge of business law and marketing.

SUBJECT OBJECTIVES

C1. The aim of the course is to learn the basic message of a functioning legal system, intellectual property protection, and various forms of property: copyright, patents, utility models, and industrial, etc.
C2. The acquisition of basic skills notification of descriptions of inventions and utility models, and industrial, etc.
C3. Ability to use patent information.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of patent information
PEK_W02 - Is able to assess the patentability
PEK_W03 - Has knowledge of plagiarism

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basic idea of intellectual property protection. Research, science, knowledge, discovery, invention, innovation, and innovation, a patent, utility models, industrial designs.	2
Lec2	The test procedure of patent and utility model.	2
Lec3	Patent information: sources and collections of patent documentation and literature, access to information and databases of Patent Office.	2
Lec4	Trademarks and their legal protection. The copyright of literary and artistic works.	2
Lec5	Intellectual property protection software. intellectual property databases and domains. Plagiarism and engineering thesis- comparison.	2
		Total hours: 10

TEACHING TOOLS USED

N1. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Autor: Pyr¿a R., tytuł: Poradnik wynalazcy , wydawnictwo: Urząd Patentowy RP, rok:2008Autor: Golat A.M., tytuł: Własność intelektualna i przemysłowa, wydawnictwo: C.H. Becke , rok: 2005Autor: Dereń A.M., tytuł: Własność intelektualna i przemysłowa, wydawnictwo: Kompendium wiedzy. Ofic. Wyd. PWSzZ Nysa, rok:2007Autor: Staszko W. (red.), tytuł: Ochrona patentowa, wydawnictwo: Wyd. Uniwersytetu Saskiego, rok:1983Autor: Sieniów T., Włodarczyk W., tytuł: Własności intelektualne w społeczeństwie informacyjnym, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2001Autor: Adamczak A., Gedłek M., tytuł: Znaki towarowe w działalności małych i średnich przedsiębiorstw, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2009Autor:Adamczak A., Dobosz E., Gedłek M., tytuł: Wzory przemysłowe w działalności małych i średnich przedsiębiorstw, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2009

SECONDARY LITERATURE
Autor: Gajos M., tytuł: Opis patentowy jako źródło informacji, wydawnictwo: Wyd. Uniwersytetu Śląskiego, rok: 2000Autor: Lowe P., tytuł: Zarzadzanie technologia. Możliwości poznawcze i szanse, wydawnictwo: Wyd. Śląskie, rok: 1999Autor: Jeziorow J., tytuł: Wrocławski "Kodeks dobrych praktyk w zakresie korzystania z wyników pracy intelektualnej., wydawnictwo: Urząd Marszałkowski Województwa Dolnośląskiego, rok: 2010Autor: Golat R., tytuł: Prawo autorskie. Poradnik dla twórców.,wydawnictwo: Dom Wydawniczy ABC., rok: 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Protecting intellectual property
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W28	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec1	N1

SUBJECT SUPERVISOR

dr inż. Zygmunt Domagała tel.: 71 320-27-85 email: Zygmunt.Domagala@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo II**
Name in English: **Materials Science II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032017**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Positive credit of Materials Science I lecture course
2. Positive credit of Materials Science I laboratory practice

SUBJECT OBJECTIVES

C1. Knowledge of division rules, classification and notatation for non-alloyed steels, alloyed steels , casts and their application
C2. Knowledge of heat treatment and termo-chemical teratment basement and their influence on steel properties
C3. Knowledge of types and non-iron metals properties

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know the rules of division, classification and notatation for non-alloyed steels, alloyed steels, casts and their application
PEK_W02 - Know the basement of termo and termo-chemical treatments and their influence on steel properties
PEK_W03 - Know the types and properties of non-iron metal alloys

II. Relating to skills:
PEK_U01 - Be able to divide, classification and notation of non-alloyed steels, alloyed steels, casts and their application
PEK_U02 - Be able to determine the types of heat and termo-chemical treatment application and theit influence on steel properties
PEK_U03 - Be able to determine the types and properties of non-iron metal alloys

III. Relating to social competences:
PEK_K01 - Information retrieval and their critical analyse
PEK_K02 - Observance of custom and rules binding at academic environment

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Grey cast irons. Graphitisation. Modification of cast irons.	2
Lec2	Types of graphite and cast irons metall matrix.Classification and rules of cast irons notation.	2
Lec3	Phase transformation in steels during heating and cooling processes	2
Lec4	TTT diagrams. Hardenability. Supersaturation and ageing processes.	2
Lec5	Surface heat treatment of steel: surface hardening, carburization, nitruration.	2
Lec6	Influence of alloyed elements on phase transformations in steels.	2
Lec7	General classification and rules of non-alloyed and alloyed steels notation	2
Lec8	Alloed structural steels. Weldability	2
Lec9	Alloyed tool stels and steels with special properties: corrosion, creep and heat resistant steels.	2
Lec10	Copper, aluminium and light elements alloys	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Microstructures of steels, cast steels and cast irons based on Fe-Fe3C binary diagram	2
Lab2	Influence of heat treatment on microstructure and properties of steels	2
Lab3	Microstructures and properties of tool steels and steels with special properties.	2
Lab4	Microstructures and properties of aluminium and copper alloys.	2
Lab5	Summation, supplement and credit of laboratory practice.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. laboratory experiment
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03,	Oral-written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01-PEK_K02	Introduction test, oral answers, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M.F.Ashby, D.R. Jones - Engineerig Materials

SECONDARY LITERATURE

M. F. Ashby- Materials Selection in Mechanical Design, vol 1 and 2

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K1MBM_W12	C1, C2	Lec 1 - Lec 7	N1 - N3
PEK_W03	K1MBM_W12	C3	Lec 8 - Lec 10	N1 - N3
PEK_U01-PEK_U03	K1MBM_U16	C1 -C3	Lab 1 - Lab 3	N3 - N5
PEK_K01-PEK_K02	K1MBM_K09	C1 - C3	Lab 1 - Lab 5	N2, N3, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Włodzimierz Dudziński tel.: 320-37-80 email: wlodzimierz.dudzinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika II**
Name in English: **Mechanics II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032018**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	20			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. mathematical analysis (differentiation, integration), linear algebra, trigonometry
2. differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of the principles of classical dynamics for typical mechanical systems (discrete systems: .massl particle, system of masses particles with holonomic constrains, rigid body).
C2. Resolving some technical problems of structure and mechanical systems under dynamic loads.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with
a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define key concepts in the dynamics of mechanical systems (momentum, angular momentum, force of inertia, work, kinetic and potential energy)
PEK_W02 - He knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance)
PEK_W03 - He knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert's principle). He is familiar with the term of conservative system and with energy conservation law. He knows the dynamics equations of rotational motion and plane motion of a rigid body. Dynamics of the rigid body rotation about a fixed point

II. Relating to skills:
PEK_U01 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion and in the rotation about a fixed point. He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using the Newton's second principle.
PEK_U02 - It can calculate the frequency of free vibration for systems with one degree of freedom of the linear viscous damping and without damping. He can derive the equations of motion and calculate its parameters (angular velocity and acceleration) for rigid body loaded by torque and moves rotation.
PEK_U03 - He can determine the reaction force constraints under dynamic loads. It can calculate the kinetic and potential energy for complex mechanical systems. He is able to apply the energy conservation law to determine the differential equations of conservative system.

III. Relating to social competences:
PEK_K01 - He can search information and is able to review it critically.
PEK_K02 - He can objectively evaluate the arguments as well as rationally explain and justify the own point of view.
PEK_K03 - He can observe customs and rules of academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. The basic principles of classical mechanics. Kinematics and dynamics. Models of discrete and continuous dynamical systems in mechanics.	2
Lec2	A brief reminder of the kinematics of the material from the previous semester. Addendum: Kinematics of the rigid body rotation about a fixed point.	2
Lec3	The Newton's second law (applicable in the dynamics of the free and constrained point).	2
Lec4	The vibrations of the one-mass single degree of freedom system with the linear viscous damping and without damping. Complex notation. Free vibrations. Harmonically forced vibration, frequency characteristics, resonance. Dynamic and kinematic excitations.	2
Lec5	The forces of inertia and d'Alembert's principle. Momentum, and momentum principle. Angular momentum and angular momentum principle. The definition of work. Elementary work.	2

Lec6	The kinetic and potential energy. The principle of work and kinetic energy equivalence.The principle of conservation of energy. Conservative systems. Examples of applications.	2
Lec7	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems. The principle of the center of mass motion and the principle of momentum in multi-mass systems.	2
Lec8	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation. Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness.	2
Lec9	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces. Angular momentum in the plane motion of a rigid body and dynamics of plane motion. The kinetic energy of rigid body in a general motion. The König's theorem.	2
Lec10	Forces in plane motion of a rigid body and in the relative motion and in the rotation about a fixed point.	2
		Total hours: 20
Form of classes – Classes		Number of hours
Cl1	Practical problems of kinematics of particle, rotational motion and plane motion of rigid body.	2
Cl2	Practical problems of kinematics of relative motion of particle. Solving examples of tasks of Kinematics of rigid body rotation about a fixed point.	2
Cl3	Solving examples of tasks with dynamic free mass particle using The Newton's second law (rectilinear and curvilinear motion)	2
Cl4	The Newton's second law (applicable in the dynamics of the constrained massl particle).	2
Cl5	Examples of tasks from free vibrations of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations) Examples of tasks from forced vibration of simple mechanical systems with one degree of freedom.	2
Cl6	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy)	2
Cl7	Examples of the tasks of the dynamics and rotational motion of the rigid body using momentum principle, angular momentum principle and mass center movement rule.	2
Cl8	Dynamic force responses in the supports of rotated body.	2
Cl9	Equations of motion for rigid body in plane movement. The kinetic energy of a rigid body in a general motion. The König's theorem. Determination of the differential equations of motion of the dynamical conservative systems based on the energy conservation law.	2
Cl10	Test	2
		Total hours: 20

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02,PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01 -PEK_K03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. B. Gabryszewska, A. Pszonka: „Mechanika”, cz. II „Kinematyka i dynamika”, PWr, 1998 2. J. Zawadzki, W. Siuta: „Mechanika ogólna”, PWN, Warszawa 1971 3. J. Misiak : „Mechanika ogólna. Dynamika”. Tom II,WNT, Warszawa 1993

SECONDARY LITERATURE
1. J. Giergiel : „Mechanika ogólna”, WNT, Warszawa 1980 2. B. Skalmierski: „Mechanika” PWN, Warszawa19773. J. Leyko : „Mechanika ogólna”, WNT, Warszawa 19804. M. Klasztorny: „Mechanika” DolnośląskieWyd. Edukacyjne, Wrocław 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W07	C1	Lec1-Lec10	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_U05, K1MBM_U08	C2	Cl1-Cl9	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K1MBM_K01, K1MBM_K03, K1MBM_K04	C3	Cl1-Cl9	N2,N3,N4

SUBJECT SUPERVISOR

dr inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ergonomia i BHP**
Name in English: **Ergonomics and safety**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032019**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases, estimate of professional risk on work positions	2
Lec3	Ergonomics as interdisciplinary science	2
Lec4	Labor biomechanics - science about threats for employee health discovering, being result of executable work	2
Lec5	Dangerous and harmful agents in work environment	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE
D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ergonomics and safety
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W27	C1	Lec1, Lec2	1,2,3,4
PEK_W02	K1MBM_W30	C2	Lec3	1,2,3,4
PEK_W03	K1MBM_W26	C3	Lec4, Lec5	1,2,3,4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-odlewnictwo**
Name in English: **Manufactures techniques - casting**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032020**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge about the metallurgical process of metal ores and receiving ferrous alloys and non-ferrous metals; Has a basic knowledge about the types of engineering materials - their properties, applications and principles of their selection; Has a basic knowledge about the structure of metals and alloys as well as the principles of their classification and labeling;
2. Can determine the characteristics of the materials microstructure, identify occurring in material phases; Also is able to differentiate: the microstructure of ferrous alloys (in terms of carbon content), non-ferrous alloys and the effect of the heat treatment;
3. Can read and interpret the figures and diagrams used in the technical documentation;

SUBJECT OBJECTIVES

C1. The acquisition of general knowledge about the basic techniques of foundry manufacturing methods;
C2. Acquiring the selection skills and a critical analysis of chosen casting technology and basic parameters of that process;
C3. Acquisition and consolidation of social skills like the ability of working in a group to solve the problems effectively; The acquisition of sense of responsibility and respect for traditions existing in academia and society;

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a basic knowledge of the manual and machine manufacturing technologies of foundry molds and cores
PEK_W02 - Has a knowledge of the basic methods of melting and treatment of metallurgical alloys.
PEK_W03 - Has a basic knowledge about designing the casting products and the processes for their production with principles of technology of their selection dependent on the type of casting and the type of alloy.

II. Relating to skills:
PEK_U01 - Can analyze and design the process of production casting equipment to a simple product.
PEK_U02 - Can choose the right technology for casting and define the basic parameters of that process.
PEK_U03 - Can choose the right method of treatment of the casting alloy and define its basic parameters.

III. Relating to social competences:
PEK_K01 - Can search for information and critically analyze them, rationally explain them and justify the own point of view using the knowledge of foundry branch.
PEK_K02 - Recognizes the importance of team cooperation on ways to choose a strategy to optimally solve assigned to a group problems.
PEK_K03 - Understands the need to respect the traditions and rules in academia and society.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Discussion about the specific shape of the statethe from liquid metal, fundamental concepts and algorithms for casting production.	1
Lec2	Principles for design and construction of casting equipment.	2
Lec3	Materials and equipment used for the preparation of the molding and core sands and the methods of their manufacturing and testing their properties.	3
Lec4	Methods for manual and automatic manufacturing of foundry molds and cores.	3
Lec5	Production of molds and cores from self-and thermosetting molding sands.	2
Lec6	Manufacturing the castings using a precise technique of lost models.	1
Lec7	Knocking out and the cleaning of castings.	2
Lec8	Manufacturing the castings in metal molds.	3
Lec9	Melting casting alloys. Metallurgical and thermal treatment of cast alloys and castings. Test of the knowledge.	3
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Research the materials and molding sands. Construction of casting models and core boxes.	2
Lab2	Manual production of foundry molds and cores.	2
Lab3	Automatic production of foundry molds and cores.	2
Lab4	Production of molds and cores from self-and thermosetting molding sands.	2

Lab5	Manufacturing the castings in metal molds.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	short exam
F2	PEK_K01 - PEK_K03	report
P = średnia z wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000;
2. Tabor A. Odlewnictwo wyd. „Akapit" Kraków 1996;
3. Murza-Mucha P., Techniki wytwarzania – Odlewnictwo. PWN, Warszawa 1978;
4. Granat K. Laboratorium z odlewnictwa, skrypt PWr, Wrocław 2007;
5. Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skr. P.Warsz. Warszawa 1981;

SECONDARY LITERATURE
1. Lewandowski J. L.; Tworzywa na formy odlewnicze, wyd.: „Akapit" Kraków 1997;
2. Błaszkowski K. Technologia formy i rdzenia, Warszawa 1990;
3. Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufactures techniques - casting
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1MBM_W21	C1, C2	lec1, lec3-9	N1-N5
PEK_W03	K1MBM_W21	C2	lec2	N1- N3, N5
PEK_U01	K1MBM_U27	C2	la1	N2-N3, N5
PEK_U02, U03	K1MBM_U27	C1, C2	La1-La5	N2-N5
PEK_K01	K1MBM_K01	C3	La1-La5	N2-N5
PEK_K02, PEK_K03	K1MBM_K04, K1MBM_K06	C3	La1-La5	N2-N5

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji maszyn I**
Name in English: **Fundamentals of Machine Design I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032022**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10	20	
Number of hours of total student workload (CNPS)	90		60	60	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	3		2	2	
including number of ECTS points for practical (P) classes			2	2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4	1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic understanding of the types of engineering materials, their structure, properties and properties, processing, applications and selection rules. 2 It has a basic knowledge of mechanics, strength of materials and manufacturing techniques. 3 He has knowledge of the methods of mapping geometric formations on the plane and the principles of saving design of machine elements and the performance of their schemes.
2. Skills: 1 Able to read and interpret drawings and diagrams used in the technical ability to perform the technical documentation. 2 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 3 It can be used in the process of constructing knowledge gained on subjects: Metallurgy, Mechanics, Strength of materials, Engineering Graphics.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2. Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the process of design and engineering.
C2. Gaining knowledge of the construction, operation and use of the major machine components (connections) and the rules for their selection and construction.
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is to construct a simple device with screw drive (for example, a screw press, bearing puller, scissor lift, car jack, etc.) while using the knowledge of the connections, used in mechanical engineering (screw, bolt, dowel, keyways, spline, serrated, snap-fitting, welded and spring).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge in the design, principles of design, design features, and knows the algorithm design and construction.
PEK_W02 - It has a basic knowledge of connections in the construction of machines, their use and design calculations.
PEK_W03 - He has knowledge of the factors affecting the fatigue strength of machine elements and how they are taken into account in the design calculations.
II. Relating to skills:
PEK_U01 - Able to independently formulate and solve simple technical tasks.
PEK_U02 - He can choose and calculate the basic connection used in mechanical engineering.
PEK_U03 - He can choose the optimal (in light of the criteria used) machine parts and know their limitations.
III. Relating to social competences:
PEK_K01 - Can search information and carry out their critical analysis.
PEK_K02 - Able to work independently and in a team.
PEK_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Defined notions of technical product and design. Design features, principles of design. Rationale for the existence of a product. Design and construction - differences. Description of the process of design.	2
Lec2	Stress, fatigue, fatigue strength and method of its determination. Smith's and Haighe's graphes.	2
Lec3	Factors affecting the reduction of fatigue. Method of accounting them in the calculation. β - fatigue stress concentration factor.	2
Lec4	Allowable stress k - means for their appointment. Factor of safety and actual safety factor.Joints in mechanical engineering, classification and characteristics	2
Lec5	Bolted connections, thread specifications. Determination of the forces and moments on the thread. The minimum height of the nut in the screw.	2

Lec6	Efficiency and self-locking of a power screw. The notion of preload. Method for the calculation of bolted connections with preload. Calculations of thread forms.	2
Lec7	Shaft-hub connections: keys, splines, serrated joints. Dowel connections. Main features and calculation rules.	2
Lec8	Welded and pin connections. Specifications, principles of design and calculations.	2
Lec9	Pressed connections. Analytical bases of geometry selection, elements fit.	2
Lec10	Steel elastic connectors. Fundamentals of strength calculations of selected types of springs. Forming of cylindrical coil springs.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Health and Safety Training. Determination of static stiffness, energy dissipated and acquired in elastic-damping elements.	2
Lab2	Determination of the frictional characteristics of the cross slide bearing.	2
Lab3	Determination of the resistance to motion of tapered roller bearings.	2
Lab4	Theoretical and practical identification of resonance in the shaft of a machine with not balanced mass.	2
Lab5	Research of the pressed connections.	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed device.	2
Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	4
Proj3	Calculations and analysis of designed elements (power screw, bearings, bolts, etc..).	7
Proj4	Performance of assembly drawing designed device and working drawings of elements selected by lecturer.	7
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. laboratory experiment
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	exam, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Quizzes, oral response, the report of the laboratory
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	defense of project, quizzes, evaluation of computational design review, review of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Podstawy konstrukcji maszyn; Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999. 2. Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT. 3. Beitz G.; Nauka konstruowania . Warszawa, WNT 1984. 4. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982. 5. Roloff / Matek, Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

SECONDARY LITERATURE

1. A. Dziama; Metodyka konstruowania maszyn, PWN, Warszawa, 1985. 2. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT.1966. 3 .Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982. 4. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer-Verlag 1985. 5. Niezgodzinski M., Niezgodziński T.; Wzory, wykresy i tablice wytrzymałościowe Warszawa, PWN 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machine Design I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1MBM_W18	C2	Lec1 - Lec10	N1-N5
PEK_W03	K1MBM_W18	C2, C3	Lec3	N1, N2, N3, N5
PEK_U01 - PEK_U03	K1MBM_U14, K1MBM_U18, K1MBM_U21	C1-C3	Proj1-Proj4, Lab1 - Lab5	N2-N5
PEK_K01 - PEK_K03	K1MBM_K10	C3	Lab1 - Lab5	N2-N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Stanisław Krawiec tel.: 71 320-40-56 email: Stanislaw.Krawiec@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria mechanizmów i manipulatorów**
Name in English: **Theory of Mechanisms and Manipulators**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032023**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			20	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of fundamental laws in statics, kinematics and dynamics
3. Skill in fuction analysis, derivatives, basic matrix and vector operations

SUBJECT OBJECTIVES

C1. Acquire knowledge in topology, kinematics and dynamics of mechanisms and manipulators
C2. Acquire and understanding of basic mechanisms and manipulators
C3. Getting skills in determining kinematic and dynamic parameters

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Understands theoretical fundamentals of mechanism and robot topology
PEK_W02 - Has the knowledge of kinematic and dynamic analysis methods
PEK_W03 - Is able to commentate results of analysis, evaluate their correctness

II. Relating to skills:
PEK_U01 - Is able to evaluate topological carrectness of kinematic systems (redundant costraints)
PEK_U02 - Is able to determine kinematic and dynamic properties
PEK_U03 - Is able to create models of simple planar mechanisms and manipulators

III. Relating to social competences:
PEK_K01 - Has a conviction of responsibility for the work done

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms, movable properties	2
Lec2	Kinematics of mechanisms	2
Lec3	Kinematics of mechanisms, cont.	2
Lec4	Planetary gear trains	2
Lec5	Manipulators' properties. Planar serial and parallel systems	2
Lec6	Matrix description of spatial systems	2
Lec7	Kinetostatic analysis	3
Lec8	Friction in joints, efficiency	2
Lec9	Dynamic motion analysis, motion fluctuation	3
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Introduction to modelling mechanisms in SAM (Simulation and Analysis of Mechanisms) – presentation of examples	2
Proj2	Mechanisms' topology: rules of drawing digrams, topology analysis - joint classification, mobility (test, project)	2
Proj3	Rules of creating models in SAM system, creating simple models, model motion simulation, presentation of analysis results	2
Proj4	Kinematic analysis - velocity and acceleration determination - vector methods (test, project)	2
Proj5	Kinematic analysis - velocity and acceleration determination using SAM (project)	2
Proj6	Planar manipulators - matrix notation of kinematics (project)	2
Proj7	Modelling manipulators using SAM: forward and inverse tasks (project)	2
Proj8	Anaysis of planetary transmissions, angular velocity ratio determination (test, project)	2

Proj9	Modelling of planetary transmissions and gear linkage mechanisms using SAM (project)	2
Proj10	Joint force and external equilibrium determination (test, project)	2
		Total hours: 20

TEACHING TOOLS USED

N1. problem lecture
N2. self study - preparation for project class
N3. individual project
N4. tutorials
N5. preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written examination
P = Ocena z egzaminu		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project defence
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01	test
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002; Miller S.: Theory of machines and mechanisms. Analysis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1996; Gronowicz A. i inni: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE

Olędzki A.: Fundamentals of machines and mechanisms theory (in Polish). WNT 1987; Morecki A., Oderfeld J.: Theory of machines and mechanisms (in Polish). PWN 1987; Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory of Mechanisms and Manipulators
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W17	C1, C2, C3	Lec1-Lec9	N1 - N5
PEK_U01, PEK_U02, PEK_U03	K1MBM_U11	C1, C2, C3	Proj1-Proj10	N2, N3, N4
PEK_K01	K1MBM_K04	C3	Proj1-Proj10	N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Antoni Gronowicz tel.: 71 320-27-10 email: antoni.gronowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032024**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the complex functions and differential equations.

SUBJECT OBJECTIVES

C1. Getting knowledge about the basic description methods of automatic systems.
C2. Getting knowledge about the basic analysis methods of automatic systems.
C3. Getting knowledge about the basic synthesis methods of automatic systems.
C4. Learning to design control systems.
C5. The practical skills to build and run basic automation systems.
C6. Skills to evaluate the performance of control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of basic methods for describing automation systems.
PEK_W02 - Knowledge of basic methods to analyze automation systems.
PEK_W03 - Knowledge of methods to synthesize automation systems.

II. Relating to skills:
PEK_U01 - Can define the mathematical description of the automation system.
PEK_U02 - Able to analyze the function of the automation system.
PEK_U03 - Can design automation system.

III. Relating to social competences:
PEK_K01 - Can broaden their knowledge by using additional aids.
PEK_K02 - Can think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic terms, the structure of control systems and their classification.	2
Lec2	Description of linear automation systems: differential equations, transfer function, time characteristics.	2
Lec3	Description of linear automation systems: the frequency response, the frequency characteristics.	2
Lec4	Dynamic objects: proportional, inertial, differential.	2
Lec5	Dynamic objects: Integral, oscillating, delay.	2
Lec6	Automatic control. Requirements. Static control. astatic control.	2
Lec7	Controllers: PI, PD, PID	2
Lec8	Nonlinear systems. Methods of description and analysis. Discrete automatic control.	2
Lec9	Boolean algebra, combinational systems.	2
Lec10	Logic sequential systems. Credit.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Static and dynamic characteristics of automatic objects.	2
Lab2	Frequency characteristics of automatic objects.	2
Lab3	Simulation tests of automatic objects in Matlab-Simulink system.	2
Lab4	On-off control.	2
Lab5	Programming languages of PLC controllers.	2
Lab6	Mathematical fundamentals of digital automation systems.	2
Lab7	Elements and contactor-relay systems.	2
Lab8	Logic combinational systems.	2

Lab9	Modeling and programming of sequential processes.	2
Lab10	Modeling and programming of complex processes. Credit.	2
		Total hours: 20

TEACHING TOOLS USED

N1. self study - self studies and preparation for examination
N2. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	Exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01-PEK_K02	Average grade
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Automatic Control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W01, K1MBM_W16	C1-C3	Lec1-Lec15	N1
PEK_U01 - PEK_U03 PEK_K01 - PEK_K02	K1MBM_K05, K1MBM_U05	C4-C6	Lab1-Lab15	N2

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Naplocha tel.: 27-22 email: krzysztof.naplocha@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-przeróbka plastyczna**
Name in English: **Manufacturing techniques-plastic working.**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032025**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basic mechanical properties of engineering materials.
2. Have a basic knowledge of physics and mathematics.
3. Have skills in measurement methods, techniques for measuring and evaluating the results of the measurement.

SUBJECT OBJECTIVES

C1. Understanding the different manufacturing technologies by processing plastic products. Method used to investigate the effect of shaping the properties of the manufactured products.
C2. Understanding the phenomena limiting plastic forming processes.
C3. Knowledge of modern technologies for shaping plastic.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic technologies and material plastic forming process parameters.
PEK_W02 - Able to properly define the problem in the field of plastic forming and properly be characterized.
PEK_W03 - Can choose the right technology plastic forming and defining the basic parameters of the process.

II. Relating to skills:
PEK_U01 - Can search for information on plastic forming and execute their critical analysis.
PEK_U02 - Can use the theoretical knowledge gained in forming the lecture and apply it in practice.
PEK_U03 - Able to perform selected laboratory tests and correct to assess their performance.

III. Relating to social competences:
PEK_K01 - Can think and act in a creative way.
PEK_K02 - Acquires the ability to work as a team.
PEK_K03 - Understands the impact of engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	History of plastic processing.	1
Lec2	Effect of plastic forming process on the properties of the product.	2
Lec3	Sheet metal forming processes. Analysis of cutting and bending processes.	2
Lec4	Course of process of formation of articles about non - the developable surface.	2
Lec5	Processes of forming lumps. Analysis of the process of rolling plates and profiles.	2
Lec6	The conduct and analysis of the extrusion process.	2
Lec7	The course and forging process analysis.	2
Lec8	Manufacture of metal in the drawing process.	2
Lec9	Metal Forming Tools.	2
Lec10	Overview of modern technologies for shaping plastic.	2
Lec11	Final test.	1
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Deforming on hold and annealing metals.	2
Lab2	Rolled metal sheets and profiles.	2
Lab3	Squeezing metallurgical and machine parts.	2
Lab4	Manufacture of metal in the drawing process.	2
Lab5	Expression - cut, bending and pressing.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷ PEK_W03	Colloquium.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03 PEK_K01÷PEK_K03	quizzes, laboratory report, participate in discussions problem
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

The Gronostajski J., Plastic processing of metals, Wrocław 1974Morawiecki M., Sadok L., Wosiek the E., Theoretical bases of technological processes of plastic alteration, Wyd. Silesia, Katowice 1981
http://www.metalplast.pwr.wroc.pl/instrukcje.html

SECONDARY LITERATURE

The Romanowski the P., Guide of plastic processing on hold, the Publishing house Scientifically - Technical, Warsaw 1976. the Erbel the S., Kuczyński the K., Marciniak the Z., Plastic Processing of, PWN, Warsaw 1981.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing techniques-plastic working.
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01÷ PEK_W03	K1MBM_W21	C1÷ C3	Lec1÷ Lec10	N1
PEK_U01÷PEK_U03	K1MBM_U29	C1÷ C3	Lab1÷ Lab5	N2, N3, N4
PEK_K02÷ PEK_K03	K1MBM_K04	C1÷ C3	Lab1÷ Lab5	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Andrzej Dolny tel.: 21-74 email: andrzej.dolny@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-spawalnictwo**
Name in English: **Manufacturing techniques - welding**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032026**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1.Has a basic knowledge concerning metallurgical processes of treatment of ores, production of steel and non-ferrous metals, has a basic knowledge about mechanical properties of engineer materials, organized knowledge about types of metallic engineer materials, its composition, properties, applications and rules of right choice.
2. 2.Has a detailed knowledge about structures of steel and cast iron, rules of its classification and description, has a basic knowledge about thermal and thermo-mechanical treatment, knowledge about alloyed steels and non-ferrous metals and alloys, has the theoretical knowledge about electric circuits.
3. 3.Can analyze macrostructures of materials, technological imperfections, can estimate features of microstructure of metals, can identify phases using the balance curves, can distinguish microstructures according to amount of carbon in steel, influence of thermal treatment, can analyze electric circuits, understands technical drawings, can prepare technical documentation

SUBJECT OBJECTIVES

C1. Getting of basic knowledge about joining of metals with use of welding methods.
C2. Getting of skills of the right choice of joining and basic parameters of the process.
C3. Obtaining and keeping of social competences concerning ability to cooperate in the student's group with a goal to solve problems effective way. Responsible, honest and serious approach to new duties, respecting customs of academic society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows types of joints, welding positions, description of joints, reasons of cracking of joints
PEK_W02 - Knows basic methods of welding and parameters of the process
PEK_W03 - Has the knowledge concerning metallurgy of welding processes, brazing/soldering, resistance welding and thermal cutting

II. Relating to skills:
PEK_U01 - Can define basic parameters of welding, describe basic properties of welding equipment and make a right choice of consumables
PEK_U02 - Can define basic parameters of brazing/soldering and resistance welding, describe basic properties of welding equipment and make a right choice of consumables
PEK_U03 - Can define basic parameters of thermal cutting, analyze influence of cutting on properties of the cutting surface and precision of following of the shape

III. Relating to social competences:
PEK_K01 - Shows ability necessary to cooperate in a team with a goal to improve methods of right strategy of optimal solving of problems
PEK_K02 - Is able to assess properly ratios, explain and justify his own point of view with use of a knowledge concerning basic matters of material science.
PEK_K03 - Respects customs and rules of academic society

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization of the lecture, Safety in welding, Types of welds and joints, welding positions	2
Lec2	Basics of metallurgy of welding processes. Fuel gas welding of steel, cast iron and non-ferrous metals	2
Lec3	Basic information about arc welding. Shielded manual metal arc welding	2
Lec4	Gas shielded tungsten arc welding GTAW. Gas shielded metal arc welding GMAW.	2
Lec5	Submerged arc welding and electroslag welding. Welding with use of concentrated energy sources	2
Lec6	Brazing and soldering. Braze welding	2
Lec7	Resistance pressure joining, Friction welding	2

Lec8	Thermal oxygen, plasma and laser cutting. Water cutting. Hardfacing and thermal spraying	2
Lec9	Stresses and deformations in welding. Thermal treatment of welded joints	2
Lec10	Acceptance tests of welded structure. Quality systems in welding	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Organization of the lab. Safety in welding. Fuel gas welding of steel. Stresses and deformations in welding.	2
Lab2	Brazing and soldering of steel, copper and aluminum. Thermal oxygen and plasma cutting	2
Lab3	Shielded manual metal arc welding. Submerged arc welding	2
Lab4	Gas shielded tungsten and metal arc welding. Robotic welding	2
Lab5	Resistance pressure joining. Friction welding	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	verbal answers, short tests

P = średnia z F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Ambroziak, A. (ed.). Manufacturing techniques. Welding. Laboratory. Wrocław University of Technology, 2011, http://Www.Dbc.Wroc.Pl/

SECONDARY LITERATURE

1 Pilarczyk, J. (eds.): Advisory Engineer. Welding. Vol I and II, WNT Warszawa, 2003, 2005

2 Klimpel A: Welding, Resistance Welding and Cutting Metals., WNT, Warsaw, 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Manufacturing techniques - welding

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W21	C1, C3	Le1 - Le10	N1, N5
PEK_U01 - PEK_U03	K1MBM_U28	C1, C2, C3	Lab1 - Lab5	N2, N3, N4
PEK_K01 - PEK_K03	K1MBM_K04	C3	Lab1 - Lab5	N2 - N5

SUBJECT SUPERVISOR

dr inż. Piotr Białucki tel.: 42-71 email: piotr.bialucki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Tworzywa sztuczne**
Name in English: **Polymers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032027**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge in the field of materials science and chemistry.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of construction, preparation, modification and properties of polymeric materials
C2. Acquisition of basic knowledge about the technology used for processing plastics
C3. Learning how the selection of polymeric materials in certain applications.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the basic groups of polymers, their structure, properties,
PEK_W02 - He knows the technology used for the processing of polymeric materials,
PEK_W03 - He knows the basic applications of polymeric materials.

II. Relating to skills:
PEK_U01 - Able to identify polymeric materials
PEK_U02 - Can indicate the processing technology for producing a selected product from the plastic material,
PEK_U03 - Place the selected polymeric materials for specific applications.

III. Relating to social competences:
PEK_K01 - Searches of information and its critical analysis,
PEK_K02 - Team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group,
PEK_K03 - Compliance with the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basics, nomenclature. Classification and distribution of plastics	2
Lec2	Construction and preparation of polymers and plastics. Polymerization processes and the production of plastic plastics.	2
Lec3	Construction of the polymers and the resulting properties.	2
Lec4	Models mechanical behavior of polymers. Rheology and behavior of the plastic during processing	2
Lec5	Transformation of plastics, the impact of environmental conditions on the behavior of materials polymer.	2
Lec6	Methods for modification of polymeric materials and their impact on the property. Preparation of polymer composites.	2
Lec7	Overview of polymeric construction materials - Properties and application of thermoplastic materials.	2
Lec8	Primary processing technologies plastics - injection molding	2
Lec9	Manufacturing technologies of polymeric materials - extrusion and thermoforming	2
Lec10	Joining and processing technologies niche plastics	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Polymeric materials and methods for their identification	2
Lab2	Technologies of plastics joining	2
Lab3	Primary processing technology - injection molding	2
Lab4	Secondary processing technologies - Vacuum thermoforming and blow molding	2

Lab5	Tools for processing plastics	2
		Total hours: 10

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for laboratory class N3. laboratory experiment N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	quiz
F2	PEK_U02	test, oral answer
F3	PEK_U03	quiz, oral answer
F4	PEK_K01, PEK_K02, PEK_K03	oral answer, report
P = (F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Robert Sikora, Przetwórstwo tworzyw wielkocząsteczkowych, Warszawa : "Żak", 1993;Wojciech Kucharczyk, Wojciech Żurowski, Przetwórstwo tworzyw sztucznych dla mechaników, Radom : Politechnika Radomska. Wydawnictwo, cop. 2005; Izabella Hyla, Tworzywa sztuczne : własności, przetwórstwo, zastosowanie, Gliwice : Wydawnictwo Politechniki Śląskiej, 2000.

SECONDARY LITERATURE

Piotr Jasiulek, Łączenie tworzyw sztucznych metodami spawania zgrzewania, klejenia i laminowania, Krosno, Wydaw. i Handel Książkami "KaBe", 2004;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Polymers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W03	K1MBM_W13	C1	Lec1-Lec10	N1
PEK_U01-PEK_U03, PEK_K01, PEK_K02, PEK_K03	K1MBM_K09, K1MBM_U29	C2, C3	Lab1-Lab5	N2-N4

SUBJECT SUPERVISOR

dr inż. Roman Wróblewski tel.: 320-21-70 email: r.m.wroblewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Hydrostatyczne układy napędowe**
Name in English: **Hydrostatic drive systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032029**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of fluid mechanics.
2. Student can solve diferential equations of mathematical models of hydraulis components and systems.
3. Student possess basic knowledge of classic mechanics.

SUBJECT OBJECTIVES

C1. Students acquaintance withbasic lows of hydrostatic drive systems.
C2. Students acquaintance with hydraulic components and their working principle.
C3. Students acquaintance with configuration of simple hydrostatic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student should be able to define requirements for hydraulic fluids of hydrostatic drive systems.
PEK_W02 - In the result of lesson student should be able to describe working pinciple of basic components of hydrostatic system.
PEK_W03 - In the result of lesson student should be able to characterize of working of basic hydrostatic drive systems.

II. Relating to skills:
PEK_U01 - In the result of lesson student should be able to analyse operation of hydrostatic components and systems.
PEK_U02 - In the result of lesson student should be able to calculate basics parameters of hydrostatic drive system.
PEK_U03 - In the result of lesson student should be able to interpret basic characteristic of hydrostatic components and systems.

III. Relating to social competences:
PEK_K01 - In the result of lesson student should possess ability of information analysis with diferent complex level.
PEK_K02 - In the result of lesson student should possess ability of objective argument evaluate, efficient explanation and justification own opinion with help of knowledge of hydrostatic drive systems.
PEK_K03 - In the result of lesson student should possess ability of follow the rules valid in academic environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements.	1
Lec2	Basic symbols of hydraulic and pneumatics components.	1
Lec3	Hydraulic fluids - their properties.	2
Lec4	Positive displacement pumps - systematics, characteristics, efficiencies.	2
Lec5	Valves - systematics, types, functions.	2
Lec6	Hydraulic and volumetrics losses in displacement machines and in the system.	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Experimental determination properties of working fluid - bulk modulus.	1
Lab2	Experimental determination resistance character in hydraulic pipes - linear resistance.	2
Lab3	Local resistences in hydraulic systems. Orifice as a local resistance - cavitation effect.	2
Lab4	Experimental determination pump characteristic.	2
Lab5	Static characteritics of conventional directional control valve.	2
Lab6	Check.	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. laboratory experiment
N4. report preparation
N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03PEK_K01 -PEK_K03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	test, report, oral response
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Kollek W.: Gear pumps (in polish). Zakład Narodowy im. Ossolińskich, Wrocław 1996.
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Osiecki A.: Machines hydrostatic drive (in polish). WNT, Warszawa 1996.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.

SECONDARY LITERATURE
Szydelski Z.: Hydraulic drive and control in vehicles and heavy duty machines. WNT 1980.
Kollek W.: Basics of hydraulic drive theory. NOT, Wrocław 1978.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrostatic drive systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W01	C1	Lec1,Lec2, Lec3	N1,N2
PEK_W02	K1MBM_W08	C2	Lec3, Lec4	N1,N2
PEK_W03	K1MBM_W08, K1MBM_W20	C3	Lec4,Lec5	N1,N2
PEK_U01	K1MBM_U09	C1,C2	Lab1,Lab2, Lab4	N3,N4,N5
PEK_U02	K1MBM_U09, K1MBM_U24	C3	Lab3,Lab4, Lab5	N3,N4,N5
PEK_U03	K1MBM_U24, K1MBM_U25	C1,C3	Lab2,Lab5	N3,N4,N5

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metoda elementów skończonych**
Name in English: **Finite Element Method**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			20	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength materials. Analysis of beam, plate and shell structures. Fundamentals of engineering materials.
2. Matrix algebra
3. Skills in basic CAD tolls. Skills for solving basic engineering elements with use of classical elastic theory.

SUBJECT OBJECTIVES

C1. Learn the basics of the finite element method theory
C2. Learn how to prepare proper model for FEM calculations
C3. Learn to model and perform simulations of the effort of the load carrying structures with use of numerical methods

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Have knowledge in the fundamentals of finite element method
PEK_W02 - Have the knowledge to prepare proper geometrical and discrete model to solve FEM task.
PEK_W03 - Is able to use FEM in practical application of calculation of engineering structures. Can formulate and solve problems of the

ultimate strength of load carrying structures.

II. Relating to skills:
PEK_U01 - Skills in software for the FEA
PEK_U02 - Have the knowledge to prepare proper geometrical and discrete model to solve the task in the range of elastic deformation.
PEK_U03 - Is able to perform FEA in the field of liner and nonlinear statics, dynamics, vibrations and linear buckling.

III. Relating to social competences:
PEK_K01 - Learn the responsibility for his work.
PEK_K02 - Creative thinking and acting
PEK_K03 - Learn team work due to the necessity of information flow during project realisation

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Development of the numerical methods in the theory of constitutive equations.	1
Lec2	Introduction and basic assumptions of FEM	1
Lec3	Approximation functions, classifications of finite elements, convergence conditions	2
Lec4	Construction of stiffness matrix of the fundamental finite elements (plate, shield, beam, solid)	1
Lec5	Characteristics of the fundamental finite elements 1D, 2D, 3D and presentation of the basic relations	2
Lec6	Definition of the material model used in simulations of static, dynamic problems with use of FEM.	1
Lec7	Mehtodics of discrete model creation	1
Lec8	Numerical simulations with use of FEM in statics, dynamics and thermal problems	1
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of the software	1
Proj2	Discrete model creation principles. Assumptions and simplifications of the model	2
Proj3	Solid models discretization. Analysis of the parameters (type of the element, mesh density) and its influence on the results.	2

Proj4	Designing and modeling of the thin walled beam and shell structures	3
Proj5	Boundary conditions: DOF and load applicaiton	2
Proj6	Principles of the creation of the complex models of load carrying structures.	2
Proj7	Principles of design and modeling of structural nodes and the load transfer	2
Proj8	Results analysis. Effort criterion.	2
Proj9	Modal analysis, buckling and thermal load	2
Proj10	Individual modeling of selected structural node	2
		Total hours: 20

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. problem exercises
N3. project presentation
N4. individual work and preparation to the exam

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01-PEK_K03	mark on the basis of the simulation project part
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusiński E., Metoda elementów skończonych. System COSMOS/M, WKiŁ Warszawa 1994
Rusinski E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE

Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wyd. PWr Wrocław 2002
Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005
Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Finite Element Method
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W18, K1MBM_W19	C1		N4
PEK_W02	K1MBM_W19	C2		N2, N4
PEK_W03	K1MBM_W18	C3		N4
PEK_U01, PEK_K01	K1MBM_K02, K1MBM_U22	C1		N2
PEK_U02, PEK_K02	K1MBM_K02, K1MBM_U22	C2		N1, N2
PEK_U03, PEK_K03	K1MBM_K02, K1MBM_U19, K1MBM_U22	C3		N1, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Eugeniusz Rusiński tel.: 71 320-42-85 email: Eugeniusz.Rusinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji maszyn II**
Name in English: **Fundamentals of Machine Design II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032031**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			20	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic knowledge of metallurgy, construction materials, mechanics, strength of materials and manufacturing techniques, engineering graphics. 2 It has a basic knowledge of Fundamentals od Machine Design I (process design and engineering, connections used in mechanical engineering) and perform the technical documentation using AutoCAD.
2. Skills: 1 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 2 It can be used in the process of constructing knowledge gained on subjects: metallurgy, mechanics, strength of materials, Engineering Graphics, Fundamentals of Machine Design I.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2 Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the design of machine shafts (structural calculations, the selection of geometric features, resonance, mounting elements on the shaft) and the holder shafts - bearings (bearings characteristics, selection criteria, rules for bearing and fit).
C2. Gaining knowledge of the construction, operation, selection, design calculations and operation of the couplings and conveyor units and changing the rotation (mechanical transmission belts, chains and gears).
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is the optimal design of the drive unit driven machine (eg conveyor, ball mill, crusher, rotary kiln, etc.) The process of constructing a computer-aided both in the selection of design features (using the computer programs for the calculation of constructed elements) as well as at the stage of their graphical application (AutoCAD).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the algorithm design calculations machine shafts and shafts supporting elements.
PEK_W02 - It has an extended knowledge in the construction of clutches, their applications and the selection and calculation.
PEK_W03 - It has a basic knowledge of construction, operation, principles of selection and design calculations of the conveyor units and changing the rotation (mechanical gears: belt, chain and gear).

II. Relating to skills:
PEK_U01 - Able to independently formulate and solve simple technical tasks.
PEK_U02 - He can choose and calculate the shafts, bearings, couplings, mechanical.
PEK_U03 - It can construct an optimal (in light of the criteria used) drive any machine work.

III. Relating to social competences:
PEK_K01 - Can search information and carry out their critical analysis.
PEK_K02 - Able to work independently and in a team.
PEK_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Shafts and axes – characteristics. Theoretical bases selection of constructional features of shafts. Fundamentals of shafts and axes forming. Methods for the axial location of machine elements on a shaft. Design calculations of the shafts (preliminary, checkout). The phenomenon of resonance. Calculations of shafting for resonance in bending mode.	2
Lec2	Main features of rolling and sliding friction. Classification of bearings, main features of rolling contact and sliding bearings. Procedure and criteria for the selection of roller contact bearings. Bearing arrangement. Fits, lubrication and sealing in application for roller bearings.	2

Lec3	Classification of coupling and clutches. Main features of couplings. Selection and calculation rules. Main features of clutches. Engagement process, Work and friction losses, heat balance, service life. Equivalent friction radius.	2
Lec4	Belt transmissions, classification, general characteristic and selection criteria. Friction coupling of the belt with the wheel. Elastic slip, actual transmission ratio, load transfer coefficient. Force distribution, tensioning devices in belt. Required tension force and ways of regulation.	2
Lec5	Efficiency of belt transmission and belt durability. Characteristics material for belts. The design of pulleys (material, main dimensions). Design calculations of V-belt transmissions. Przekładnie cięgnowe cd. Przekładnie łańcuchowe, ich charakterystyka i sposób obliczania.	2
Lec6	Gear transmissions. Classification and main features. Fundamental rule of engagement. Cycloid and involute profiles.	2
Lec7	Basic rack tooth profile. Standardization of involute wheels. Basic notions. Geometry of spur gears. Generation methods.	2
Lec8	Boundary tooth number, mesh correction, addendum modification.	2
Lec9	Tooth loading model for bending and contact pressure. Service factor. Distribution of forces in spur and helical gearing.	2
Lec10	ISO recommended methods for the calculation of gear transmission, a summary.	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed drive system (operation principles, location data, quantitative data, operation conditions).	2
Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	2
Proj3	Assumption of acceptance criteria for each of the sub-assemblies of the unit. Selection of the best solution using a dedicated software.	10
Proj4	Implementation stage of the design process: assembly and selected working drawings. Drafting technique - CAD.	6
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - preparation for project class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	exam, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	defense of project, quizzes, evaluation of computational design review, review of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.Podstawy konstrukcji maszyn. Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999.2.Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom II i III, Warszawa, WNT.3.Dziama A. i inni; Przekładnie zębate. Warszawa, PWN 1995.4.Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom III i IV. W-a, WNT 1996.5. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982.6.Beitz G.; Nauka konstruowania. Warszawa, WNT 1984.7.Krawiec S.; Obliczenia konstrukcyjne przekładni pasowych i zębatych wspomaga-ne mikrokoputerem, skrypt PWr.,Wrocław, 1992.8.Capanidis D, Krawiec S. Wieleba W.; Materiały pomocnicze do ćwiczeń projektowych z PKM wspomaganych komputerowo, IKEM PWr., 1993.

SECONDARY LITERATURE
1.Jaśkiewicz Z., Wąsiewski A.; Przekładnie walcowe. Warszawa, WKŁ 1992.2.Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer- Verlag 1985.3.Niemann G., Winter H.; Maschinenelemente. Band III. Berlin, Springer- Verlag 1983.4.Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machine Design II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W18	C1	Lec1, Lec2	N1, N3, N5
PEK_W02	K1MBM_W18, K1MBM_W25, K1MBM_W28	C2	Lec3	N1, N3, N5
PEK_W03	K1MBM_W18, K1MBM_W19, K1MBM_W25	C2	Lec4-Lec10	N1, N3, N5
PEK_U01 - PEK_U03	K1MBM_U02, K1MBM_U07, K1MBM_U21, K1MBM_U34	C3	Proj1-Proj4	N2-N5
PEK_K01 - PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K05, K1MBM_K11	C1-C3	Proj1-Proj4	N2-N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Stanisław Krawiec tel.: 71 320-40-56 email: Stanislaw.Krawiec@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy napędowe pojazdów**
Name in English: **Driving Systems of Vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032032**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. positive marks of mechanics, mathematical analysis and construction of foundations.
2. basic knowledge of working various systems or machines devices.
3. Basic ability to work in groups.

SUBJECT OBJECTIVES

C1. The aim of the course is to broaden the knowledge of the construction vehicle propulsion systems and their components. The student gets acquainted with the methods of developing and preparing the characteristics of individual components of propulsion systems, traction characteristics and primary energy sources.
C2. The aim of the course is to acquire practical knowledge of the methods of calculation and selection of individual drive components and determine how to prevent undesirable phenomena such as the circulating power, etc. He knows the need for further professional development.
C3. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology. Student is responsible for own work and group work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - primary energy sources can be selected and the characteristics are known; can and described the power flow through the various elements of the powertrain, hydrostatic, hydrodynamic and mechanical, powertrain components are selected on the basis of calculations and characteristics.
PEK_W02 - can point out the use of power systems and improve them to suit your needs based on the development of technology;
PEK_W03 - is able to describe and explain the principles of operation of the various components of propulsion systems, indicate the potential for adverse effects and identify methods for their elimination.

II. Relating to skills:
PEK_U01 - can also using foreign literature to interpret the results obtained in the laboratory experiments and the use of catalogs;
PEK_U02 - is able to analyze and develop the results in order to obtain the characteristics or parameters measured in the propulsion system of vehicles and machinery at different settings of the control system;
PEK_U03 - is able to offer own ideas and own propulsion control systems performing similar functions.

III. Relating to social competences:
PEK_K01 - is capable and understands the need for continuous updating of skills and acquire new kwowledge;
PEK_K02 - is responsible for the decisions both in terms of environmental and mechanical engineering activities;
PEK_K03 - is able to work in a team and solve the tasks assigned to the various positions and is responsible for the group to achieve its intended purpose.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Systematic drive systems (systems single source, multi-source, serial, parallel, hybrid) - application examples. The basic functions performed by the powertrain (transmission, transformation, distribution, accumulation and energy recuperation) - Case studies.	2
Lec2	The characteristics of conventional primary and secondary energy sources - rules of control. Strenuous-intensity characteristics of power consumers - examples of typical load in the form of linear, area, cycle, spectrum charges etc.	2
Lec3	Propulsion systems of the "rigid" and "flexible" kinematic coupling. The issue of non-compliance kinematic and power circulating in the propulsion system - basic physical, technical effects, methods of elimination-examples.	2
Lec4	Basic structure of the propulsion system selection and selection problem of primary energy sources: a) typical mechanical drive system b) typical drive system converter c) typical hydrostatic system. Drive systems with stepper motors and servo-electric principle	2
Lec5	Issues of transients in the propulsion system under the elastic ties, starting characteristics of conventional and programmable - minimizing the negative effects of dynamic.	2
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Experimental studies hydrostatic drive earth working vehicle.	2

Lab2	Experimental studies on hybrid caterpillar driving system.	2
Lab3	Experimental determination of the characteristics of the selected receiver of energy and the choice of the optimum driveline capstans.	2
Lab4	Comparison of the boot process of asynchronous motor in the driving system	2
Lab5	Study of the effect of elastic stiffness in a driving system on its dynamic toughness.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	written-oral exam
P = egzamin pisemno ustny		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03 PEK_K01-PEK_K03	short test, laboratory report, oral answer
P = pozytywne oceny z wszystkich ćwiczeń laboratoryjnych		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Szumanowski A. , tytuł: Układy napędowe z akumulacja energii, PWN, rok: 1990Pieczonka K. , tytuł: Maszyny urabiające, Politechnika Wrocławska, rok: 1988Szydelski Z. , tytuł: Napęd i sterowanie hydrauliczne, WKŁ, rok: 1999Kaczmarek T., tytuł: Napęd elektryczny robotów, Wydawnictwo Politechniki Poznańskiej, rok: 1996Wróbel T. , tytuł: Silniki krokowe, Wydawnictwo Naukowo-Techniczne, rok: 1993Kosmol J., tytuł: Serwonapędy obrabiarek sterowanych numerycznie, Wydawnictwo Naukowo-Techniczne, rok: 1998

SECONDARY LITERATURE

Dębicki M., tytuł: Teoria samochodu, WNT , rok: 1969Szumanowski A. , tytuł: Czas energii, WKiŁ, rok: 1988Mitschke M. , tytuł: Dynamika samochodu. Napęd i hamowanie., WKiŁ, rok: 1987Michałowski K. Ocioszyński J., tytuł: Pojazdy samochodowe o napędzieelektrycznym i hybrydowym, WKiŁ, rok: 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Driving Systems of Vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W20	C1, C2, C3	Lec1-Lec5	N1, N3
PEK_W02	K1MBM_W25	C1, C2, C3	Lec2-Lec5	N1, N3
PEK_W03	K1MBM_W17	C1, C2, C3	Lec1-Lec5	N1, N3
PEK_U01	K1MBM_U01	C3	Lab1-Lab5	N2
PEK_U02	K1MBM_U24	C3	Lab1-Lab5	N2
PEK_U03	K1MBM_U25	C3	Lab1-Lab5	N2
PEK_K01	K1MBM_K07	C1, C2	Lab1-Lab5	N3
PEK_K02	K1MBM_K02	C1, C2	Lab1-Lab5	N3
PEK_K03	K1MBM_K04	C3	Lab1-Lab5	N2

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032033**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.
PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	1

Lec2	Measurement, measurement types, method and measurement principle.	1
Lec3	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec4	Dimensions, tolerance of linear dimensions nad fits.	2
Lec5	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	2
Lec6	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec7	Tolerance and machine parts measurement.	2
Lec8	Tolerating and measurements of machines parts manufactured in the process of: casting, plastic forming, welding, plastics processing.	2
Lec9	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec10	hods and means of mechanization and automation of measurements.	2
Lec11	Analysis of dimension. Fundamentals of statistical control of dimensions.	1
Lec12	Fundamentals of coordinate measurement techniques.	1
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Measurements of linear dimensions.	2
Lab3	Measurements of angular dimensions.	2
Lab4	Direct and indirect measurements of cones.	2
Lab5	Identification and measurement of threads.	2
Lab6	Assessment of the geometrical structure of the surface.	2
Lab7	Identification and measurement of cylindrical gears.	2
Lab8	Measurements of selected shape deviations.	2
Lab9	Measurements of selected displacement.	2
Lab10	Measurements of machine parts with pneumatic measurement equipment.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE

[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01; PEK_W02; PEK_W03;	K1MBM_W15	C1; C2; C3; C4; C5; C6	Wy1 - Wy12	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1MBM_U12, K1MBM_U40	C1; C2; C3; C4; C5; C6	Wy1 - Wy12	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1MBM_K04, K1MBM_K05, K1MBM_K06	C1; C2; C3; C4; C5; C6	La1 - La10	N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszyny technologiczne CNC i roboty**
Name in English: **Technological CNC machines and robots**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032036**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10	10	
Number of hours of total student workload (CNPS)	60		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about design & manufacturing process, structure and operation of machine components and assemblies, as well as principles of their selection and designing.
2. Well-grounded knowledge about basic manufacturing techniques and role of technological machines.
3. Ability to design a manufacturing process in the field of chipless forming and machining.

SUBJECT OBJECTIVES

C1. Getting acquainted with engineering of basic CNC manufacturing machines and robots, in particular with their control, drive and measurement systems.
C2. Getting acquainted with programming principles of CNC machines according to ISO standard and with principles of building and implementing driver software, as well as with methods supporting a programmer's work.
C3. Getting acquainted with principles and possibilities of using automated single- and multimachine systems for executing specific machining tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knowledge of engineering and operation principles of modern CNC manufacturing machines, in particular principles of their operation control.
PEK_W02 - Knowledge of selection principles of CNC manufacturing machines intended for specific machining tasks.
PEK_W03 - Knowledge of programming principles of CNC machines.

II. Relating to skills:

PEK_U01 - Ability to evaluate CNC manufacturing machines with respect to their suitability for specific machining tasks.
PEK_U02 - Ability to elaborate a program structure for basic CNC machines, as well as to use standard subprograms and cycles.
PEK_U03 - Ability to select and preset machining parameters, select tools and verify correctness of the developed programs.

III. Relating to social competences:

PEK_K01 - Ability to search-out and use professional literature recommended for the course and to gain knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	General characteristics of manufacturing machines and their classification. Geometrical, kinematic and dynamic structures of the machines. Technical and operational parameters. Basic requirements.	2
Lec2	Parts, mechanisms and components of CNC manufacturing machines: bodies, spindle and guiding assemblies, tooling and workpiece systems. Main drive and feeding systems of modern manufacturing machines. Measurement, diagnostics and supervision systems.	2
Lec3	Basics of automatic control of manufacturing machines. Classification of control systems (NC, CNC, DNC, AC and PLC systems).	2
Lec4	Introduction to programming numerically controlled machines – geometrical basics of CNC control, coordinate systems, driver structure, interpolation. Ways of computer-aided programming – machining simulators.	2
Lec5	Review of groups of CNC machines: lathes, milling machines, grinding machines (technical & usable features and purpose of the machines).	2
Lec6	Review of groups of CNC machines: machining centres, autonomous machining stations (technical & usable features and purpose of the machines). Structure and purpose of coordinate measuring machines.	2
Lec7	CNC machines for electrochemical and laser machining (technical & usable features and purpose of the machines).	2
Lec8	Multimachine, robotized manufacturing systems, production centres and lines (organizational structures and application fields). Computer-integrated manufacturing systems (CIM).	2

Lec9	Machines and devices for additive manufacturing and reverse engineering techniques – exemplary applications. Trends in development of CNC manufacturing machines (machines for HSC and HPC machining, hexapods, intelligent and hybrid machine tools).	2
Lec10	Credit colloquium.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	The use of robots in sheet and spot welding processes.	2
Lab2	Control of machines in sheet metal forming processes.	2
Lab3	The use of Coordinate Measuring Machine (CMM).	2
Lab4	Automation of technological processes using PLC controllers (FESTO system).	2
Lab5	Machines to implement additive technology (Rapid Prototyping). Laboratory crediting.	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Selection of a machine tool, preparation of a workpiece, selection of tools and machining parameters.	2
Proj2	Determination of characteristic points of a contour and location of a workpiece in the machine-tool workspace. Linear and circular interpolation.	2
Proj3	Elaboration of a driver software to control the manufacturing process on a CNC machine – establishing corrective functions; programming movements with correction of tool dimensions. Subprograms technique, incremental programming, programming movements in a loop.	2
Proj4	Elaboration of a driver software to control the manufacturing process on a CNC machine – use of machining cycles at programming. Completion of the project and its verification.	2
Proj5	Summary of the work – presentation of the project and its assessment.	2
		Total hours: 10

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides
N2. Own work – preparation for crediting the lecture
N3. Own work – preparation for projekt class, laboratory
N4. Presentation of the project
N5. Consultancies

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Credit colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Assessment of the project preparation
F2	PEK_U01 - PEK_U03	Defence of the project
P = 0.5(F1+F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warsaw, 2000 (in Polish).
Kosmol J.: Automation of machine tools and machining. WNT Warsaw, 2000 (in Polish).
Honczarenko J.: Numerically controlled machine tools. WNT Warsaw, 2009 (in Polish).
Programming of CNC machine tools. Editorial Office REA. Warsaw, 1999 (in Polish).
Nikiel G.: Programming of CNC machine tools on the example of control system Sinumerik 810D/840D. ATH Bielsko-Biała, 2004 (available in internet) (in Polish).
Habrat W.: Operation and programming of CNC machine tools. Operator's handbook. KaBe, Krosno, 2007 (in Polish).
Kosmol J., Słupik H.: Programming of numerically controlled machine tools. Silesian University of Technology, Gliwice, 2001 (in Polish).

SECONDARY LITERATURE
Engineer's handbook. Machining. Vol. 1, 2, 3. WNT Warsaw, 1992 – 1994 (in Polish).
Instruction manual of Sinumerik control system programming (available in internet) (in Polish).
Dudik K., Górski E.: Lathe operator's handbook. WNT Warsaw, 2000 (in Polish).
Dudik K., Górski E.: Milling machine operator's handbook. WNT Warsaw, 2003 (in Polish).
Catalogues of tools used at CNC machine tools (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technological CNC machines and robots
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W35	C1 - C3	Wy1 - Wy9	N1, N3
PEK_U01 - PEK_U03	K1MBM_U17	C1 - C3	Pr1 - Pr4; Lab1 - Lab5	N2, N4
PEK_K01 - PEK_K03	K1MBM_K04	C1 - C3	Pr1 - Pr4; Lab1 - Lab5	N2- N5

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy eksploatacji i remontów maszyn**
Name in English: **Fundamentals of machine exploitation and repair**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032037**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge of chemistry, physics, engineering drawing, material science and machine component construction; knows the principles of matching typical machine components; understands the necessity of lubrication and wear preventing measures in machine operation; knows the basic technological processes for typical machine parts; understands the necessity of protecting the natural resources and reducing the amount of wastes; is aware of the consequences of polluting the environment with production wastes.
2. The student has knowledge concerning the hazards arising from industrial activity and machine operation; knows the international conventions and the Polish laws applying to environmental protection, and the environmental aspects of constructing, using and upgrading machines; is aware of the importance of and understands the nontechnical aspects and consequences of engineer and production manager activity, including its impact on the environment, and the consequent responsibility for the decisions made.

SUBJECT OBJECTIVES

C1. The student is to acquire basic knowledge about machine operation processes; to understand the systemic approach to operation and to the description and assessment of the operation process; to learn to describe the technical condition and reliability of an object.
C2. The student is to learn models of the reliability of simple repairable and unrepairable objects and of the reliability of complex objects.
C3. The student is to acquire skills of planning stocks of spare parts and consumable materials; to learn the principles of implementing repair management, the methods of regenerating worn out machine parts, modernizing machines, waste acquisition and recycling; to learn the principles of preventing and diagnosing in the operation of machines and the environmental principles of their operation.
C4. The student is to learn how to process rating indices and operational test simulation results; to acquire basic knowledge relating to diagnosing and assessing the condition of machines through the measurement and analysis of such machine operating parameters as energy consumption, machine component heating, vibration and noise levels and machine unit positioning accuracy; to learn to determine the technical condition of a machine, the degree of its wear and the range of repairs.
C5. The student is to acquire the skill of selecting a machine repair system and organizing repairs.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student understands the systemic approach to the operation process, knows how to describe this process and the technical condition of an object and knows the principles of assessing its reliability.
PEK_W02 - The student has knowledge relating to the assessment of the technical condition of an object, the cost-effectiveness of a machine repair, the way of preparing and carrying out the repair; understands the impact of the machine and the processes being conducted on the human being and the environment; knows the principles of eco-friendly machine operation.
PEK_W03 - The student knows the methods of assessing machine condition; can assess the need for, viability and range of a machine repair.

II. Relating to skills:
PEK_U01 - The student can assess the condition of simple and complex technical objects and their reliability.
PEK_U02 - The student can assess the need for a repair and its essential extent, select a method of regenerating parts, manage the stock of consumable materials and spare parts.
PEK_U03 - The student can minimize the adverse effects of a machine and the process being run on the personnel and the environment.

III. Relating to social competences:
PEK_K01 - The student knows how to search for information on machine repairs and to critically evaluate this information.
PEK_K02 - The student can objectively evaluate diagnostic parameters and collaborate in a team to select the optimum method of bringing a machine back to its original operating condition.
PEK_K03 - The student can objectively evaluate arguments, substantiate her/his ideas, using machine operation knowledge.

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Basic machine operation terms. The praxeological and systemic approach to operation.	2
Lec2	The description and assessment of the operation process.	2
Lec3	The description of the technical condition of an object.	2
Lec4	The notion of reliability. The reliability of simple repairable and unrepairable objects.	2
Lec5	The reliability of complex objects.	2
Lec6	The planning of spare parts and consumable materials inventories. The technically justified methods of regenerating machine parts.	2
Lec7	Repair management, repair systems, machine modernization.	2
Lec8	Prevention and diagnostics in machine use. Waste acquisition, recycling and neutralization.	2
Lec9	Environmental aspects of constructing, operating and repairing machines.	2
Lec10	The rational lubrication of machines, lubrication techniques, minimal lubrication. The treatment and neutralization of lubricants, cooling agents and technological fluids.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	The basic operational states of a technical object, operating process rating indices. The analysis of the condition of a technical object (a car, an engineering machine) on the basis of its fuel and energy consumption.	2
Lab2	The study of the influence of selected operating parameters of a machine on its energy consumption, the assessment of machine condition.	2
Lab3	The analysis of the repairability of a selected technical object. The determination of repair time and weak links.	2
Lab4	The assessment of the energy consumption, clearance, preload and condition of machine spindle bearings.	2
Lab5	The vibroacoustic diagnosis of the technical condition of machine assemblies.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. tutorials
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 ÷ PEK_W03	written examination
P = ocena z egzaminu		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02 ÷ PEK_U03, PEK_K01 ÷ PEK_K03	short tests
F2	PEK_U02 ÷ PEK_U03, PEK_K01 ÷ PEK_K03	reports from laboratory classes
P = średnia ze wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Konspekty przekazane przez prowadzącego,
2. Ziemba S: Problemy rozwoju nauki o eksploatacji maszyn i urządzeń technicznych, PWN W-wa 1983,
3. Olearczyk E: Zarys teorii użytkowania urządzeń technicznych, WNT W-wa,
4. Gołąbek A: Elementy teorii eksploatacji - skrypt PWr,
5. Podniało A: Paliwa, oleje i smary w ekologicznej eksploatacji, WNT W-wa 202

SECONDARY LITERATURE

Miesięcznik: Inżynieria i Utrzymanie Ruchu Zakładów Przemysłowych

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of machine exploitation and repair
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_K10, K1MBM_U06, K1MBM_U32, K1MBM_U37	C1, C2	Lec1-Lec5	1, 2, 4, 5
PEK_W02	K1MBM_K02, K1MBM_K04, K1MBM_K10, K1MBM_U14, K1MBM_U32, K1MBM_U35, K1MBM_W11, K1MBM_W20, K1MBM_W25	C3	Lec6-Lec10	1, 2, 4, 5

PEK_W03	K1MBM_K02, K1MBM_K08, K1MBM_K10, K1MBM_U32, K1MBM_U35, K1MBM_W15, K1MBM_W25, K1MBM_W26	C4, C5	Lec1-Lec10	1, 2, 3, 4, 5
PEK_U01	K1MBM_K02, K1MBM_K05, K1MBM_K11, K1MBM_U12, K1MBM_W11, K1MBM_W15, K1MBM_W18, K1MBM_W25	C2, C4, C5	La1-La5	2, 3, 4
PEK_U02	K1MBM_K05, K1MBM_K10, K1MBM_U12, K1MBM_U32, K1MBM_W25, K1MBM_W26	C3, C4, C5	La1-La5	2, 3, 4, 5
PEK_U03	K1MBM_K02, K1MBM_K05, K1MBM_W25	C1, C3	La1-La5	2, 3, 4, 5

SUBJECT SUPERVISOR

dr inż. Zbigniew Wasiak tel.: 27-81 email: zbigniew.wasiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie w produkcji**
Name in English: **Management in production**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM032038**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows and understands the nature of the management process and the basic functions of management.
2. Understands the basic concepts and basic economic rights and economic phenomena and their effects.
3. Posesses a basic knowledge of manufacturing processes.

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of the production and manufacturing processes
C2. Knowledge of methods and techniques for managing different types of manufacturing processes
C3. The acquisition of skills in planning, organizing and controlling of production processes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Distinguishes and characterizes by different types of production systems.
PEK_W02 - Can define the concepts of production and technological processes.
PEK_W03 - Has knowledge of the methods and techniques of production systems management.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristics of manufacturing organizations	1
Lec2	Characteristics of production systems	2
Lec3	Manufacturing system, its organization and components	2
Lec4	Classification of production processes	1
Lec5	Types and forms of production	2
Lec6	Methods of manufacturing control systems (pull, push and squeez)	2
Lec7	Methods of organization of production systems	4
Lec8	Features of bottlenecks in manufacturing processes	1
Lec9	Methods of manufacturing inventory management	3
Lec10	Principles of planning and scheduling	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W1, PEK_W2, PEK_W3,	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Chlebus E.: "Techniki komputerowe CAx w inżynierii produkcji", Wydawnictwa Naukowo-Techniczne, Warszawa 2000,
2. Durlik I.: "nżynieria zarządzania : Cz. 1 i Cz.2", Wydawnictwo Placet, Warszawa 2007,
3. Liwowski B.: "Podstawowe zagadnienia zarządzania produkcją", Oficyna Ekonomiczna, Kraków 2006

SECONDARY LITERATURE
1. Rogowski A..: "Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie", Wydawnictwa Fachowe CeDeWu, Warszawa 2010,
2. Burchart-Korol D.: "Zarządzanie produkcją i usługami", Wydawnictwo Politechniki Śląskiej, Gliwice 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management in production
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W1, PEK_W2, PEK_W3	K1MBM_W24	C1, C2	Lect1 - Lect10	N1

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Budowa pojazdów samochodowych**
Name in English: **Construction of vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	120				
Form of crediting	Examination				
Group of courses					
Number of ECTS points	4				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	2.4				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of machine design
2. The ability to associate and use knowledge

SUBJECT OBJECTIVES

C1. Knowing the main units and systems of motor vehicles
C2. Understanding the basic principles of the selection of types of teams and systems in motor vehicle
C3. Knowledge and understanding of the workings of teams and systems in motor vehicle

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has a basic knowledge of the construction and operation of major components or motor vehicle
PEK_W02 - It has a basic knowledge of the names of the various components and systems of a motor vehicle.
PEK_W03 - Versed in the current state and the latest trends in design and development of vehicles

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic information about the ingredients of the road transport system	1
Lec2	Classification of vehicles. Approval. The elements of identification	2
Lec3	Fundamentals of traffic engineering. resistance to motion	1
Lec4	The choice of power source. Power on wheels and engine characteristics	1
Lec5	Construction of automotive powertrain vehicles	2
Lec6	Construction of car chassis. Bearing and suspension system	2
Lec7	Wheels and tires	1
Lec8	The construction of the steering	2
Lec9	Construction of the brake system	2
Lec10	Automation systems of your vehicle	1
Lec11	The criteria for assessing the safety car	1
Lec12	Compatible vehicles	1
Lec13	Outdoor Lighting Vehicle	1
Lec14	CAN / BUS	1
Lec15	Features built-ins of vehicles with special	1
		Total hours: 20

TEACHING TOOLS USED

N1. multimedia presentation
N2. case study
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	exam
F2	PEL_W02	exam
F3	PEL_W03	exam
P = F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Reimpell J., Betzler J.: Chassis cars. Basic construction. Optics Warsaw 2001
PAWrzecioniarz, W.Ambroszko, A.Górniak - Energy Efficient Design of powetrain and body, Wrocław University of Technology, 2011

SECONDARY LITERATURE
L. Prochowski: Mechanical Movement. Publisher of Science and Technology, Warsaw, 2005.
M. Zając: Transmission systems for trucks and buses. WKiŁ Warsaw 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Construction of vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_KM_W04, K1MBM_W18	C1-C3	WY1-WY15	N1- N3

SUBJECT SUPERVISOR

dr inż. Wojciech Ambroszko tel.: 71 347-79-18 email: wojciech.ambroszko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy tribologii**
Name in English: **Fundamentals of Tribology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 He has ordered knowledge about the types of engineering materials - metal, ceramic, polymer and composite materials.2. It has a basic knowledge of the construction, operation and use of the main components and machine assemblies.3. It has a basic knowledge of physics, chemistry, statistics.
2. Skills: 1. It can analyze the macroscopic fractures, microstructure of materials, technological drawbacks of origin, is able to determine the characteristics of the microstructure of metallic materials.2. He can choose the material on a given machine element and can explore its basic properties.
3. Competencies: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineer.2. Is aware of the importance of behavior in a professional manner and have a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. Familiar with the processes of friction, wear and lubrication of moving nodes and methods for machine control these processes in terms of minimizing their effects (special attention will be paid to the construction and technological methods of increasing the reliability and durability of sliding pairs, as well as the problem of lubrication and lubricant selection as an effective prevention of friction and wear).
C2. Understanding the impact of selected parameters of friction vector, ie, pressure, velocity slip material cooperating associations and grease on the tribological characteristics of sliding pairs. Get to know the influence of the structure of the material to abrasion and impact bushing stiffness for load distribution in the bearing friction.
C3. Show students that they can effectively counteract the negative effects of friction in the moving solid contact with real objects illustrate some of the issues discussed theoretically in the lecture.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the processes of friction, wear and lubrication of moving nodes machine.
PEK_W02 - Know the basic types of lubricants and their applications.
PEK_W03 - He knows the design and technological methods of increasing the reliability and durability of sliding pairs.

II. Relating to skills:
PEK_U01 - It can choose materials for sliding nodes and understand relationships and dependencies between the material used and its durability.
PEK_U02 - It can perform basic tests of materials used in the nodes of friction, interpret them and implement in the final node machines.
PEK_U03 - He can use the theoretical knowledge acquired friction and lubrication of the lecture and apply it in practice.

III. Relating to social competences:
PEK_K01 - It can search for information and critically analyze them.
PEK_K02 - Properly define and resolve dilemmas, adheres to the principle of professional ethics.
PEK_K03 - Able to work independently and as a team, and properly assess their own tasks and priorities of the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program and requirements. Brief history of tribology. Elastic contact of smooth bodies. The real contact of solids. The problem of the surface layer.	2
Lec2	Friction and wear processes, their distribution and characteristics. Sliding and rolling friction. Theories of friction. Effect of pressure and sliding velocity on the friction and wear.	2
Lec3	Characteristics of materials (metal and others) on the sliding nodes and the rules for their selection. Simple and reversed pair of friction. Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2

Lec4	Grease as a construction material. Objectives lubrication. The way of obtaining o fluid friction. Distribution of lubricants. Lubricating oils and their properties. Greases, their distribution and characteristics.	2
Lec5	Final test.	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	1.Determining of properties of slide bearing materials.	2
Lab2	2.Determining of coefficient of static friction.	2
Lab3	3 Research of lubricity of greases using a four ball tester.	2
Lab4	4. Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	5. Study materials for the seizure.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. laboratory experiment
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Lawrowski Z.; Tribologia, Tarcie, zużywanie i smarowanie. W-a, PWN, 1993.2.Garkunov D. N.; Trybotechnika. Moskva, Mašinostroenie, 1999.3.Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.4.Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990.5. Embedded detailed instructions posted on the website: www.ikem.pwr.wroc.pl/pkmit

SECONDARY LITERATURE

1.Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag, 2000.2.Lawrowski Z.; Technika smarowania. W-a, PWN, 1987.3.Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Tribology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W11, K1MBM_W18, K1MBM_W26	C1	Lec1, Lec2	N1, N2, N5
PEK_W02	K1MBM_W18, K1MBM_W25	C1	Lec4	N1, N2, N5
PEK_W03	K1MBM_W21, K1MBM_W22, K1MBM_W26	C1	Lec3	N1, N2, N5
PEK_U01 - PEK_U03	K1MBM_U01, K1MBM_U04, K1MBM_U06, K1MBM_U15, K1MBM_U20	C2, C3	Lab1 - Lab5	N3, N4, N5
PEK_K01 - PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K04	C3	Lab1 - Lab5	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napęd hydrauliczny**
Name in English: **Hydraulic drive**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20	10	
Number of hours of total student workload (CNPS)	60		60	30	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of fluid mechanics.
2. Student can solve diferential equations of mathematical models of hydraulis components and systems.
3. Student possess basic knowledge of hydrostatic drive systems.

SUBJECT OBJECTIVES

C1. Students acquaintance with simple and advanced hydraulic components.
C2. Students acquaintance with hydraulic drive systems.
C3. Students acquaintance with control and regulation methods selected parameters of hydraulic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student has knowledge for description of basic hydraulic systems in vehicles and heavy duty machines.
PEK_W02 - In the result of lesson student has knowledge for design of hydraulic drive systems.
PEK_W03 - In the result of lesson student has knowledge for description hydraulic components for control or regulation selected parameters.

II. Relating to skills:
PEK_U01 - In the result of lesson student is able to design hydraulic system with control system - make suitable calculations and on their basis student is able to select suitable hydraulic components with proper dimensions and properties.
PEK_U02 - In the result of lesson student is able to make measurements of hydraulic components and systems and describe results and formulate proper conclusions.
PEK_U03 - In the result of lesson student is able to build and start and analyse working hydraulic and electrohydraulic drive system.

III. Relating to social competences:
PEK_K01 - Student can cooperate in group during hydraulic and electrohydraulic system building and report preparation.
PEK_K02 - Student can plan measurements and project preparation.
PEK_K03 - Student correctly identyfi and solve problems with hydraulic and electrohydraulic system during its building. Student formulate appropriate conclusions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements, list of references.	1
Lec2	Hydraulic systems properties.	1
Lec3	Speed regulation of hydraulic motor during fast and working movement.	2
Lec4	Hybrid hydraulic systems.	1
Lec5	Cavitation effect, calculaction of sucking line of hydraulic pump.	1
Lec6	Hydraulic brake systems.	1
Lec7	Hydraulic ABS systems.	2
Lec8	Hydraulic systems of travel mechanism.	1
Lec9	Steering servomechanisms.	1
Lec10	Multipumps systems.	1
Lec11	Synchronisation of hydraulic actuators movement.	2
Lec12	Hydropneumatic suspension, vibration dampers.	1
Lec13	Load-sensing hydraulic systems.	2
Lec14	Thermal balance of hydraulic systems.	1
Lec15	Design of hydraulic drive.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Introduction - laboratory topics presentation, check form, requirements. Laboratory regulations and industry safety.	1
Lab2	Sequence control of hydraulic motors.	2
Lab3	Serial and papralel connection of hydraulic actuators.	2
Lab4	Control of hydraulic system with proportional reliefe valve.	1
Lab5	Hydraulic systems with check valves and flow regulator.	2
Lab6	Methods of safety increasing in hydraulic systems - controlled check valve.	1
Lab7	Functions of hydraulic accumulator.	2
Lab8	Functions and applications of relief valve with unloading.	1
Lab9	Load-sensing system tests.	1
Lab10	Regulation with constant power in hydraulic system.	1
Lab11	Volumetric control.	1
Lab12	Comparison tests of speed control and regulation systems for hydraulic actuator.	2
Lab13	Methods of power losses reduction in hydraulic systems.	1
Lab14	Tests of dynamics processes in hydraulic systems.	1
Lab15	Check.	1
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Introduction to project.	1
Proj2	Generating of system structure.	1
Proj3	Preparation of basic calculations.	2
Proj4	Selection of typical components.	2
Proj5	Preparation of static characteristic of the system.	2
Proj6	Description of system operation and selected components specification.	1
Proj7	Project presentation and check.	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for project class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02 PEK_U03	oral response for practical veryfication of design and buliding of systems.
F2	PEK_U02	report
F3	PEK_U03	student's activity note
P = (2F1+F2+F3)/4		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01-PEK_K03	Project check
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Kollek W.: Gear pumps (in polish). Zakład Narodowy im. Ossolińskich, Wrocław 1996.
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Osiecki A.: Hydrostatic drive of machines (in polish). WNT, Warszawa 1996.
Garbacik A., Szewczyk K.: Hydraulic drive and control. Basics of systems designing (in polish). Skrypt Politechniki Krakowskiej, Kraków 1998.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.

SECONDARY LITERATURE

Jędrzykiewicz Z.: Design of hydrostatic systems. Basics (in polish). Skrypt 1313. AGH Kraków 1992.
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydraulic drive
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_KM_W03, K1MBM_W14, K1MBM_W20	C2 C3	Lec1 Lec4 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N1
PEK_W02	K1MBM_KM_W03, K1MBM_W08, K1MBM_W14, K1MBM_W20	C1 C2	Lec1 Lec2 Lec5 Lec14 Lec15	N1 N3
PEK_W03	K1MBM_W16, K1MBM_W20	C1 C2 C3	Lec1 Lec3 Lec6 Lec7 Lec9 Lec11 Lec13	N1
PEK_U01	K1MBM_KM_U03, K1MBM_U23, K1MBM_U25	C1 C2 C3	Proj1 Proj2 Proj3 Proj4 Pojr5 Proj6 Proj7 Lab13	N1 N3
PEK_U02	K1MBM_U12, K1MBM_U24	C1 C2 C3	Lab4 Lab9 Lab10 Lab11 Lab12 Lab14	N2 N4
PEK_U03	K1MBM_U09, K1MBM_U23, K1MBM_U24	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab12 Lab13	N2 N4
PEK_K01	K1MBM_K04, K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N2 N4
PEK_K02	K1MBM_K04, K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N2 N3 N4
PEK_K03	K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N2 N3 N4

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie spajania**
Name in English: **Joining technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. - The student knows the types of welds, welding positions, joints marking, causes of welded joints cracking
- The student knows the basic welding methods and parameters of the welding processes
- The student has knowledge of the fundamentals and applications of soldering, brazing, resistance welding and thermal cutting
2. - The student is able to select the right technology (method) of joining (bonding) and define basic parameters of the process;
- The student is able to select the right technology (method) of thermal cutting and define basic parameters of the process;
- The student is able to design a simple bonding process of the product

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the different types of welded structures
C2. Acquiring the ability to develop bonding technology
C3. Searching for information and its critical analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the performance of various welded structures
PEK_W02 - Knows welding, resistance welding, soldering, brazing and adhesive bonding technologies of different metals and alloys
PEK_W03 - Has knowledge of use of welding, resistance welding, soldering, brazing and adhesive bonding

II. Relating to skills:
PEK_U01 - Is able to select the right bonding technology
PEK_U02 - Is able to select the appropriate parameters of welding, soldering, brazing, resistance welding and adhesive bonding
PEK_U03 - Is able to design bonding process of different types of structures

III. Relating to social competences:
PEK_K01 - searching for information and its critical analysis
PEK_K02 - team cooperation on improving methods for the selection of a strategy to optimally solve assigned problems
PEK_K03 - objective evaluation of arguments, rational explanations and justifications of own point of view, using knowledge of welding technology

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to economics of welding processes	2
Lec2	Technological parameters of manual metal arc welding	2
Lec3	Technological parameters of TIG welding	2
Lec4	Technological parameters of submerged arc welding	2
Lec5	Technological parameters MAG/MIG welding	2
Lec6	Advanced soldering and brazing technologies	2
Lec7	Selected aspects of resistance welding	2
Lec8	Adhesive technology of engineering materials	2
Lec9	Laser welding	2
Lec10	Welding of pressure vessels	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Selection of MMA welding parameters	2
Lab2	Selection of MIG, MAG, TIG welding parameters	2
Lab3	Selection of filler materials for welding high-alloy steels	2
Lab4	Influence of welding parameters on the process of resistance weld forming. Evaluation of resistance welded joints.	2
Lab5	Adhesive bonding of basic engineering materials	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03; PEK_K03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01- PEK_U03 PEK_K01 - PEK_K03	short test
P = Średnia z F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Klimpel A.: Spawanie, Zgrzewanie i Ciecie Metali., WNT, Warszawa, 1999
2. Tasak E.: Spawalność stali,Fotobit, Kraków,2002
3. Pilarczyk J., Pilarczyk J. : Spawanie i napawanie elektryczne metali, Wyd. Śląsk, Katowice 1996
4. Ferenc K.,Ferenc J.: Konstrukcje spawane. Projektowanie połączeń, WNT, Warszawa 2000

SECONDARY LITERATURE
Pilarczyk J. (red.): Poradnik Inżyniera. Spawalnictwo. T. I i II, WNT Warszawa, 2003, 2005
Normatywy spawalnicze
Normy

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Joining technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_W21	C1-C3	lec 1-10 lab 1-5	1-5
PEK_U01_PEK_U03	K1MBM_U21	C1-C3	lec 1-10 lab 1-5	1-5
PEK_K01-PEK_K03	K1MBM_K02	C1-C3	lec 1-10 lab 1-5	1-5
PEK_W01-PEK_W03	K1MBM_TSW_W03	C1-C3	lek 1-10 lab 1-5	1-5

SUBJECT SUPERVISOR

dr inż. Tomasz Piwowarczyk tel.: 4255 email: tomasz.piwowarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowa symulacja procesów kształtowania plastycznego**
Name in English: **Computer simulation of plastic forming processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032203**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic understanding of the processes and machinery for plastic forming.
2. It has a basic understanding of the foundations of the theory of finite element methods.
3. It has a basic understanding of the strength of materials, mechanics and the theory of machines and mechanisms.

SUBJECT OBJECTIVES

C1. To gain insight into the field of modern engineering tools for analysis and optimization of plastic forming processes.
C2. To gain basic knowledge and skills to build mathematical models of forming processes
C3. To know the influence of the process parameters on the forming forces.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows the construction of mathematical models of plastic forming processes.
PEK_W02 - It has a basic knowledge of the possible applications of the finite element method to the process analysis and optimization of forming processes.
PEK_W03 - It knows the basic relationships between material properties and parameters of forming process.

II. Relating to skills:
PEK_U01 - It gain the skills necessary to build mathematical models of plastic forming processes.
PEK_U02 - Is able to perform the calculation and initial optimization of the plastic forming process.
PEK_U03 - Is able to identify which of the process parameters significantly affect the forming forces.

III. Relating to social competences:
PEK_K01 - It acquires beliefs about the responsibility for the work.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Plastic forming - types of processes, the basic process parameters.	1
Lec2	The model of the process, geometry transfer, calculation model building.	1
Lec3	Fundamentals of plastic deformation.	2
Lec4	Models of materials, stress-strain curves, yield criterion.	1
Lec5	Modelling of bulk metal forming processes.	3
Lec6	Modelling of sheet metal forming.	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Introduction to computer simulation of the plastic forming processes in the computing environment.	1
Proj2	Modelling of selected examples of plastic forming processes.	2
Proj3	Analysis and determination of the influence of process parameters on the forming forces (friction, temperature, speed).	2
Proj4	Preparation of design assumptions for the selected item shaped by forming processes.	1
Proj5	Description of the process geometry and its export to the FEM program.	1
Proj6	Building the model in the FEM program.	1
Proj7	Making calculations for the various process parameters and/or the geometry of the process.	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem exercises
N3. self study - preparation for project class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project rating
F2	PEK_U01, PEK_U02, PEK_U03	test
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Joseph R. Davis: Metals handbook. Vol. 14, Forming and forging ASM International Handbook Committee.
Altan, Taylan; Tekkaya, A. Erman: Sheet Metal Forming - Processes and Applications, ASM International.
Hosford, William F.; Caddell, Robert M.: Metal Forming - Mechanics and Metallurgy, Cambridge University Press

SECONDARY LITERATURE
Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003
Morawiecki M., Sadok L., Wosiek E.: Przeróbka plastyczna- podstawy teoretyczne. Wydawnictwo Śląsk 1986
Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer simulation of plastic forming processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_TSW_W05	C1, C2, C3	Wy1-Wy6	N1,N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_TSW_U05	C1, C2, C3	Pr1-Pr7	N2,N3
PEK_K01	K1MBM_K04	C3	Pr3	N2

SUBJECT SUPERVISOR

dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Narzędzia skrawające**
Name in English: **Cutting tools**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032204**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of manufacturing in machining
2. He has skills in measurement methods, techniques for measuring and evaluating the results of measurement
3. Can obtain information from literature, databases and other sources, and to draw conclusions and formulate and justify opinions

SUBJECT OBJECTIVES

C1. Expanding knowledge of cutting tools, cutting edge geometry, tools materials and coatings used on the cutting edge.
C2. Knowing the rules of proper tool selection, due to working conditions, treatment efficiency and manufacturing costs.
C3. Gaining knowledge of wear and regeneration blunted cutting tools.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to correctly classify cutting tools, know their structure and geometry.
PEK_W02 - Student can choose the modern technological processes cutting tools due to the efficiency and cost of production.
PEK_W03 - The student is able to explain the physical and chemical phenomena occurring at the cutting edge during machining.

II. Relating to skills:
PEK_U01 - Students can choose the tool materials due to optimal cutting.
PEK_U02 - Student can determine what is the influence of cutting edge geometry on the effects of machining technology.
PEK_U03 - Students should be able to use the computer programs used for the selection of tools set machining conditions.

III. Relating to social competences:
PEK_K01 - Is aware of the importance of behavior in a professional way, well-defined and resolve dilemmas.
PEK_K02 - Recognize the effects of the impact of technology on the environment and related social responsibility of science and technology.
PEK_K03 - Is aware of the necessity of individual and group activities that go beyond the activities of engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role of tools and equipment in the production of machine parts	2
Lec2	Tool materials and their selection	2
Lec3	The geometry of the cutting edge. Reference systems and dimensioning of the blade. The role and importance of the angles of the blades in the cutting process.	2
Lec4	Characteristics and application of tools	2
Lec5	Cutters and cutter heads. Thread Tools and gears. Colloquium	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Measurement and tool setting in flexible production system.	2
Lab2	The measurement tool components.	2
Lab3	Turning with inserts WIPER type.	2
Lab4	Machinability determination for choosen tools.	2
Lab5	The choice of cutting tools with the use of computer programs.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03 PEK_K01, PEK_K02, PEK_K03	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	report on laboratory exercises
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Autor: Piotr Cichosz, tytuł: Narzędzia skrawające, wydawnictwo: WNT , rok: 2006
Autor: Mieczysław Feld, tytuł: Uchwyty obróbkowe, wydawnictwo: WNT, rok: 2002

SECONDARY LITERATURE
Autor: Henryk Żebrowski, tytuł: Przyrządy i uchwyty obróbkowe, , wydawnictwo: Oficyna Wyd. PWr., rok: 1983

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Cutting tools
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_TSW_W01, K1MBM_W22	C1, C3	Lec1 - Lec5	N1, N4, N5
PEK_U01, PEK_U02, PEK_U03	K1MBM_TSW_U01, K1MBM_U26, K1MBM_U31	C1, C2, C3	La1 - La5	N2, N3, N5
PEK_K01, PEK_K02, PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K07	C1	Lec1, La1, La5	N1, N5

SUBJECT SUPERVISOR

dr inż. Marek Kołodziej tel.: 41-81 email: marek.kolodziej@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie laserowe w wytwarzaniu**
Name in English: **Laser Technology in Manufacturing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of optics and optical systems impact on the light beam
2. Basic knowledge of electromagnetic radiation's interaction with matter
3. Knowledge of the heat treatment's issues and its impact on the changes taking place in the material

SUBJECT OBJECTIVES

C1. Acquiring knowledge of the construction and the laser processing operation's
C2. Acquiring the ability to select the appropriate laser system to the task in
C3. Independent acquisition of information and its use to solve engineering problems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the principles of operation and construction of high-power lasers
PEK_W02 - He knows the laser beam forming systems and the interaction of radiation with matter
PEK_W03 - He is familiar with the scope of lasers in manufacturing

II. Relating to skills:
PEK_U01 - He can choose the right laser system for a given treatment process
PEK_U02 - Acting in an appropriate way with the specialized laser equipment
PEK_U03 - Depending on the desired process he is able to select the appropriate beam forming system

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basics of high-power lasers	2
Lec2	Laser beam forming systems and laser safety	2
Lec3	Impact of the laser beam with matter	2
Lec4	Laser cutting and wellding	2
Lec5	Laserl cladding and micromachining	2
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Overview of laser radiation generators	2
Lab2	Laser cutting	2
Lab3	Welding using the laser beam	2
Lab4	Laser cladding	2
Lab5	Engraving and laser micromachining	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
N4. demonstration of laser processes
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03,	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03,	shortl exam
P = średnia F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

J. Kusiński: ”Lasery i ich zastosowanie w inżynierii materiałowej”, Wydawnictwo Naukowe Akapit, 2000.

A. Klimpel: "Technologie laserowe w spawalnictwie" Wydawnictwo Politechniki Śląskiej, 2011.

SECONDARY LITERATURE

E. Kannatey-Asibu: “Principles of Laser Materials Processing”, Wiley, 2009.

J.C. Ion: „Laser Processing of Engineering Materials”, Elsevier, 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser Technology in Manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_TSW_W03, K1MBM_W21	C1, C2	Lec1-Lec5	N1- N3, N5

PEK_U01-PEK_U03	K1MBM_TSW_U03, K1MBM_U26, K1MBM_U28	C2, C3	Lab1-Lab5	N2-N5

SUBJECT SUPERVISOR
dr inż. Tomasz Baraniecki tel.: 26-62 email: tomasz.baraniecki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń wytwórczych**
Name in English: **Operation maintenance of manufacturing machines and devices**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032212**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure and operation of machine components and assemblies, as well as principles of their selecting and designing
2. Basic knowledge about operation, reliability and safety of machines.
3. Well-grounded knowledge about basic manufacturing techniques and role of manufacturing machines.

SUBJECT OBJECTIVES

C1. Getting acquainted with principles of the Total Productive Maintenance (TPM) concept.
C2. Getting acquainted with basic TPM tools and methods allowing to increase efficiency of machine stock maintenance. Getting acquainted with principles of determining indices describing progress at implementing the TPM methodology.
C3. Getting acquainted with possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of scope and principles of selecting a maintenance strategy of manufacturing machines and devices.
PEK_W02 - Knowledge of basic TPM tools and indices.
PEK_W03 - Knowledge of basic features and possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

II. Relating to skills:
PEK_U01 - Ability to use the acquired knowledge to formulate tasks aimed at improving a maintenance system of manufacturing machines and devices.
PEK_U02 - Ability to determine indices determining progress at implementing the TPM methodology.
PEK_U03 - Ability to use modern IT tools for computer-aided managing the maintenance processes.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to gain knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic problems related to maintenance of manufacturing machines and devices: service requirements, cause and effect analysis of machine failure, role and significance (benefits) of maintenance organization and planning.	2
Lec2	History and development of the TPM concept (characteristics of basic TMP pillars). Characteristics of basic TPM tools – exemplary applications.	2
Lec3	Maintenance strategies – idea of systematic and system-related attitude to maintenance problems. Measures and indices determining efficiency of implementing the TPM methodology.	2
Lec4	CMMS-class computer systems supporting maintenance management (requirements and functions of selected systems, system selection criteria).	2
Lec5	Implementing the TPM methodology to industrial practice (exemplary solutions of implementing). Crediting the course.	2
		Total hours: 10

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides.
N2. Own work – preparation for crediting the lecture.
N3. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Credit colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Basics of operation of machines and devices. Editorial Office WSiP. Warsaw, 2007 (in Polish).

Słowiński B.: Engineering of machine operation. Editorial Office of Koszalin University of Technology. Koszalin, 2011 (in Polish).

Kaźmierczak J.: Operation of technical systems. Editorial Office of Silesian University of Technology. Gliwice, 2000 (in Polish).

SECONDARY LITERATURE

Hebda M.: Elements of the theory of technical systems operation. Editorial Office MCNEMT. Radom, 1990 (in Polish).

Żółtowski B.: Basics of machine diagnostics. Editorial Office ATR Bydgoszcz, 1996(in Polish).

Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warsaw, 2000 (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of manufacturing machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W18, K1MBM_W26	C1 - C3	Wy1 - Wy5	N1 - N3
PEK_U01 - PEK_U03	K1MBM_U32	C1 - C3	Wy5	N2
PEK_K01 - PEK_K03	K1MBM_K04	C1 - C3	Wy1 - Wy5	N1 - N3

SUBJECT SUPERVISOR
dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia w procesach wytwarzania**
Name in English: **Metrology in manufacturing techniques**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032220**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics.
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C2. Gaining the ability to analyze the results of measurements, measurement errors and expressing measurement uncertainty in dependence of production lot scale.
C3. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C4. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to identify and define the quantity of the measuring machine parts. He knows and is able to determine the arrangements for ensuring the measurement integrity.
PEK_W02 - Can name the elements of the measurement system and define its functional characteristics. He knows the characteristic values measured in different types of machines.
PEK_W03 - He knows the principles governing the creation of tools, components and measuring systems in dependence of production lot scale.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use literature related to the assessment of the geometry of the product. Can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can create documents for the implementation of the measurements on the test bench.
PEK_U03 - Can use industrial measuring equipment management systems.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, measurement itegrity.	1
Lec2	Elements of measurenment systems and their properties.	1
Lec3	The method of determining the measurement uncertainty.	2
Lec4	Distribution of the variability of dimensions for typical processes.	2
Lec5	Toleration of machines in various technological processes.	2
Lec6	Designing of measuring devices's heads .	1
Lec7	Design and control tests for checking the geometry of the product.	1
Lec8	Integration of measuring stands.	1
Lec9	Mechanization and automation of measurement processes.	1
Lec10	Methods of measurement systems analysis.	2
Lec11	Methods and tools for monitoring measurement equipment.	1
Lec12	Elements of statistical control of manufacturing processes.	1
Lec13	Organization and documentation of the process control of machines.	2
Lec14	Analysis of tolerance and interchangeability of parts.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	1
Lab2	Checking selected metrological characteristics of measuring instruments.	2
Lab3	Selection of equipment for specific measurement tasks.	2
Lab4	Analysis of the measurement system.	2
Lab5	Measurement in the integrated measurement environment.	2
Lab6	Analysis and implementation of the CMM measurement tasks.	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. report preparation
N3. self study - preparation for laboratory class
N4. tutorials
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03; PEK_K01; PEK_K02; PEK_K03;	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1]Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.

SECONDARY LITERATURE

[1] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.
[2] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)
[3] Humienny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004
[4] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.
[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.
[6] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.
[7] Zelczak A.:" Pneumatyczne pomiary długości". WKŁ, Warszawa 2006.
[8] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology in manufacturing techniques
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1MBM_W15	C1; C2; C3; C4	Wy1 - Wy14	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1MBM_TSW_U01, K1MBM_U01, K1MBM_U12	C1; C2; C3; C4	La1 - La6	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1MBM_K04, K1MBM_K05	C1; C2; C3; C4	Wy1 - Wy14, La1 - La6	N1; N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badanie jakości wyrobów**
Name in English: **Research of qualities of products**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032221**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should has a basic knowledge about the basic mechanical properties of engineering materials; has ordered knowledge about the types of metallic engineering materials - their structure, properties, applications and principles of selection; has detailed knowledge about the structures of steel and cast iron, the principles of classification and labeling; has a basic knowledge about heat and thermo-chemical treatment, has a knowledge about alloy steels and non-ferrous metals and alloys.Has a theoretical knowledge about circuitry.
2. Can analyze the macroscopic fractures, microstructure of materials, technological defects; is able to determine the characteristics of the microstructure of metallic materials; is able to identify the phases on the basis of equilibrium diagrams; can distinguish between the microstructure in terms of carbon content in steel, the influence of heat treatment; can analyze circuits, can read and interpret the drawings and diagrams used in technical documentation
3. Has a basic knowledge of the manufacturing processes of products from the liquid metal, the plastic molding, welding and machining techniques.
Has a basic knowledge of metrology of geometrical quantities.

SUBJECT OBJECTIVES

C1. To familiarize students with methods of product quality assesment manufactured from the liquid metal, through the plastic molding, welding techniques and machining.
C2. Acquisition of knowledge about the basic methods of quality assesment of castings, forgings, stampings, rolled products, drawn, welded products, welded and brazed, glued, screwed, sintered products form metal powders, products manufactured by machining, heat-treated products and products made of plastics.
C3. The acquisition and consolidation of social skills including emotional intelligence involving the ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in the acting; observance of customs in academia environment and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic methods of quality assessment of castings and products made by methods of plastic working.
PEK_W02 - Knows the basic quality assessment methods of products made by prosesses like welding, glueing, screwing and sintered products from metal powders.
PEK_W03 - Knows the basic quality assessments methods of products manufactured by machining, heat treatement and plastic products.

II. Relating to skills:
PEK_U01 - Can choose the appropriate method for the quality assessment of products manufactured by castings and by methods of
plasting working and specify a quality class of product .
PEK_U02 - Can choose the appropriate method for the quality assessment of products produced in the process of welding and specify a quality class of product .
PEK_U03 - Can choose the appropriate method for the quality assessment of products manufactured by machining and plastic products and specify a quality class of product .

III. Relating to social competences:
PEK_K01 - Searching for the information and critical analysis,
PEK_K02 - Objective evaluation of arguments to justify, the rational translation and his own point of view using the knowledge about the casting, plastic forming and welding, machining and plastics
PEK_K03 - Observance with the customs and rules of the academic environment,

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts and terminology in systems to ensure product quality. The techniques used for quality control of products.	2
Lec2	Aspects of the application of non-destructive testing for quality control of products.	2
Lec3	The methods and principles for quality assessment of the castings.	2
Lec4	Methods of quality assessment of rolled, drawn and extruded products.	2

Lec5	Methods of quality assessment of forged, sintered and after the thermo-chemical treatment products	2
Lec6	Testing and quality control methods of welded products	2
Lec7	Testing and quality control methods of welded and brazed products	2
Lec8	Testing and quality control methods of glued and screwed products. Methods of quality assessment of plastic products	2
Lec9	Methods of quality assessment of products made by machining	2
Lec10	Coordinate measuring techniques in the assessment of product quality.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	The study of selected parameters of cast products and the assessment of their quality.	2
Lab2	The study of selected parameters of product manufactured by plastic processing technologies and the assessment of their quality.	2
Lab3	The study of selected parameters of product manufactured by welding processes and the assessment of their quality.	2
Lab4	Computed tomography in product quality control.	2
Lab5	The study of selected parameters of product manufactured by machining and the assessment of their quality.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_K01 - PEK_K03	Written - oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	oral examination, short test
P = średnia z wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Praca zbiorowa. Zarządzanie jakością, T4. metody oceny jakosci wyrobów technicznych. Politechnika Krakowska. 2000r.
Łabanowski J. Ocena jakości wyrobów hutniczych. Wyd. PWSZ w Elblągu. 2008r.

SECONDARY LITERATURE
Zymonik Janusz i Zofia. Systemy jakości w wytwarzaniu maszyn. SIMPRESS, Wrocław, 1997r.
Mirski Z., Technologia i badanie materiałów inżynierskich : laboratorium. Oficyna Wydawnicza Politechniki Wrocławskiej, 2010r.
Subject standards PN-EN ISO.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Research of qualities of products
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W15	C1, C2	Lec 1 1-Lec5	N1, N4, N5
PEK_W02	K1MBM_W15	C1, C2	Lec1, Lec2, Lec7, Lec8	N1, N4, N5
PEK_W03	K1MBM_TSW_W04, K1MBM_W15	C1, C2	Lec1, Lec2, Lec9, Lec10	N1, N4, N5
PEK_U01	K1MBM_TSW_U04, K1MBM_U12	C1, C2, C3	Lab1, Lab2, Lab4	N2, N3
PEK_U02	K1MBM_U12	C1, C2, C3	Lab3, Lab4	N2, N3
PEK_U03	K1MBM_U12	C1, C2, C3	Lab4, Lab5	N2, N3
PEK_K01 - PEK_K03	K1MBM_K04	C3	Lec1 - Lec10, lab1 - Lab5	N4, N5

SUBJECT SUPERVISOR

dr inż. Wiesław Derlukiewicz tel.: 27-38 email: wieslaw.derlukiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English: **MASTER THESIS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **MMM032250**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				450	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				15	
including number of ECTS points for practical (P) classes				15	
including number of ECTS points for direct teacher-student contact (BK) classes				15.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of manufacturing techniques and production systems documented by positive marks in all subjects in within the specialty of Technologies and Manufacturing Systems
2. Can apply their knowledge. Carry out experimental research, seek an information from the literature. Speak a foreign language at the level which let to express self-opinions and write master's thesis in the field of production techniques and production systems. Can analyze the results of the research and specify the conclusions.
3. Is aware of the importance of non-technical aspects and impacts of engineering, to respect the principles of ethics and social role of technical college graduate.

SUBJECT OBJECTIVES

C1. Based on the acquired knowledge while studying, preparation of master thesis by the solution of research problem in the field of the specialty of Technologies and Manufacturing Systems.
C2. Writing a master thesis and presentation of its achievements in relation to current information in literature.
C3. Acquisition and consolidation of independent work skills, determination of the priorities to tackle the task and awareness of responsibility for own work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a necessary knowledge of realization the engineering tasks, their description, documentation and presentation.
PEK_W02 - Has a basic knowledge of the organization and implementation of master thesis, on issues related to the specialty of Technologies and Manufacturing Systems.
PEK_W03 - Has a basic knowledge in methodology of presenting the results of done work and background skills needed for the communicating in engineering teamwork.

II. Relating to skills:
PEK_U01 - Can critically analyze and evaluate existing manufacturing processes, production systems and technological machines. Can work independently to realize the degree of master's thesis, using research techniques and methods known during studies.
PEK_U02 - Can acquire concrete information from the literature also in foreign languages. Can to interpret and critically evaluate the research results.
PEK_U03 - Knows how to edit a master's thesis complying with prevailing requirements of method and style of writing. Can present it orally to a wider audience using multimedia capabilities, including the occurrence to the diploma committee.

III. Relating to social competences:
PEK_K01 - As a graduate student is aware of being the next leader, who knows how to organize the work and determine the self-priorities for the others, can manage a team of people as well as work together in the group taking the different roles.
PEK_K02 - Is gaining characteristics of a person working alone, according to the principles of ethics with an awareness of the responsibility for their own work.
PEK_K03 - Acquires attention to style and form of expression of own views in native and a foreign languages, especially in English, understands the need of continuing education and developing professional skills throughout their live.

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. case study
N2. self study - self studies and preparation for examination
N3. multimedia presentation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Working in the semester, preparing master's thesis as a work.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Literature of the master's thesis topic agreed with the promoter.

SECONDARY LITERATURE
1. Kozłowski R.: Praktyczny sposób pisania prac dyplomowych; Wolters Kluwer Polska sp. z o.o. 2009;
2. Kalita C.: Zasady pisania licencjackich i magisterskich prac badawczych; Poradnik dla studentów; Wyd. ARTE 2011

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MASTER THESIS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W25, K1MBM_W30	C1 - C3		N1, N2, N4
PEK_U01 - PEK_U03	K1MBM_U41, K1MBM_U42, K1MBM_U45	C1, C2		N1 - N4
PEK_K01 - PEK_K03	K1MBM_K01, K1MBM_K04, K1MBM_K05, K1MBM_K06, K1MBM_K09	C1 - C3		N1 - N4

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie układów wieloczłonowych**
Name in English: **Modelling of multibody systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the theory of machines and mechanisms
2. Ability to analyze the kinematics and kinetostatics of mechanisms

SUBJECT OBJECTIVES

C1. Understanding of building of discrete computational multibody models
C2. Understanding the principles of planning research, taking into account the working conditions (kinematic excitations, dynamic excitations, forces, torques, masses in multibody dynamic analysis of computer systems
C3. Ability to critically assess the results of simulations of machinery in computer systems for dynamic analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Ability to apply professional computer system for simulating and analyzing dynamic multibody
PEK_U02 - The ability to model the loads and the nature of work and the ability to analyze the mechanism of the results of the simulation of the multi-segment
PEK_U03 - The ability to compute the kinematics and dynamics of selected groups of mechanisms

III. Relating to social competences:

PEK_K01 - Acquires care about the aesthetics of the work, including projects and reports
PEK_K02 - Knowledge of how to take responsibility for own work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of building a multibody models	2
Proj2	Basics of modeling mechanisms in the MD.Adams system - modeling links, kinematic pairs, kinematic excitations	3
Proj3	Basics of modeling mechanisms in the MD.Adams system - modeling loads and perform calculations and analysis of results	3
Proj4	The test of modeling multibody system	2
Proj5	Kinematic and kinetostatic analysis of linkage mechanisms - building virtual models	2
Proj6	The analysis of kinematic and dynamic properties of the linkage mechanism (project)	2
Proj7	Analysis of gears (normal, planetary and differential) - principles of construction of virtual model	2
Proj8	The analysis of kinematic and dynamic properties of the gears (project)	2
Proj9	Building models of manipulators - direct and inverse task of kinematics	2
Proj10	Simulation researches of manipulators (project)	2
Proj11	Building models of spatial mechanisms - constraints, excitations	2
Proj12	Modeling and simulations of spatial mechanisms (project)	3
Proj13	Modeling and simulations of spatial mechanisms - analysis of the results of calculations	3
		Total hours: 30

TEACHING TOOLS USED

N1. problem discussion
N2. project presentation
N3. self study - preparation for project class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K02	building the virtual model - test
F2	PEK_U02,PEK_U03, PEK_K01,PEK_K02	report, defence of the report
P = (1/5)F1+(4/5)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Gronowicz A. i inni: Teoria maszyn i mechanizmów. Zestaw problemów analizy i projektowania. Oficyna wydawnicza PWr. Wrocław 2000.
[2] Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna wydawnicza PWr. Wrocław 2003.
[3] Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007.

SECONDARY LITERATURE
[1]Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna wydawnicza PWr. Wrocław 1996.
[2] Miller S.: Układy kinematyczne. Podstawy projektowania. WNT 1988.
[3] MD. Adams – Reference Manual, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modelling of multibody systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_U04	C1	Pr1 to Pr4	N1
PEK_U02, PEK_U03	K2MBM_U05, K2MBM_U09	C2, C3	Pr5 to Pr13	N1, N2, N3, N4

PEK_K01, PEK_K02	K2MBM_K03, K2MBM_K05	C2, C3	Pr5 to Pr13	N1, N2, N3, N4

SUBJECT SUPERVISOR
dr inż. Monika Prucnal-Wiesztort tel.: 71 320-27-10 email: Monika.Prucnal@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania maszyn**
Name in English: **Fundamentals of Machinery Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to manufacturability of a design and manufacturing technologies.
2. Basic knowledge in the field of materials science and strength of materials.

SUBJECT OBJECTIVES

C1. Acquiring of knowledge of the heuristic methods of group and the individual designing.
C2. Acquiring of skills in the field of utilization of methodological tools in the initial stage of designing and algorithmic tools in the phase of purpose specifying.
C3. Acquiring of an ability of practical application of knowledge of designing, technology and organization.
C4. Acquiring of an ability to organize work in a team and to fulfil own specified tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a detailed knowledge of individual and group designing.
PEK_W02 - Has a detailed knowledge of existing tools used in the initial and the final stage of the designing process.
PEK_W03 - Has a detailed knowledge of the methods of assessment and classifying of developed concepts.

II. Relating to skills:
PEK_U01 - Can organize work for others in a project group, as well as fulfil the assigned tasks in the group.
PEK_U02 - Can search for information in the available literature on the techniques and methods of searching solutions in the designing process.
PEK_U03 - Can formulate guidelines for the designing process based on specific requirements and limitations.

III. Relating to social competences:
PEK_K01 - Can think creatively.
PEK_K02 - Can make a report of a carried out engineering work.
PEK_K03 - Can determine the consequences of decisions made in a group in which he works.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, assessment rules and literature. Creation of models of a real problem - the process and technological ones.	2
Lec2	Utilization of methods of more detailed characterization of designing goal in widespread technical systems (e.g. brake structures, recuperative units, steering mechanisms, etc.).	2
Lec3	Practical usage of heuristic and algorithmic methods: morphological table, tree of solutions, example and own design.	2
Lec4	Example and practice of system reconstruction.	2
Lec5	Synthesis - example and practice of process and system designing.	2
Lec6	Synthesis of own evaluation criteria.	2
Lec7	Classifying of significance of criteria.	2
Lec8	Organizing initial solutions.	2
Lec9	Assessment of preliminary designing solutions.	2
Lec10	Detailing of selected - pre-designed device or system.	2
Lec11	Selection of models - functional and analytical. Initial calculations.	2
Lec12	Documentation of the project.	2
Lec13	Remodelling of an own algorithm of designing.	2
Lec14	Methods of popularising solutions.	2
Lec15	Summary of the lectures and additional explanations.	2
		Total hours: 30
Form of classes – Project		Number of hours

Proj1	Scope of the project, rules of assessment, literature. Construction of object models (e.g. structures of: brakes, recuperation systems, steering mechanisms, etc.). Selection of the designing object.	2
Proj2	A practical usage of heuristic and algorithmic methods (morphological table, tree of solutions for own project).	2
Proj3	Synthesis of own evaluation criteria - example and practice. Classifying significance of criteria.	2
Proj4	Creating and managing initial solutions. Preliminary assessment of designing solutions.	2
Proj5	More detailed characterization of the selected pre-designed device.	2
Proj6	Preparation of technical documentation.	4
Proj7	Remodelling of an own algorithm of designing.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Final test. Participation in problem discussions.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of the project preparation. Presentation of the project.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Dietrich M. (red), Fundamentals of Machinery Design, PWN, Warszawa, editions after 2000 (in Polish).
[2] Dziama A. Methodology of Machinery Design, PWN, Warszawa, 1985 (in Polish).
[3] Góralski A. (red), Task, Method, Solution: Technics of Creative Thinking, WNT, Warszawa, 1977 (in Polish).
[4] Pahl G., Beitz W.: Engineering Design, WNT, Warszawa 1984 (in Polish).
[5] Skarbiński M., Skarbiński J.: Manufacturability of Machinery Design. PWN Warszawa 1982 (in Polish).

SECONDARY LITERATURE
[1] Dziama A. et al. (red),Fundamentals of Machinery Design, PWN, Warszawa, 2002 (in Polish).
[2] Kurmaz L. et al. Fundamentals of Machinery Design, PWN, Warszawa, after 2000 (in Polish).
[3] Kurmaz L. et al. Fundamentals of Machinery Design, PWN, Warszawa, after 2000 (in Polish).
[4] Norton R. L.: Machine Design: An Integrated Approach. 3/E. Prentice Hall, 2006.
[5] Pahl G., Beitz W. et al. Engineering Design. A Systematic Approach. Springer, 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machinery Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W06	C1	Lec1 - Lec15	N1, N2
PEK_W02	K2MBM_W06	C2	Lec1 - Lec15	N1, N2
PEK_W03	K2MBM_W06	C1, C2	Lec6 - Lec9	N1, N2
PEK_U01	K2MBM_U14	C2, C4	Proj1 - Proj6	N3
PEK_U02	K2MBM_U01	C3	Proj2	N3
PEK_U03	K2MBM_U07	C2, C3	Proj1	N2, N3
PEK_K01	K2MBM_K10	C1, C2	Proj1 - Proj4, Proj7	N3
PEK_K02	K2MBM_K03	C3	Proj1 - Proj6	N3, N4
PEK_K03	K2MBM_K05	C4	Proj1 - Proj5	N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Franciszek Przystupa tel.: 71 320-21-55 email: franciszek.przystupa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie maszyn i urządzeń**
Name in English: **Machines and devices control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of electronics, electrotechnics, automatics and the most common used control systems.
2. Student possess basic knowledge of calsic mechanics and fluid mechanics.
3. Student possess basic knowledge of consrtuction of simple hydraulic systems and components: pumps, motors, cylinders and valves.

SUBJECT OBJECTIVES

C1. Get knowledge and skills in area of construction and working and application principle of automatics devices (sensors, controllers, actuators, operator panel) and software in machines and devices.
C2. Acquaint students with working principle of electrohydraulic components with continous operation (proportional valves and servovalves) and its application in hydraulic drive systems.
C3. Acquaint students with control and regulations techniques selected parameters of hydraulic drive systems especiallyspeed of hydraulic actuator.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student schould be able to explane design rules, programm and starting the most common used machines control systems.
PEK_W02 - In the result of lesson student schould be able to explane design rules of machines equipped with hydraulic and electrohydraulic drive.
PEK_W03 - In the result of lesson student schould be able to call and describe advanced automatics systems equipped with different kinds of regulators.

II. Relating to skills:
PEK_U01 - In the result of lesson student schould be able to select apptioprate components machines control systems and programm control device to propertly realize specified functions.
PEK_U02 - In the result of lesson student schould be able to design and build hydraulic and electrohydraulic systems performing defined functions.
PEK_U03 - In the result of lesson student schould be able to prepare to operation electrohydraulic device and plan and execute tests. On the basis of tests results student schould be able to formulate appriopriate conclusions.

III. Relating to social competences:
PEK_K01 - Student can cooperate and work in the group during building hydraulic and electrohydraulic systems and during report preparation.
PEK_K02 - Student can plan and execute tests during laboratory.
PEK_K03 - Student can propertly identify and solve problems during program control systems and building hydraulic and electrohydraulic systems. Student can formulate appriopriate conclusions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Structure and types of control systems. Sensors, their typer, properties and examples.	2
Lec2	Requirements for automation systems, reliability and availability, MTBF	2
Lec3	Industrial controllers, modes of control systems working. PLC controllers, their constructions, operation, programming and application examples.	2
Lec4	Safety acpects in machines and devices, compatibility requirements, statements and standards, examples of sefety devices. Systems of industrial communication and dispersed control systems.	2
Lec5	Numerical control systemsCNC, their construction and operation, displacements measurement in CNC machine tool, functions of selected CNC systems assemblies, interpolation, position regulation, possibilities of NC programs generation, standard STEP-NC.	2
Lec6	Electrical servodrives (NC axies): analog and digital, their properties and examples. Linear direct drives.	2
Lec7	Control RC systems of industrial robots. Construction and types of industrial robots. Methods of industrial robots programming.	2
Lec8	Human-machine interfaces HMI, their functions, signals, symbols, requirements, control panels and HMI examples. Superior control systems, vizualizations systems and SCADA control systems.	2

Lec9	Methods of speed control of hydraulic actuator.	2
Lec10	Proportional valves as control components in systems.	2
Lec11	Hydraulic regulators and proportional directional control valves	2
Lec12	Logic valves in proportional technique.	2
Lec13	Load-sensing - systems, efficiencies.	2
Lec14	Controllers and regulators in hydraulic systems.	2
Lec15	Regulation systems with electrohydraulic servovalves.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Sensors in automation systems.	2
Lab2	Examples of logic systems.	2
Lab3	Construction of sequence control system.	2
Lab4	Continous regulation systems, controlles sets selection and regulation quality tests.	2
Lab5	Programming controllers freely programmed PLC.	2
Lab6	Numerical control systems of CNC machines tool.	2
Lab7	RC control systems of industrial robots.	2
Lab8	Reversible systems.	2
Lab9	Fast movement systems.	2
Lab10	Throttle-serial speed control of hydraulic actuator.	2
Lab11	Throttle-parallel speed control of hydraulic actuator.	2
Lab12	Volumetric speed control of hydraulic actuator.	2
Lab13	Hydraulic actuator control with proportional directional control valve.	2
Lab14	Hydraulic actuator control with Load-sensing directional control valve.	2
Lab15	Position regulation system with electrohydraulic servovalve.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. work at test stands for programm machines control devices.
N5. work at electrohydraulic test stand for student's individual systems building.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	oral response for practical verification of design, programm and building control systems.
F2	PEK_U03	report
F3	PEK_U01 PEK_U02 PEK_K01-PEK_K03	student's activity note.
P = (2F1+F2+F3)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Presentation – slides for lectures (electronic version),
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Tomasiak E.: Hydraulic and pneumatic drives and control (in polish). Wydawnictwo Polit. Slaskiej, Gliwice, 2001
Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.
Kosmol J.: Automation of machine tool and machining (in polish). WNT, 2000.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.
Norvelle F. D.: Electrohydraulic control systems. Prentice-Hall INC, New Jersey 2000.

SECONDARY LITERATURE

Legierski T., Wyrwał J., Kasprzyk J., Hajda J.: Programming PLC controllers (in polish). WNT, 1998.
Palczak E.: Dynamics of hydraulic components and systems (in polish). Wydawnictwo Ossolineum, Wrocław, 1999.
Honczarenko J.: Industrial robots: construction and application (in polish). WNT, 2004.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Machines and devices control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W04	C1 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N1
PEK_W02	K2MBM_W06	C2 C3	Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N1
PEK_W03	K2MBM_W04	C1 C3	Lec6 Lec11 Lec13 Lec14 Lec15	N1
PEK_U01	K2MBM_U13	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N2 N3 N4
PEK_U02	K2MBM_U09, K2MBM_U13	C2 C3	Lab8 Lab9 Lab10 Lab11 Lab13 Lab14	N3 N5
PEK_U03	K2MBM_U05, K2MBM_U11	C2 C3	Lab1 Lab4 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N5
PEK_K01	K2MBM_K03, K2MBM_K04, K2MBM_K10	C2 C3	Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N5
PEK_K02	K2MBM_K05, K2MBM_K10	C2 C3	Lab1 Lab4 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N4 N5
PEK_K03	K2MBM_K06, K2MBM_K10	C1 C2 C3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N4 N5

SUBJECT SUPERVISOR

dr hab. inż. Zygmunt Kudźma tel.: 71 320-45-99 email: zygmunt.kudzma@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika Analityczna**
Name in English: **Analytical Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041005**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differential and integral calculus)
2. Linear algebra (matrices, determinants), geometry, trigonometry
3. Mechanics I and mechanics II in range of study stage I

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of Lagrangian mechanics in the dynamics of mechanical holonomic systems (for systems with constrains depending and not depending from time). Knowledge of vibration analysis of linear holonomic conservative systems with many degrees of freedom.
C2. Knowledge of the dynamics of a rigid body in case of the spherical rotation about a fixed point. The using in to the gyroscope (in approximate theory range). Elementary knowledge of the theory of mass collisions (elastic and inelastic collision)
C3. Ability to independently analyze complex mechanical systems with a holonomic constrains which are not depend on time to determine : differential equations of movement, natural vibration frequency spectrum, the modal matrix. The ability of dynamic analysis of rigid bodies in case of the spherical rotation about a fixed point and gyroscope.
C4. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and socjety

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can define a discrete mechanical holonomic system and its possible and virtual displacements. He knows the fundamental problem of dynamics. He knows the classification of dynamical systems in respect of the constrain types. He knows the general equation of dynamics and the principle of virtual work.
PEK_W02 - He knows the notion of generalized coordinates and configuration space of a dynamical system. He knows the concept of generalized forces (active and inertia). He knows the Lagrange’s equations of the first and second kind.
PEK_W03 - He knows the variational interpretation of virtual displacements, the central equation of the dynamics and the Hamilton’s principle. He has an elementary knowledge of gyroscopic systems and collision theory.
II. Relating to skills:
PEK_U01 - He is able to apply the virtual work principle and d'Alembert’s principle for holonomic systems
PEK_U02 - He can derive the differential equations of motion of discrete dynamical systems by using Lagrange’s equations and by using the energy conservation law for conservative holonomic systems.
PEK_U03 - He can calculate the spectrum of natural frequencies and can determine the modal matrix for discrete conservative linear systems. He is able to analyze the dynamics of the gyro using the approximate theory (gyroscopic moment and reaction forces in the supports). He can calculate the collision coefficients in inelastic collision.
III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT	
Form of classes – Lecture	Number of hours

Lec1	Curriculum. Requirements. Examples of dynamic systems. Constrains and their types, classification systems for the sake of the constrain types (holonomic systems), possible velocities and possible displacements.	2
Lec2	The fundamental problem of dynamics, virtual displacement, the notion of ideal constraints, the general equation of dynamics, the virtual work principle.	2
Lec3	The dynamic general equation for the rotational and planar motion of rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples).	2
Lec5	Generalized forces. Configuration space. Lagrange's equations (of II type).	2
Lec6	Lagrange's equations (cont. examples, applications). Lagrangian.	2
Lec7	Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	2
Lec8	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes.	2
Lec9	Harmonically forced vibration, frequency characteristics, an example of oscillation analysis of two- degree- of- freedom system.	2
Lec10	The dynamics of a rigid body in general motion: the orientation, the recognition issue. Kinematics and dynamics of rigid body in case the spherical rotation about a fixed point (reminder of the course Mechanics II), the angular momentum in the general movement.	2
Lec11	The dynamic equations for general motion of rigid body (Euler's equation).	2
Lec12	Gyroscope (approximate theory).	2
Lec13	An outline of linear elastic particle collisions theory, inelastic collision rate.	2
Lec14	Variational approach of Lagrangian mechanics.	2
Lec15	The central Lagrange's equation. Fundamental integral mechanical principle (Hamilton's principle)	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements.	2
Cl2	Solving of static problems by using a principle of virtual work	2
Cl3	Solving of dynamic problems by using a dynamic general equation (d'Alembert' s principle).	2
Cl4	Derivation of motion differential equations based on the energy conservation law and Lagrange's equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl5	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl6	Solving some kinematic and dynamic problems in case of the spherical rotation about a fixed point of a rigid body.	2
Cl7	Final test	2
Cl8	Credits. Improvement of marks	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01- PEK_W03	written and oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. B. Gabryszewska, A. Pszonka, "Mechanics", part II, kinematics and dynamics, Wrocław University of Technology, 1988;
2. J. Zawadzki, W. Siuta, "General Mechanics", PWN, Warsaw, 1971;
3. B. Skalmierski, "Mechanics", PWN, Warsaw, 1982;
4. M. Lunn, A First Course in Mechanics, Oxford Science Publications, 1991

SECONDARY LITERATURE

1. M. Kulisiewicz St. Piesiak, "Methodology of modeling and identification of mechanical dynamical systems", WUT. , 1994;

2 J. Leyko, "General Mechanics", WNT, Warsaw, 1980;

3 J. Giergiel, "General Mechanics", WNT, Warsaw, 1980

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analytical Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_W01, K2MBM_W02	C1, C2	Lec 1 to Lec 15	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K2MBM_U02, K2MBM_U04	C3	Cl 1 to Cl 8	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K06	C4	Cl 1 to Cl 8	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Maciej Kulisiewicz tel.: 320-27-60 email: maciej.kulisiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie materiałów inżynierskich**
Name in English: **Design of engineering materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in such disciplines as: Materials science, Strength of materials, Manufacturing technology, processing and recycling of materials, design and examination methods of structure and properties of materials.
2. Skills in usage of technical data and specialized computer software.
3. Skills in collaboration with other users of engineering materials and specialists in the fields of design, manufacturing, processing, and application of materials.

SUBJECT OBJECTIVES

C1. Obtaining the skills in design of chemical composition and structure of engineering materials to produce products with desired mechanical and operational properties.
C2. Obtaining the skills in materials selection for technical applications.
C3. Obtaining the skills in failure analysis of materials and design of repair processes for improvement of products durability.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possesses advanced knowledge on structure- properties relationship as well as on strengthening mechanisms in materials and their practical usage for material design of products.
PEK_W02 - Knows the fundamentals and design philosophy of modern engineering materials.
PEK_W03 - Knows the criteria and methodology of materials selection and can participate in engineering design of products.

II. Relating to skills:
PEK_U01 - Able to design the materials structure in order to obtain the desired operational properties of product.
PEK_U02 - Able to select a material for a specific product with consideration of economical and ecological aspects.
PEK_U03 - Able to conduct the failure analysis of material and design the repair process for improvement of product durability.

III. Relating to social competences:
PEK_K01 - Possesses the collaboration skills and able to lead the research teams in engineering design process.
PEK_K02 - Is prepared to conduct the research on materials design of products.
PEK_K03 - Possesses the skills of objective evaluation of arguments and formulation of rational conclusions concerning the use of engineering materials for different products and operational conditions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to design of materials. Effect of chemical composition, processing and microstructure on properties of materials.	2
Lec2	Design of structure of material for specific working conditions.	2
Lec3	The role and significance of alloy phase diagrams in design of materials.	1
Lec4	Strengthening mechanisms in metals and alloys - theory and practice.	4
Lec5	The failure analysis - case study.	1
Lec6	Metal matrix composites - fundamentals in design.	3
Lec7	Criteria and quantitative methods of materials selection in engineering design.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Selection of material for chosen structural component - project, part I.	2
Proj2	Design of chemical composition of steel with desired hardenability.	2
Proj3	Design of microstructure of steel in the process of heat treatment - part I.	2
Proj4	Design of microstructure of steel in the process of heat treatment - part II.	2
Proj5	Individual materials expertise combined with selection of material - part I.	2
Proj6	Individual materials expertise combined with selection of material - part II.	3
Proj7	Selection of material for chosen structural component - project, part II.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. case study
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03	short test, oral answers, report, discussion
F2	PEK_U01÷PEK_U03;PEK_K01, PEK_K03	defence of project
P = 0,3F1+0,7F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

O. Wyatt, Introduction to Materials engineering; M.F. Ashby, Selection of Materials in Engineering Design, G.E. Totten, Steel Heat Treatment; 1.J.P. Schaffer, A. Saxena, S.D. Antolovich, T.H. Sanders, S.B. Warner: The science and design of engineering materials, WCB/McGraw-Hill, 1999; W. Dudzinski, Structural Materials in Machine Construction

SECONDARY LITERATURE

M.F. Ashby, D. Jones, Engineering Materials 2; W.F, Hosford, Physical Metallurgy

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of engineering materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_W05, K2MBM_W10	C1, C2	Lec1÷Lec7	N1, N2, N3
PEK_U01 - PEK_U03	K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C1, C2, C3	Pr1÷Pr7	N2, N3, N4
PEK_K01 - PEK_K03	K2MBM_K03, K2MBM_K06, K2MBM_K07, K2MBM_K09, K2MBM_K10	C2, C3	Pr1÷Pr7	N2, N4, N5

SUBJECT SUPERVISOR

dr inż. Krzysztof Widanka tel.: 320-37-00 email: krzysztof.widanka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria powierzchni**
Name in English: **Surface engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041007**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students should have a well-established expertise in manufacturing, especially machining treatments, as well as a basic understanding of measurements of geometric and surface.
2. Students should have a well-established knowledge of the technical drawing, mathematics, physics and materials science.
3. The student should be able to overall planning of the experiment and solve simple technical problems.

SUBJECT OBJECTIVES

C1. To provide knowledge about the possibilities of shaping and describing certain geometric and physical characteristics of the surface layer.
C2. Presentation of the influence of physical characteristics of the surface layer on its future, performance characteristics and the ability to modify the functional properties of the surface layer.
C3. Presentation of the ways to measure the geometrical and physical characteristics of the surface layer.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students should define the surface layer and its main features physical attributes and geometry.
PEK_W02 - Students should know the ability to modify the characteristics of the surface layer due to the expected performance characteristics.
PEK_W03 - Students should know the basic methods of coating.

II. Relating to skills:
PEK_U01 - The student should be able to analyze data from the literature, planning experiments and analyzing the results.
PEK_U02 - Students should have the ability to analyze and describe the physical and geometrical characteristics of the surface layer and the influence of these characteristics by modifying the operating characteristics of the surface layer.
PEK_U03 - The student should be able to use the devices for measuring the physical geometry and the surface layer of the object.

III. Relating to social competences:
PEK_K01 - Students should be able to work in a group and be aware of the responsibility of the collective work.
PEK_K02 - Students should understand the need for continuous learning and increasing their knowledge and skills with the changing technical and social considerations.
PEK_K03 - Students should be aware of coexistence and relations of knowledge and skills in many fields of science.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristic properties of the surface layer (SL) of an object	2
Lec2	The ways and test methods and measurement SL 2D and 3D roughness	2
Lec3	Functional features of the surface in operation of machinery and equipment	2
Lec4	Opportunities to develop surfaces with specific properties and chip and chipless methods	2
Lec5	Methods for modifying the physical and geometrical characteristics of SL with chipless methods	2
Lec6	The correlation between physical attributes and geometric properties of the SL and its functional features	2
Lec7	Coating	2
Lec8	Colloquium	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Analysis of surface changes in the machining process I	2
Lab2	Analysis of surface changes in the machining process II	2
Lab3	Measurement of shape and position of machine parts	2
Lab4	Measurement of physical characteristics of the surface layer	2

Lab5	Application of wavelet analysis, fractal and FFT to describe the condition of the surface	2
Lab6	The use of a vision system to measure the impact of protective coatings on cutting edges wear	2
Lab7	Mathematical modeling of surface structures	2
Lab8	Grading	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F2	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F3	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F4	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F5	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F6	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises

F7	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
P = (F1+F2+F3+F4+F5+F6+F7)7		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Burakowski T., Wierzchoń T, tytuł: Inżynieria powierzchni, wydawnictwo: WNT, Warszawa 2005

SECONDARY LITERATURE

1. Oczos K., Lubimov V., tytuł: Struktura geometryczna powierzchni. Podstawyklasyfikacji., wydawnictwo: Oficyna Wydawnicza Politechniki Rzeszowskiej, rok: 20032. Wieczorowski M., Cellary A., Chajda J., tytuł: Przewodnik po pomiarach nierównosci powierzchni czyli o chropowatości i nie tylko, wydawnictwo: Zakład WydawniczyM-Druk, Poznan, rok: 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Surface engineering** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechanical Engineering and Machine Building**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2MBM_W08	C1; C2; C3	Lec1 - Lec7	N1
PEK_U01; PEK_U02; PEK_U03	K2MBM_U05, K2MBM_U08, K2MBM_U11	C1; C2; C3	La1 - La7	N2; N3
PEK_K01; PEK_K02; PEK_K03	K2MBM_K05, K2MBM_K06, K2MBM_K07	C1; C2; C3	La1-La8	N2; N3

SUBJECT SUPERVISOR

dr inż. Maciej Kowalski tel.: 41-81 email: maciej.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**
Name in English: **Strength of materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041009**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the strength of uniform materials

SUBJECT OBJECTIVES

C1. Explanation of the nature and consequences of distinct behavior of non-uniform materials, with particular regard to metallic materials including fractures and/or exposed to subcritical fracture development and materials fracturing due to deformations located in shear bands
C2. Adoption of the criteria and assessment principles for material resistance to development of brittle fracture and the criteria for controlling plastic fracture development and the criteria for creep fracture
C3. Presentation of the possibilities and principles of practical application of the acquired knowledge for the purposes of preventing catastrophic brittle fracture development, preventing and/or controlling shear and creep fracture and for the purposes of predicting and evaluating durability, quality improvement and reliability determined by the above-mentioned types of fracture

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The students are able to determine the potential causes and effects of particular types of material fracture, and propose a method to address the problem
PEK_W02 - The students are able to propose the assessment methodology for material resistance to fracture, and use the obtained results to select a method to prevent the potential consequences of brittle, ductile and creep fracture
PEK_W03 - The students are able to evaluate the differences between, and results of particular types of damage and propose actions which delay and/or eliminate the most dangerous material damage, i.e. fracture. In other words, the students have basic impact on the quality of production processes, reliability and durability of finished products, and thereby on safety and the costs of production, exploitation, monitoring and renovations

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The principles of the analysis of potential damages and their consequences. Risk assessment criteria. The importance of the knowledge about damage mechanism.	2
Lec2	Maps of strain, local damage and material fracture mechanisms	2
Lec3	Introduction to the mechanisms of brittle fracture	2
Lec4	The methodology for testing resistance to catastrophic fracture development in plane strain condition (KIC) and plain stress condition (Kc). The methodology for testing COD and the J-integral	2
Lec5	The possibilities and principles of practical application of KIC for the purposes of predicting and preventing catastrophic fracture development	2
Lec6	Application of the criteria of yield before fracture and leak before fracture as a method to avoid catastrophic fracture development. The principles of using material properties diagrams (KIC-R0,2)	2
Lec7	The strain rate as a criterion for the assessment of material resistance to creep. The factors affecting the strain rate during creep	2
Lec8	The methods for predicting and evaluating the durability of materials working in creep conditions	2
Lec9	Introduction to the mesomechanics of fracture caused by the location of strains in shear bands	2
Lec10	The criteria and principles of preventing and/or controlling fracture caused by the location of strains in shear bands. Examples of practical applications	2
Lec11	The diagrams of yield strains depending on the location of strains and the fracture of materials during their cold-working	2
Lec12	The principles of using the forming limit diagrams to solve typical technical issues.	2
Lec13	The maps of strain mechanisms and the mechanisms of fracture of hot-working materials. The principles of using the maps to prevent fracture	2

Lec14	The principles and examples of multicriteria selection of materials. The definition and meaning of material index	2
Lec15	The causes and effects of properties degradation due to the processing and exploitation of materials in particular conditions. The methodology for testing the degree of degradation of the mechanical properties of a material and its impact on the assumed durability of a technical structure (examples)	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01, PEK_W02, PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Neimitz A.: Mechanika pękania. PWN, Warszawa 1998.Ashby F. M.: Materials selection in mechanical design. Elsevier 2005.Dzidowski E. S.: Mechanizm pękania poślizgowego w aspekcie dekohezji sterowanej metali. Wyd. PWr., Wrocław 1990.Dzidowski E. S.: Physical concept of shear fracture mesomechanism and its applications. Central European Journal of Engineering, 2011, nr 1(3), s. 217-233.Dzidowski E. S.: Jak projektować, wytwarzać i eksploatować rury do bezpiecznej pracy pod ciśnieniem. Rudy i Metale, 2008, nr 11, s. 714-721.

SECONDARY LITERATURE

Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_W03	C1,C2,C3		N1,N2

SUBJECT SUPERVISOR
dr hab. inż. Edward Dzidowski email: edward.dzidowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania elementów i zespołów maszyn**
Name in English: **Testing of Elements and Assemblies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has ordered knowledge of mathematics and the laws of physics, mechanics.
2. Student is able to use and retrive information from the literature and the Internet.

SUBJECT OBJECTIVES

C1. Knowledge of research methods used in solid mechanics.
C2. Knowledge of test equipment and measuring.
C3. Knowledge of registration and processings of measurement results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can choose the right measurement method based on the test piece of machinery and carry out a measurement.
PEK_U02 - Student can prepare a report and discussion the results.

III. Relating to social competences:
PEK_K01 - Student is able to think and act creatively.
PEK_K02 - Student is able to work on tasks independently and in groups.
PEK_K03 - Student understands the need and knows the possibility of lifelong learning.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Non-contact determination of the spatial structure and shape of the surface.	2
Lab2	Holographic interferometry application in displacements measurements of machine elements.	2
Lab3	Speckle photography application in solids investigations.	2
Lab4	Application of electronic speckle pattern interferometry (ESPI) to examine of machine parts	2
Lab5	Application of photoelasticity method in experimental design of machine elements.	2
Lab6	Investigations of machine elements using photoelasticity coating method.	2
Lab7	Determine of fluid velocity distribution using laser method.	2
Lab8	Measurement of the geometry of machine elements using navigation system.	2
Lab9	Strain gage method application in machines testing.	2
Lab10	Performance testing of the propulsion system overhead traveling crane winch.	2
Lab11	Automatic evaluation of defective butt welded joints.	2
Lab12	Measurement and analysis of noise.	2
Lab13	Fuel consumption as a function of engine load.	2
Lab14	Loading of load-carrying structure of overhead travelling crane.	2
Lab15	Research static and dynamic characteristics of wheels.	2
		Total hours: 30

TEACHING TOOLS USED

N1. tutorials
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U02, PEK_K01- PEK_K03	Lab exercise reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Orłoś Z., Doświadczalna analiza odkształceń i naprężeń, PWN, Warszawa 1977 (in Polish).
Szczepiński W., Metody doświadczalne mechaniki ciała stałego, PWN, Warszawa1984 (in Polish).
Będziński R., Biomechanika inżynierska. Zagadnienia wybrane, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997 (in Polish).
Roliński Z., Tensometria oporowa: podstawy teoretyczne i przykłady zastosowań, WNT, Warszawa 1981 (in Polish).

SECONDARY LITERATURE
J.W. Dally, Experimental Stress Analysis, College House Enterprises Llc, 2005.
Beckwith T.G., Mechanical Measurements, Prentice Hall, 1995.
Rastogi K., Optical Measurement Techniques and Applications., Artech House, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Testing of Elements and Assemblies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2MBM_U05, K2MBM_U11, K2MBM_U12	C1, C2, C3		N1, N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2MBM_K10	C1, C2, C3		N1, N2, N3, N4

SUBJECT SUPERVISOR
dr inż. Sylwia Szotek tel.: 71 320-29-83 email: Sylwia.Szotek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zintegrowane systemy wytwarzania**
Name in English: **Integrated manufacturing systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possess a knowledge on methods and technique of manufacture and base of industrial engineering
2. Able to design a process of manufacture by machining and chip-less methods
3. Possess a knowledge on CAD, CAM CAPP systems, able to use CAD/CAM programs

SUBJECT OBJECTIVES

C1. Cognition of informatics systems of an enterprise and a sense of well-ordered flow of part information
C2. Cognition of advanced, engineering techniques and tools allowing to resolve of problems, manufacturing system improvement and rules their integration
C3. Cognition of informatics platforms used for manufacturing process integration

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define tasks of informatics subsystem for manufacturing processes by machining ad chip-less methods
PEK_W02 - Able to select of proper programs aiding of engineering, assuring information flow consistency
PEK_W03 - Able to indicate sources of manufacture disturbances and efficient organizing of the process

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Know role of man in integrated manufacturing systems
PEK_K02 - Able to teem working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scale of production, sources of manufacture disturbances, importance of efficient process organization	2
Lec2	Activity fields of the enterprise and related specific informatics sub systems, planing and control of enterpice activities (PPC), Preparing production areas and manufacturing areas (CAD?CAPP/CAM)	2
Lec3	Subsystems of manufacturing, aims and task of integration, connection of inhomogeneous components as a whole for improvement of effectiveness of production course in disturbances and variable conditions of manufacture	2
Lec4	Conception of computer integrated manufacture, platforms of integration	2
Lec5	Methods of creation of technological and business knowledge and proper knowledge bases supported decision making	2
Lec6	Data flow between CAD and CAM systems. Methods of aiding of design and technology records defined rules of integrated product model creation, comprising design and technological features	2
Lec7	Informatics architecture of integrated system of manufacture, informatics strategy, CIM, integration of technical and organizational features aiming efficient product manufacture	2
Lec8	Integration of CAX systems as base for integration systems of manufacture	2
Lec9	Process planing (CAPP) in the frame of integrated systems	2
Lec10	Integrated design and concurrent engineering, the role in manufacturing preparation time shortening, common features, differences	2
Lec11	Specific features of chip-less methods in CAD/CAM and CAPP systems, the role of external CAE systems and expert systems	2
Lec12	Linear and batch production, methods of production smoothness ensure, synchronization and balance of production, manufacturing nests and flexible manufacturing systems	2
Lec13	Integrated CAD/CAM/CAE programs, designing and product live cycle management (PLM)	2
Lec14	Enterprice models, visualization of information flow	2

Lec15	Business and engineering areas integration, problems with exchange of different type of information, development of exchange information on product systems, standard IS95.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_K01 - PEK_K02	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Griffin R. W., Management footing of organizations, PWN, Warszawa 2007.
Pająk E., Production managemet. Product, technology, organization., PWN, Warszawa
Lisowski E., Axiomatization and integration of designing tasksTech. PK publishing, Krakow, 2007
E. Chlebus; CAX computer techniques in engineering. WNT 2000.
Kasprzak T. (ed.), Reference models in business management, Difin, Warszawa 2005,

SECONDARY LITERATURE
Hobbs, Chris. A practical approach to WBEM / CIM management / Boca Raton [etc.] : Auerbach, cop. 2004.
Walsh R. A., tytuł: McGraw-Hill machining and metalworking handbook,
McGraw-Hill, 2006
Talavage, Joseph. Flexible manufacturing systems in practice : applications, design, and simulation / New York ; Basel : Marcel Dekker, 2010.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Integrated manufacturing systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W03	K2MBM_W04, K2MBM_W06, K2MBM_W07, K2MBM_W09	C1, C3	Lec1 - Lec3, Lec5, Lec12 - Lec15	N1, N2, N3
PEK_W02	K2MBM_W05, K2MBM_W06, K2MBM_W07	C1 - C3	Lec4, Lec6 - Lec11, Lec13, Lec14	N1, N2, N3
PEK_K01- PEK_K02	K2MBM_K04, K2MBM_K10	C1 - C3	lec1-15	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Adam Niechajowicz tel.: 40-49 email: adam.niechajowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Dynamika maszyn roboczych i pojazdów**
Name in English: **Dynamics of working machines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041103**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	30	
Number of hours of total student workload (CNPS)	60		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of analytical mechanics, linear algebra and differential equations confirmed by completion of relevant courses at university level
2. Has basic knowledge of drive systems for machinery and vehicles
3. Has basic knowledge of the theory of vehicle movement

SUBJECT OBJECTIVES

C1. Consolidate and increase knowledge of the dynamic phenomena occurring in the working machines and vehicles
C2. Acquire skills to solve engineering problems related to the dynamics of working machines and vehicles
C3. To gain the habit of caring about the aesthetics of the work, including projects and reports, and consolidate the awareness of second-degree graduate, as a future leader

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has consolidated and expanded knowledge of dynamics of systems with one degree of freedom, many degrees of freedom and continuous
PEK_W02 - has expanded and consolidated knowledge of ways to minimize vibrations and the dynamics of working machines
PEK_W03 - has expanded and consolidated knowledge of vehicle dynamics

II. Relating to skills:
PEK_U01 - is able to apply the appropriate computational methods and appropriate computer programs for vibration analysis and dynamic phenomena in mechanical devices
PEK_U02 - is able to shape and modify the dynamic properties of working machines and vehicles according to the needs
PEK_U03 - is able to plan and carry out experiments for identifying some dynamic properties of various working machines and vehicles

III. Relating to social competences:
PEK_K01 - has expanded the competence in care about the aesthetics of the work, including projects and reports
PEK_K02 - has consolidated the awareness of second-degree graduate, as a future leader

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Dynamics of mechanical linear systems with one degree of freedom	2
Lec2	Dynamics of mechanical linear systems with finite amount of degrees of freedom	2
Lec3	Dynamics of continuous mechanical systems	2
Lec4	Classical and operational modal analysis	2
Lec5	Nonlinear dynamics - selected issues	2
Lec6	Classical methods of vibration isolation. Tuned mass damper	2
Lec7	Active and semi-active vibration isolation	2
Lec8	Selected methods of description and analysis of random vibrations. Stochastic description of road surfaces irregularities	2
Lec9	Vertical dynamics of vehicles	2
Lec10	Longitudinal vehicle dynamics	2
Lec11	Lateral Vehicle Dynamics	2
Lec12	Dynamics and vibration in powertrains in vehicles systems and working machines	2
Lec13	Mitigation and damping of noxious vehicle movements	2
Lec14	Selected problems the dynamics of cranes	2
Lec15	Vibration machines - vibrators	1
Lec16	Selected problems of dynamics of rotating machinery	1
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Experimental determination of the moments of inertia of machines and their components	2
Lab2	Identification of the dynamic model of crane girder with use of classical experimental modal analysis	2
Lab3	Testing of dynamic effects in the steering system of industrial vehicle	2
Lab4	Testing of a dynamic properties of pneumatic nonlinear vibroisolation system	2
Lab5	Testing of a effectiveness load sway damping system for overhead crane	2
Lab6	Testing of a dynamic properties of mobile working machine manipulator	2
Lab7	Testing of a vibration stability system for unsprung wheeled vehicle	2
Lab8	Testing of dynamic load of a crane caused driving on uneven track	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Analysis of the work of a given crane and familiarization with a norms refer to dynamic calculations of this type of machines	2
Proj2	Building a simple mathematical model that allows approximate analysis of selected dynamic phenomena occurring during the operation of a given crane	2
Proj3	Building a crane simulation model that takes into account, inter alia, rope flexibility and stiffness of the rail-wheel contact	2
Proj4	Simulation studies of selected dynamic phenomena occurring during crane operation. Interpretation of the results with respect to current standards	2
Proj5	Simulation studies of the impact of applied solutions on dynamics of virtual crane	2
Proj6	Analysis of construction and operating conditions of given industrial wheeled vehicle. Familiarization with selected standards referring to the dynamics of this type of machines	2
Proj7	Building a simple mathematical model that allows approximate analysis of selected dynamic phenomena occurring during the operation given industrial vehicle	2
Proj8	Building the simulation model of given industrial wheeled vehicle	2
Proj9	Simulation studies of selected phenomena and dynamic characteristics of an object such as: snaking, angular oscillations and dynamic stability	2
Proj10	Simulation studies the impact on the dynamics of the test vehicle different structural changes	2
Proj11	Getting acquainted with construction and analysis of operation of the given machine as a source of excessive vibration	2
Proj12	A preliminary assessment of the possibility of minimizing vibration of given machine supported by relevant calculations	2
Proj13	Building of simulation models of given machine redesigned in order to reduce vibroactivity	2
Proj14	Simulation study of effectiveness of solutions used to minimize vibrations	2
Proj15	Presentation of the results obtained by students. Preparation of the report	2
		Total hours: 30

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for project class
N4. self study - preparation for laboratory class
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U03, PEK_K01÷PEK_K02	short tests, laboratory reports
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02÷PEK_U03, PEK_K01÷PEK_K02	Rating developed models and reports from the undertaken calculations and analysis
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Bereś W.: Dynamika pojazdów i maszyn roboczych ciężkich. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1983r.[2] Giergiel J.: Drgania Mechaniczne. Wydawnictwo AGH, Kraków 2000r

SECONDARY LITERATURE
[1] Uhl T.: Komputerowo wspomagana identyfikacja modeli konstrukcji mechanicznych. WNT, Warszawa 1997r. [2] Kaliski S.: Drgania i fale. PWN, Warszawa 1986r.[3] Randall R. B., Tech B.: Frequency Analysis. Brüel and Kjær 1987r.[4] Dudek D.: Elementy dynamiki maszyn górnictwa odkrywkowego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1994r.[5] Dudziński Piotr: „Lenksysteme für Nutzfahrzeuge - Theorie und Praxis", Springer 2005r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dynamics of working machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W02	C1	Lec1÷Lec5	N2, N5
PEK_W02	K2MBM_KE_W02	C1	Lec6, Lec7, Lec12, Lec14÷Lec16	N2, N5
PEK_W03	K2MBM_KE_W02	C1	Lec8÷Lec13	N2, N5
PEK_U01	K2MBM_KE_U01	C2	Pr1÷Pr15	N2, N3
PEK_U02	K2MBM_KE_U01	C2	Pr5, Pr10÷Pr15	N2, N3
PEK_U03	K2MBM_KE_U01	C2	La1÷La8	N1, N2, N4
PEK_K01	K2MBM_K03	C3	La1÷La8, Pr1÷Pr15	N2
PEK_K02	K2MBM_K07	C3	Pr1÷Pr15	N2, N3

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Problemy smarowania i zużywania maszyn**
Name in English: **Lubrication and wear problems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a structured understanding of the physical and physicochemical processes occurring in the tribological nodes .2. It has a basic knowledge of the mechanics of continuous media, including the basics of fluid mechanics and flow issues.
2. Skills: 1 It has the ability to apply fundamental fluid mechanics for the fluid flow and its use in art.
3. Social competence: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineering, including its impact on the environment and the associated responsibility for their decyzje.2.Potrafi think in an entrepreneurial manner.

SUBJECT OBJECTIVES

C1. Acquire advanced theoretical knowledge of tribological wear and its type.
C2. Detailed understanding of the types of lubricants, their tribological properties and rheology.
C3. Gaining an ability to select the type and amount of lubricant to lubrication friction and knowledge of the fundamentals of circuit design and environmental aspects of lubrication lubrication assemblies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has detailed knowledge of the tribological wear of materials used in the nodes of friction.
PEK_W02 - He has detailed knowledge of lubricants, their tribological properties and rheology.
PEK_W03 - He has detailed knowledge of the ways of lubricating oils and greases plastic and basic knowledge on lubrication system design.

II. Relating to skills:
PEK_U01 - He can select materials for friction nodes.
PEK_U02 - He can choose the type and amount of lubricant to friction nodes.
PEK_U03 - He can design a simple installation lubrication and define the basic parameters that will determine its reliable functioning.

III. Relating to social competences:
PEK_K01 - He can think and act creatively.
PEK_K02 - It can objectively evaluate the arguments rationally explain and justify their own point of view, using the knowledge gained during lectures and laboratory exercises.
PEK_K03 - It can work, search for information and critically analyze them, both individually and collectively.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Terms and organization of classes, framework programs, the terms of credit. Introduction to lubrication and wear in the construction and operation of machinery.	2
Lec2	Tribological wear. Terms: adhesion of the surface layer, the surface free energy. Work of adhesion.	2
Lec3	Types and characteristics of lubricants. Properties and application of lubricants. The testing of lubricants (including lubricity, mechanical stability, service life and thermal stability).	2
Lec4	Basic rheology of lubricants. Capillary and rotational rheometry. Rheological greases steady flow conditions and with the use of methods for dynamic oscillation. Linear viscoelasticity.	2
Lec5	Methods of lubrication. Selection of the type and amount of lubricant for the lubrication of friction.	2
Lec6	Process automation lubrication. Construction of central lubrication systems. Examples of applications for central lubrication systems in various industries.	2
Lec7	Basic design of lubrication. The environmental aspects of lubrication assemblies.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Test of resistance to abrasive wear of the materials used in the nodes of friction.	2

Lab2	Measurement of density and viscosity of lubricating oils. Determination of the viscosity index of lubricating oils.	2
Lab3	Lubrication of slioding bearings. Determination of the frictional characteristics of the cross slide bearing. Evaluation of the impact of oil viscosity on the process of hydrodynamic lubrication.	2
Lab4	Determining the properties of lubricating greases.	2
Lab5	Measuring the degree of penetration of lubricating greases and study the rheological properties of lubricating greases (compilation flow curves, determination of yield stress).	2
Lab6	Research on the influence of the wall material for the formation of a boundary layer greases in the lubricant.	2
Lab7	Studies on impact of length, diameter and shape of circular pipe pressure drop in lubricants arts.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class
N5. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_K01 - PEK_K03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Krawiec S. Kompozycje smarów plastycznych i stałych w procesie tarcia stalowych węzłów maszyn. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011. [2] Płaza S., Fizykochemia procesów tribologicznych. Wydawnictwo Uniwersytetu Łódzkiego, Łódz 1997. [3] Bartz W., J., Schmierfette, Renningen-Malmsheim, expert-Verlag, 2000. [4] Bartz W., J.,Getriebe-schmierung. Ehningen bei Bóblingen, expert-Verlag 1989. [5] Czarny R., Smary plastyczne. Wydawnictwo Naukowo-Techniczne, Warszawa 2004. [6] Czarny R., Systemy centralnego smarowania maszyn i urządzeń. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000. [7] Wysocki M., Systemy smarownicze w przemyśle ciężkim. Wydawnictwo Śląsk, Katowice 1971. [8] Laboratory manuals available on the website of the Department PKMiT.

SECONDARY LITERATURE

[1] Froischteter G. B, Trilisky K. K., Ishchuk Yu. L., Stupak P. M., Rheological and thermophysical properties of greases. Gordon & Breach Science Publishers, Londyn 1989. [2] Ishchuk Yu. L., Lubricating grease manufacturing technology. New Age International Limited Publishers, New Delhi 2005. [3] Ferguson J., Kembłowski R., Reologia stosowana płynów. Wydawnictwo Marcus, Łódź 1995. [4] Matras Z., Transport reologicznie złożonych cieczy nienewtonowskich w przewodach. Wydawnictwo Politechniki Krakowskiej, Kraków 2001. [5] Garkunov D. N., Tribotechnika. Masinostroenie, Moskva 1985. [6] Kosteckij B. I., Trenie, smazka i iznos w masinach. Izdatelstvo Technika, Kiev 1970. [7] Lawrowski Z., Tribologia - tarcie, zużywanie i smarowanie. Wydawnictwo Naukowe PWN, Warszawa 1993. [8] Płaza S., Margielewski L., Celichowski G., Wstęp do tribologii i tribochemia. Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Lubrication and wear problems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W03, K2MBM_W05, K2MBM_W08	C1	Lec1, Lec2	N1, N2, N3
PEK_W02	K2MBM_KE_W03, K2MBM_W05	C2	Lec3, Lec4	N1, N2, N3
PEK_W03	K2MBM_KE_W03, K2MBM_KE_W06, K2MBM_W05	C3	Lec5, Lec6, Lec7	N1, N2, N3
PEK_U01	K2MBM_U05, K2MBM_U07, K2MBM_U14	C1	Lab1	N3, N4, N5
PEK_U02	K2MBM_U05, K2MBM_U07, K2MBM_U14	C2, C3	Lab2 - Lab5	N3, N4, N5
PEK_U03	K2MBM_KE_U03, K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C3	Lab5 - Lab7	N3, N4, N5

PEK_K01	K2MBM_K01, K2MBM_K07, K2MBM_K10	C1, C2, C3	Lab1 - Lab7, Lec1- Lec7	N1 - N5
PEK_K02	K2MBM_K01, K2MBM_K07	C1, C2, C3	Lab1 - Lab7, Lec1- Lec7	N1 - N5
PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K07, K2MBM_K10	C1, C2, C3	Lab1 - Lab7, Lec1- Lec7	N2, N4, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Stanisław Krawiec tel.: 71 320-40-56 email: Stanislaw.Krawiec@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Synteza układów mechanicznych**
Name in English: **SYNTHESIS OF MECHANICAL SYSTEMS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041106**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in mathematical analysis and classical mechanics.
2. Knowledge of fundamental the theory of mechanisms and machines.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge allowed to choice of the optimal kinematic scheme of a mechanism - designed to fulfill the specified requirements.
C2. Skill in geometrical synthesis ofchosen linkages and cam mechanisms.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of forms of mechanisms' structure notation.
PEK_W02 - Knowledge of fundamental methods of type synthesis of kinematic systems.
PEK_W03 - Knowledge of fundamental methods of gepmetrical synthesis of kinematic systems.

II. Relating to skills:
PEK_U01 - Student is able to create set of mechanism schemes.
PEK_U02 - Student is able to carry out geometrical synthesis of linkage mechanism.
PEK_U03 - Student is able to design cam mechanisms and planetary gears.

III. Relating to social competences:
PEK_K01 - Purchasing care about the aesthetics of the work, including projects and reports.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Forms of mechanisms' structure notation.	2
Lec2	Methods of type synthesis, set of possible solutions creation.	2
Lec3	Criteria and selection of optimal structure solution.	2
Lec4	Criteria and selection of optimal structure solution.	2
Lec5	Methods of dimensional synthesis of linkages mechanisms.	3
Lec6	Methods of dimensional synthesis of adjustable mechanisms.	2
Lec7	Synthesis of mechanisms with higher pairs.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Analysis of topology of kinematics systems. Rattionality of mechanism topology (test and project).	2
Proj2	Methods of notation of topology (test and project).	2
Proj3	Type synthesis. Making of possible sets of the solutions (test).	2
Proj4	Type synthesis cont. Selection for optimal solution (project).	2
Proj5	Dimensional synthesis of linkages mechanisms (test and project).	3
Proj6	Synthesis of mechanisms with higher pairs.	2
Proj7	Synthesis of planetary gears (project).	2
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. traditional lecture with the use of transparencies and slides
N3. problem exercises
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W01, PEK_W01	exam
P = ocena z egzaminu		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	tests, project discussion
P = średnia ocen z kartkówek i projektów		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
SYNTHESIS OF MECHANICAL SYSTEMS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01 - PEK_W03	K2MBM_KE_W04	C1-C2	L1-L7	N1-N2
PEK_U01- PEK_U03	K2MBM_KE_U04	C1-C2	Pr1-Pr7	N3-N4
PEK_K01	K2MBM_K03	C1-C2	L1-Wy7, L1-Pr7	N1-N4

SUBJECT SUPERVISOR

dr inż. Sławomir Wudarczyk tel.: 71 320-27-10 email: Slawomir.Wudarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza stanów ustalonych i nieustalonych układów hydraulicznych**
Name in English: **Analysis stable and transient states of hydraulic systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041124**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics. Basic knowledge of the construction of hydrostatic and pneumatic power systems, knowledge about relations present in this type of power systems.
2. Knowledge of the principle of operation, construction, basic parameters and the role the individual components in hydrostatic or pneumatic power system.
3. Ability to formulate conclusions based on its observations and laboratory tests. Willingness extend knowledge of a more complete description of the phenomena occurring in hydraulic and pneumatic systems.

SUBJECT OBJECTIVES

C1. To acquaint students with extended and more complete mathematical description of systems taking into account the dynamic phenomenas occurring in the hydraulic and pneumatic power systems. Provide students with the mathematical description and the real waveforms of the basic parameters of power systems, demonstrate the convergence of the results obtained from the presented mathematical models with the results recorded during the test of real systems.
C2. To acquaint students with extended descriptions of individual components of hydraulic and pneumatic systems. Presentation of the dynamic characteristics of selected system components. Pointed the corelation and description of the interaction between system components together with an indication characteristic dynamic correlations of those connections. Indication of the risks and benefits of presence of the dynamic phenomena in the hydrostatic and pneumatic power systems as well as the acquisition of skills of preventing the occurrence of adverse dynamic effects.
C3. Exercise team working skills and to formulate written conclusions based on laboratory experiment. Identify the phenomenas based on selected and measured characteristic values of hydraulic and pneumatic systems or components.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student can describe the dynamic interactions in hydraulic and pneumatic systems. Can describe the impact of dynamic phenomena in these systems. Student be able to list, identify the cause and source of the differences in the operation of systems working in steady and unsteady conditions. Student be able to define the benefits and risks of dynamic interactions occurring during work in the unsteady conditions.
PEK_W02 - The student knows the dynamic characteristics of selected elements of hydraulic and pneumatic systems. Students can indicate the influence of parameters of selected elements on the operating characteristic of the entire system and is able to make informed and positive changes the individual components for prevent the negative effects of dynamic interactions or to improve the functioning of the system.
PEK_W03 - The student can described by mathematical models of the hydraulic and pneumatic systems working in steady and unsteady state. The student on the design stage uses mathematical models mentioned above to identify the risks resulting from dynamic interactions in the system.

II. Relating to skills:
PEK_U01 - The student analyzes the performance, characteristics, and the impact of the different components of hydraulic and pneumatic systems on the character of the work of the whole system. The student performs laboratory testing of individual components, which results are the part of the written reports.
PEK_U02 - The student analyzes the character of the work of the example hydraulic and pneumatic systems. The student independently identifies the state of the system and determines the extent to which the volatility of the selected parameter this state persists. Student, based on the results of the experiment, independently draws conclusions.
PEK_U03 - Student analizuje, na podstawie teoretycznej wiedzy zdobytej na wykładach, rodzaju i charakteru zjawisk zachodzących w elementach i całych systemów hydraulicznych i pneumatycznych, które są badane w laboratorium. Na podstawie wyników doświadczalnych sprawdzenia wiedzy teoretycznej, formułując wnioski w pisemnym sprawozdaniu.

III. Relating to social competences:
PEK_K01 - A student takes part in the work of the group of students, the goal of which is the joint planning and proper perform of a laboratory experiment.
PEK_K02 - Students practice skills to present the results of their work in writing and orally.
PEK_K03 - The student independently makes the selection and compiled the acquired theoretical knowledge with the results of a laboratory experiment.

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Introduction, presentation of the lecture content, requirements and forms of the completion. Pulsation flow and pressure - the sources , the reduction of the pressure pulsation amplitudes.	2
Lec2	The methods of calculation and modeling of unsteady flow in the hydraulic lines.	4
Lec3	Basic concepts describing the condition of the elements and the whole hydraulic system. The principle of models construction for lumped and distributed parameters.	2
Lec4	The steady operating status of hydraulic components (pumps, motors, valves) - ideal and real characteristics.	2
Lec5	Indicators describing the dynamic quality of the component of the hydraulic system.	2
Lec6	The steady operating status of the hydrostatic transmission - the ideal and the real characteristics.	2
Lec7	The dynamic models of the hydraulic valves.	2
Lec8	Analysis of the simplifying assumptions impact on the accuracy of the representation actual object by the model.	2
Lec9	Comparison of the characteristics of the hydrostatic power system during the starting phase with and without the participation of the maximum valve.	2
Lec10	Analysis of the system startup process with the hydro-pneumatic accumulator.	2
Lec11	The inhibition of the hydrostatic power system.	2
Lec12	The hydraulic long line - the resonance phenomenon.	2
Lec13	Methods of shaping hydraulic transient processes. Methods to prevent the adverse effects caused by transition phases in the machine with hydrostatic power system.	2
Lec14	Completion of the course.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	Determination of static and dynamic characteristics of the relief valve.	2
Lab3	Experimental identification of the pressure pulsation components in the hydraulic system.	2
Lab4	The experimental determination of the frequency characteristic of the proportional valve.	2
Lab5	The experimental determination of the frequency characteristic of the electrohydraulic amplifier.	2
Lab6	Mitigation method of the start phase of the hydrostatic system using the proportional valve.	2
Lab7	The impact of the hydro-pneumatic accumulator on the start phase of the hydrostatic system.	2

Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for laboratory class
N4. laboratory experiment
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	oral response, participation in problems discussions
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	laboratory reports, participation in problems discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Tomasiak E.,The drives and controls systems of the hydraulic and pneumatic, Wydawnictwo Polit. Slaskiej, Gliwice 2001, (in Polish)
2.Tomczyk J.,The dynamic models of components and systems of the hydrostatic drives, Wydawnictwa Naukowo-Techniczne, Warszawa 1999, (in Polish)
3. Palczak E., The dynamic of the hydraulic components and systems, Wydawnictwo Ossolineum, Wrocław 1999, (in Polish)
4. Stryczek S., Hydrostatic drive, Wydawnictwa Naukowo-Techniczne, Warszawa 1992, (in Polish)

SECONDARY LITERATURE

1. Pizon A.,Hydraulic and electro-hydraulic control and regulation systems, Wydawnictwa Naukowo-Techniczne, Warszawa 1987, (in Polish)
2. Kollek W., Basics of the designing hydraulic drives and controls, Oficyna Wydawnicza Polit. Wrocławskiej, Wrocław 2004, (in Polish)
3. Osiecki A., The hydrostatic drive of machines, Wydawnictwa Naukowo-Techniczne, Warszawa 2004, (in Polish)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analysis stable and transient states of hydraulic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_KE_W02, K2MBM_KE_W07	C1, C2	Lec1÷Lec14	N1, N2
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_KE_U02	C3	Lab1÷Lab7	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie hydraulicznych układów napędowych**
Name in English: **Hydraulic drive systems control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041126**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of classic mechanics and fluid mechanics.
2. Student possess basic knowledge of hydraulic components of drive systems: pumps, motors, cylinders, valves.
3. Student possess basic knowledge of construction and design od simple hydraulic systems.

SUBJECT OBJECTIVES

C1. Acquaint students with proportional technique - its applications, properties and limitations.
C2. Acquaint students with control and regulations methods selected parameters of hydraulic systems.
C3. Acquaint students with advanced hydrostatic systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student has extended knowledge of description of more advanced hydraulic components like proportional valves and servovalves.
PEK_W02 - In the result of lesson student has extended knowledge of explanation advanced control and regulation methods of selected hydraulic systems parameters.
PEK_W03 - In the result of lesson student has extended knowledge of description of advanced hydraulic and electrohydraulic systems.

II. Relating to skills:
PEK_U01 - In the result of lesson student is able to bulid hydraulic and electrohydraulic systems and analyse its working principle.
PEK_U02 - In the result of lesson student is able to preper to work hydraulic device or electrohydraulic and plan and execute measurements of selected parameters. On the basis of measurements results student is able to formulate appropriate conclusions.
PEK_U03 - In the result of lesson student is able to design device with hydraulic or electrohydraulic system according to specified requirements.

III. Relating to social competences:
PEK_K01 - Student can cooperate in group during hydraulic and electrohydraulic system building and report preparation.
PEK_K02 - Student can plan measurements during laboratory and report preparate.
PEK_K03 - Student correctly identyfi and solve problems with hydraulic and electrohydraulic system building. Student formulate appropriate conclusions

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements.	1
Lec2	Control and regulation methods in hydrostatic systems.	2
Lec3	Technique of hydraulic proportional control.	2
Lec4	Working principle and characteristics of directional control valves with proportional control.	2
Lec5	Working principle and characteristics of flow regulators and pressure valves with proportional control.	2
Lec6	Logic valves in proportional technique.	2
Lec7	Electrohydraulic servovalves.	2
Lec8	Hydrostatic systems of position regulation.	2
Lec9	Hydrostatic systems of force or torque regulation.	2
Lec10	Load-sensing systems in machines with hydrostatic drive.	1
Lec11	Load-sensing systems with fixed displacement pump.	2
Lec12	Load-sensing systems with variable displacement pump.	2
Lec13	Controllers in hydraulic systems.	3
Lec14	Volumetric control and regulation.	2
Lec15	Pump capacity regulation for Q = const., p = const., N = const.	2

Lec16	Check.	1
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory range presentation, check form, requirements.	2
Lab2	Throttle-serial regulation of hydraulic actuator speed.	2
Lab3	Throttle-parallel regulation of hydraulic actuator speed.	2
Lab4	Control and regulation throttle methods comparison.	2
Lab5	Application of proportional reliefe valve.	2
Lab6	Experimental test for critical frequency for system with proportional directional control valve.	2
Lab7	Tests of position regulation system with electrohydraulic servovalve.	2
Lab8	Check.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	oral response for practical veryfication of design and buliding of systems.
F2	PEK_U02	report

F3	PEK_U01 PEK_U03	student's activity note
P = (2F1+F2+F3)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.
Norvelle F. D.: Electrohydraulic control systems. Prentice-Hall INC, New Jersey 2000.

SECONDARY LITERATURE

Palczak E.: Dynamics of hydraulic components and systems (in polish). Wydawnictwo Ossolineum, Wrocław, 1999.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydraulic drive systems control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W05, K2MBM_KE_W07	C1 C2	Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9	N1
PEK_W02	K2MBM_KE_W05, K2MBM_KE_W07	C1 C2 C3	Lec2 Lec5 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N1
PEK_W03	K2MBM_KE_W05, K2MBM_KE_W07	C3	Lec8 Lec9 Lec10 Lec11 Lec12 Lec14 Lec15	N1
PEK_U01	K2MBM_U13	C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6	N3 N4
PEK_U02	K2MBM_U05, K2MBM_U11	C1 C2 C3	Lab2 Lab3 Lab4 Lab6 Lab7	N2 N3 N4
PEK_U03	K2MBM_U14	C3	Lab2 Lab3 Lab5	N3 N4
PEK_K01	K2MBM_K04, K2MBM_K05, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6	N3 N4
PEK_K02	K2MBM_K03, K2MBM_K05, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab6 Lab7	N2 N3 N4
PEK_K03	K2MBM_K06, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N2 N3 N4

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Uszczelnienia i techniki uszczelniania**
Name in English: **Seals and sealing technique**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041127**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge in areas related to the basics of the machine design.
2. The knowledge of the principles of operation and basic design of hydraulic and pneumatic systems.
3. Basic knowledge of plastics materials.

SUBJECT OBJECTIVES

C1. Acquainting students with the present sealing technology level, mode of action, construction of various types of technical seals. Presentation the directions of development.
C2. Presentation of the problems that occur during the design, installation and exploatation of technical sealings. Presentation of the example seals selection process of the various types of seals. Preparing students to make knowingly and proper selection and exploatation of technical seals.
C3. Acquiring skills for the identification and description of phenomenas occurring in the seals, doing an independent determination of the seal condition based on the description of external appearance and selected parameters of the seal and making the determination of suitability for further exploitation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to define the characteristics of the seals used in the technique and describe their mode of use.
PEK_W02 - The student defines the basic parameters and the use of standard technical seals, also can make differentiation and identification of the seals.
PEK_W03 - The student is able to select the the correct type of seal to the requirements of a particular application while explaining and describing the working conditions of selected seal.

II. Relating to skills:
PEK_U01 - The student is able analyze the phenomenon occurring during the seal exploitation, so that acquires the ability to control and describe the condition of the seal.
PEK_U02 - The student is able to prepare and conduct a laboratory experiment indicates the technical condition of the seal.
PEK_U03 - The student has the ability to decide on authorization to exploitation or exchange the seal on the basis of analysis of the seal technical condition.

III. Relating to social competences:
PEK_K01 - The student taking part in the work of a team of students which aim is to interpret the laboratory results based on theoretical knowledge.
PEK_K02 - Students gain the ability to link theoretical knowledge with the results of the experiment, and the formulation of a coherent conclusions.
PEK_K03 - Student presents conclusions formulated on the basis of their knowledge and the results of the laboratory tests and provide their justification of the group with teacher.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	To acquaint students with the scope of the lecture, the terms of credit, and subject literature. The function of seals in the machine design.	2
Lec2	Presentation of the basic requirements for technical seals. Classification of the technical seals. Leak testing.	2
Lec3	Fundamentals of correct sealing selection, process analysis, examples of correct application.	2
Lec4	Static seals, description, principle of operation, classification, materials, applications.	2
Lec5	Examples of the selection processes of static seals. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec6	Seals of the rotational movement, description, principle of operation, classification, the basic parameters, materials, applications.	2
Lec7	Examples of the selection processes of rotational movement seals. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec8	Seals of the reciprocating movement, description, principle of operation, classification, parameters, materials, applications.	2

Lec9	Examples of the seals selection process of the piston rod and piston in the pneumatic actuator. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec10	Examples of the seals selection process of the piston rod and piston in the hydraulic actuator. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec11	Seals operating in especially difficult work conditions, description, classification, basic parameters and materials.	2
Lec12	Examples of the selection process of the seals working in the especially difficult work conditions . Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec13	Seals untypical, special and dedicated for a specific application.	2
Lec14	Presentation of the directions of development of the seals. New trends in sealing technology.	2
Lec15	Completion of the course.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	Examination of the impact the gap width on the flow rate and pressure difference.	2
Lab3	Examination of the impact the direction of movement the piston rod on the forces measure on the seal contact area.	2
Lab4	Examination of the impact of pressure difference on the frictional force occurring in the packing set seals of the piston rod.	2
Lab5	Examination of the impact moving speed on the frictional force measure on the seal contact area.	2
Lab6	Determine the energy losses in the sealing during movement.	2
Lab7	Determining the optimal parameters of the seal exploitation.	2
Lab8	Determining the optimal parameters of the seal exploitation.	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. traditional lecture with the use of transparencies and slides
N3. report preparation
N4. tutorials
N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	oral response, participation in problems discussions
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03 PEK_K01÷PEK_K03	laboratory reports, oral response, participation in problems discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. L. A. Kondakow: The hydraulic seals, WNT 1975, (in Polish)
2. E. Mayer: The face seals, WNT 1970, (in Polish)
3. Seals and sealing thenbook, 2nd Edition, Trade and Technical Press Ltd., 1985 Anglia,
4. Poradnik: The thematic inserts about seals in the journal "Hydraulics and Pneumatics", (in Polish)

SECONDARY LITERATURE
1. Proceedings of the Conference "Seals and Sealing Technology", SIMP Wroclaw magazine "Pneumatics and Hydraulics", (in Polish)
2. H. Ebertshäuser: Dichtungen in der Fluidtechnik Resch Verlag, München 1987,
3. F.W. Reuter: Dichtungen in der Verfahrenstechnik Resch Verlag, München 1987.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Seals and sealing technique
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K2MBM_KE_W07	C1	Lec1÷Lec3, Lec13, Lec14	N2, N4
PEK_W02, PEK_W03	K2MBM_KE_W07	C2	Lec4÷Lec12	N2, N4
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K09, K2MBM_KE_U06	C3	Lab1÷Lab7	N1, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria urządzeń transportu przemysłowego**
Name in English: **Engineering of industrial transport devices**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041130**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of solid mechanics, machine design basics and the theory of mechanisms and propulsion systems
2. Ability to read drawings and diagrams in the technical documentation of machinery and industrial transport equipment and the ability to sketch diagrams presenting schemes of simple load-carrying structures and mechanisms of machines.
3. The ability to use a spreadsheet program and make 2D drawings using CAD

SUBJECT OBJECTIVES

C1. Gain of basic knowledge about the structure, function and code principles calculations of industrial transport equipment. C1.1. Knowledge of the basic structures and constructional features of carrying structures and propulsion systems of industrial transport devices for cyclic (cranes) and continuous operation (conveyors). C1.2. Knowledge of the code parameters of conditions for using cranes and links to the relevant technical parameters of these devices to ensure required operating parameters
C2. Gain basic knowledge and skill in the analytical description and calculation of code-based exploitation parameters as wel as technical and operating parameters of industrial transport equipment. C2.1. Creating the schemes of load-carrying structures and mechanisms of devices for industrial transportation and their load systems that are appropriate for given conditions of use. C2.2. Ability to carry out calculations of basic parameters to satisfy assumed technical and operating conditions for cranes and conveyors. C2.3. Skills of calculation with selection of typical parts and components of cranes and conveyors.
C3. Awareness of the inter-relationship between types of structures, design features and technical parameters of industrial transport equipment and conditions for use of these devices

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic structure and design features of load-carrying structures and propulsion mechanisms for industrial transport devices with cyclic (cranes), and continuous (conveyors) operations, respectively.
PEK_W02 - Has knowledge of the code parameters governing the use of cranes and the relationship to the relevant technical parameters to ensure the required operating characteristics for these devices are met.

II. Relating to skills:
PEK_U01 - Can create diagrams of load-carrying structures and mechanisms in industrial handling equipment, together with their load systems appropriate to the given conditions of their use.
PEK_U02 - Can calculate basic technical and operating parameters for cranes and conveyors, appropriate to the given conditions for their use

III. Relating to social competences:
PEK_K01 - Is aware of the relationships between the types of structures, design features and technical parameters for industrial transport equipment, and conditions for use of these devices
PEK_K02 - Recognizes the linkages between adequate knowledge of mathematics, mechanics, electrical engineering and electronics engineering used in industrial transport devices

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic structural and operational features of a cyclic (cranes) industrial transport devices (i.t.d.), review and specification of their structures, major parts and components, examples of design solutions	2
Lec2	Basic structural and use features of a continuous operating (conveyors) industrial transport devices (i.t.d.), review and specification of their structures, major parts and components, examples of design solutions	2

Lec3	Basic technical and operational parameters of the cyclic i.t.d., principles of standardization and evaluation criteria for intensive use, the duty exploitation groups of cranes	2
Lec4	Principles of calculation and classification of the code-based operating conditions of cranes	2
Lec5	Rules for the selection of the form and the structural development of the major nodes of load-carrying structures and mechanisms of cranes	2
Lec6	Loads for proof calculations of load-carrying structures and mechanisms of cranes, according to European standards	2
Lec7	Rules for proof calculations of the load-carrying structures and mechanisms of cranes, according to European standards	2
Lec8	Rules for selection of type of structure and structural development of major carrying joints and mechanisms-drive nodes of conveyors	2
Lec9	Calculating loads of major carrying joints and mechanisms-drive nodes of conveyors	2
Lec10	Rules for loads and proof calculations of major carrying joints and mechanisms-drive nodes of conveyors	2
Lec11	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with flat horizontal movement	2
Lec12	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with flat vertical movement.	2
Lec13	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with three-dimentional movement.	2
Lec14	Methods and systems of control for cranes	2
Lec15	Methods and systems of control for conveyors	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Analysis of the operating conditions for a given crane and calculation of its code-based classification parameters, determination of crane technical parameters to ensure meeting its required operating characteristics.	2
Proj2	Determination of the load-carrying structure and propulsion system for a givenb crane, development of computational schemes for indicated superstructure subassembly and propulsion system of the crane	2
Proj3	Calculations of code-based loads for given crane superstructure specified subassembly, determination of the most important nodes for safety of this structure, execution of a design sketches of the crane specified welded and screwed nodes.	2
Proj4	The initial selection of typical elements of specified subassembly of the crane propulsion system, design sketches of the crane specified nodes of this subassembly	2
Proj5	The calculation of the maximum overload of the selected element of specified crane propulsion system subassembly in its transient periods of work and validation of the typical elements selection	2
Proj6	Analysis of given conveyor operational conditions and the initial calculation of technical parameters to satisfy these conditions, determination of the conveyor drive system structure	2

Proj7	Initial selection of typical elements of the conveyor drive system specified subassembly, the execution of a design sketch of a given node of this subassembly, the calculation of the maximum overload of the selected elements of specified conveyor propulsion system subassembly in its start-up, validation of the conveyor typical elements selection	2
Proj8	Ordering of the crane and conveyor calculations and design sketches before their presentation for mark	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K	Answers during design presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Piątkiewicz A., Sobolski R. – Cranes. WNT Warsow 1977
[2] Goździecki M., Świątkiewicz H. – Conveyors. WNT Warsow 1978

SECONDARY LITERATURE
[1] Vershoof J. - Cranes. Design, Practice and Maintenance. Professional Engineering Publishing Limited, London &Bury St. Edmonds 2000r.
[2] Gładysiewicz L. – Belt conveyors. Theory and calculations. Publ. Wroclaw University of Technology 2003r.
[3] European Standard EN13001-1:2007 - Crane safety. General design. Part 1. General principles and requirements
[4]European Standard EN13001-2:2007 - Crane safety. General design. Part 2. Load effects.
[5] Catalogues of unified components of cranes and conveyors offered by firms: FAMAK, DEMAG, ABUS, KONE CRANES, AUMUND

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering of industrial transport devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W09	C1	Lec1, Lec2	N1, N2, N3
PEK_W02	K2MBM_KE_W09	C1	Lec3 to Lec15	N1, N2, N3
PEK_U01, PEK_U02	K2MBM_U01, K2MBM_U07	C2	Proj3 to Proj7	N2, N3, N4
PEK_K01, PEK_K02	K2MBM_K06	C3	Lec1 to Lec15, Proj1 to Proj7	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Eugeniusz Grabowski tel.: 71 320-28-89 email: Eugeniusz.Grabowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy hybrydowe w pojazdach i maszynach roboczych**
Name in English: **Hybrid drives in working machines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041131**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a knowledge in a frame of earth working machines and vehicles driving systems. Student is aware of solved putted into use on environmental. Student has an advanced knowledge in a frame of mathematics and phisics.
2. It has an advanced knowledge of the design of control algorithms. He knows the proper terminology. It has a basic knowledge of the principles of operation of electronic components.
3. Can use measuring devices and measuring devices. Able to work in groups in various roles, and to develop and formulate conclusions.

SUBJECT OBJECTIVES

C1. The aim of the course is to expand knowledge of the design and operating principles powertrains including hybrids. The student is able to design control systems for hybrid systems working machines, known traction characteristics of selected vehicles.
C2. The course aims to raise awareness of the range of dynamic phenomena, experimental research. It can acquire, also with foreign literature and materials to use them.
C3. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has extended knowledge of the terminology associated with the operation of propulsion systems including hybrid
machines and work vehicles;
PEK_W02 - has the knowledge necessary to carry out a proper selection of individual elements in hybrid drive systems and to formulate and solve related problems;
PEK_W03 - explains the mechanism of energy loss during the transformation and transmission of energy and chooses the control algorithm of the hybrid system.

II. Relating to skills:
PEK_U01 - able to develop a simple plan of experimental research, carry the experiment, and to formulate conclusions
PEK_U02 - able to design a propulsion system so as to obtain its brief foredesing action
PEK_U03 - be able to specify a path for power and estimate the power flow dissipation in the proposed drive system

III. Relating to social competences:
PEK_K01 - know the range of having own knowledge and own skills and understands the need for continuous training and professional development;
PEK_K02 - indevidually initiates and takes a simple research tasks;
PEK_K03 - can indyvidually search the literature and also in foreign languages.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of the propulsion system, hybrid types and propulsion systems, single and multi-source power systems.	2
Lec2	Primary and secondary sources of energy: electrical, mechanical, hydraulical, fue -calorific value. Fuel cells. The efficiency of energy processed. Power converters for AC and DC operated from vehicles.	2
Lec3	A detailed overview of the energy storage. The problems and limitations associated with it. Resistance and power consumption while moving.	2
Lec4	Structure parallel hybrid powertrain. The choice of elements and calculations.	2

Lec5	Structures mixed hybrid propulsion systems. The choice of elements and calculations	2
Lec6	Structures mixed hybrid propulsion systems. The choice of elements and calculations	2
Lec7	Propulsion systems of "mild", selection of components and calculations. Non-conventional propulsion systems equipment and vehicles.	2
Lec8	Computational method for selecting the individual components of hybrid powertrains. Problems associated with the delivery of energy recovered to the source. The amount and efficiency of energy recuperation based on the cycle of the vehicle.	2
Lec9	Computational method for selecting the individual components of hybrid powertrains. Problems associated with the delivery of energy recovered to the source. The amount and efficiency of energy recovery based on the schedule of the vehicle.	2
Lec10	Analysis of the possibility of reducing engine power and efficiency of the transmission.	2
Lec11	The recuperative braking wheeled vehicles. Problems with receiving energy and preserving the direction of motion. Construction of hybrid brakes.	2
Lec12	The braking proces of working tools of earth working vehicles. The methodology and energy.	2
Lec13	The use of electronic systems to control hybrid systems working machines.	2
Lec14	Modeling of hybrid drive systems for wheeled vehicles. Modeling of sources and receivers of energy.	2
Lec15	Overview of hybrid drives for use in vehicles and working machines.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Study the possibility of accumulation of energy in the hydrostatic drive system extended arm loader bucket.	2
Lab2	Performance testing of the propulsion system overhead traveling crane.	2
Lab3	Accumulation and recuperation of energy in the inertial propulsion system.	2
Lab4	Energy efficiency of the filling process of a bucket in earth working vehicles.	2
Lab5	Hydrostatic driving system experimental test.	2
Lab6	Accumulation and energy recuperation mechano-electrical and electrical drive systems.	2
Lab7	Badania sprawności przetwarzania energii generatora prądotwórczego.	2
Lab8	Badanie procesu urabiania ośrodków ziarnistych. Wpływ doboru narzędzia na energooszczędność procesu.	2
		Total hours: 16

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03 PEK_K01-02	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03 PEK_K03	report on laboratory exercises, short test
P = odpowiedzi ustne		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1 "Electric and hybrid vehicles Design Fundamentals", Husain, I., CRC PRESS, 2011
2 "Fundamentals of hybrid vehicle drives," Szumanowski A Warsaw-Radom, 2000
3 "Hybrid Electric Vehicles Design", Szumanowski A., Institute for Sustainable Technologies NRI / 2006
4 "The accumulation of energy in vehicles", Szumanowski A., optics, 1984
5 "Motor vehicles with electric and hybrid", K. Michalowski, Ocioszyński J., optics, Warsaw 1989
6 "Alternative fuels and vehicle propulsion systems", J. Diaper Merkisz I., Publisher University of Technology, Poznan, 2006
7 "Electric vehicles", Poplawski E. optics, Warsaw, 1994
8 "Energy efficient powertrains working machines", Ocioszyński J., Publishing House of Warsaw University of Technology, Warsaw, 1994
9 "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Second Edition", M. Ehsani, Y. Gao, CRC PRESS, 2009
10th "Propulsion systems for hybrid vehicles," Miller JM, The Institution of Electrical Engineers, 2003
11th "Electric Vehicle Technology Explained", Larminie J., Lowry, J., Wiley, 2003
12th "The rationalization of labor power system of a passenger car using fuzzy logic", PhD thesis Korniak J., supervisor: prof. Assoc. Mr Rojek.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hybrid drives in working machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W01, K2MBM_KE_W04, K2MBM_KE_W09	C1	Lec1-Lec7	N1,N3
PEK_W02	K2MBM_KE_W01, K2MBM_KE_W04	C2	Lec1-Lec7	N1,N3
PEK_W03	K2MBM_KE_W09	C1, C2	Lab1-Lab8	N1, N3
PEK_U01	K2MBM_KE_U01	C3	Lec1-Lec15	N1, N3
PEK_U02	K2MBM_KE_U06	C3	Lab1-Lab8	N2
PEK_U03	K2MBM_U01, K2MBM_U05	C3	Lab1-Lab8	N2
PEK_K01	K2MBM_K10	C1, C2, C3	Lec1-Lec15	N1, N3
PEK_K02	K2MBM_K02, K2MBM_K09	C1, C2, C3	Lec1-Lec15	N1, N3
PEK_K03	K2MBM_K04, K2MBM_K05	C3	Lab1-Lab8	N2

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy mechatroniczne w pojazdach i maszynach roboczych**
Name in English: **Mechatronics systems in industrial vehicles and machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041132**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of automation confirmed by completion of relevant course at university level
2. Has basic knowledge of the theory of machines and mechanisms

SUBJECT OBJECTIVES

C1. To gain knowledge of the structure, programming and operation of mechatronic systems working machines and vehicles
C2. To gain skills of experimental research and diagnostics of mechatronic systems of working machines and vehicles
C3. To gain and consolidate awareness of links between knowledge of mechanics, electronics and computer science and awareness of the responsibility for the work

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of sensors used in working machines and vehicles
PEK_W02 - has basic knowledge of controllers and communication standards used in working machines and industrial vehicles
PEK_W03 - has knowledge of structure and principles of operation of the typical mechatronic systems used in working machines and industrial vehicles

II. Relating to skills:
PEK_U01 - is able to carry out experimental research and diagnostics of a typical industrial vehicle mechatronic system
PEK_U02 - is able carry out experimental research and diagnostics of a typical mechatronic system of crane

III. Relating to social competences:
PEK_K01 - is aware of and understanding the relationship between knowledge of mechanics, electronics and computer science
PEK_K02 - is aware of the responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introduction to mechatronic systems in vehicles and working machines	2
Lec2	Sensors in mechatronic systems of working machines and vehicles. Temperature sensors. Proximity transducers	2
Lec3	Sensors in mechatronic systems of working machines and vehicles. Sensors of linear and angular displacement. Speed and acceleration sensors	2
Lec4	Sensors in mechatronic systems of working machines and vehicles. Sensors for measurement of forces, moments, pressures and flows	2
Lec5	Controllers and operator panels in mechatronic systems of working machines and vehicles and their programming	2
Lec6	Microcontrollers in mechatronic systems of working machines and vehicles and their programming	2
Lec7	Typical communication standards used in control systems of vehicles and working machines	2
Lec8	Navigation systems used in industrial vehicles	2
Lec9	Automation systems used in transmission systems of industrial vehicles and working machines	2
Lec10	Advanced automation systems supporting the process of positioning of manipulators of earthmoving machines	2
Lec11	Automatic systems for excavating and loading of crushed material	2
Lec12	Automatic safety and diagnostic systems in industrial vehicles	2
Lec13	Selected automation systems used in agricultural machines	2
Lec14	Automation of storage and transhipment processes	2
Lec15	Overview of automation systems used in cranes	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Experimental studies of selected transducers from the point of view their efficiency in automatic systems of working machines and vehicles	2
Lab2	Selection of elements and programming of the control system of working machine manipulator	2
Lab3	Sample operator panel programming for industrial vehicle	2
Lab4	Examination of jib crane monitoring system	2
Lab5	The investigation of the new generation's mechatronic steering system for articulated vehicle	2
Lab6	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab7	Experimental studies of a robot used for ropeway's rope diagnostics	2
Lab8	Testing of a laser positioning system of transhipment vehicle manipulator	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K02	laboratory reports, short tests

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r.[2] Dudziński P.: Lenksysteme für Nutzfahrzeuge - Theorie und Praxis. Springer, 2005r.[3] Czabanowski R.: Sensory i systemy pomiarowe. Oficyna Wydawnicza Politechniki Wrocławskiej, 2010r.

SECONDARY LITERATURE

[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki iMagazynowania, 1998r.[2] Zimmermann W., Schmidgall R.: Magistrale danych w pojazdach. WKiŁ, 2008[3] PLUS+1 GUIDE - User Manual. Sauer-Danfoss 2012r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronics systems in industrial vehicles and machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec1÷Lec4	N2, N5
PEK_W02	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec5÷Lec7	N2, N5
PEK_W03	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec8÷Lec15	N2, N5
PEK_U01	K2MBM_KE_U06	C2	La1÷La3, La5, La7, La8	N1, N2, N3, N4
PEK_U02	K2MBM_KE_U06	C2	La1, La4, La6	N1, N2, N3, N4
PEK_K01	K2MBM_K06	C3	Lec1÷Lec15, La1÷La8	N1, N2, N3, N4, N5
PEK_K02	K2MBM_K05	C3	La1÷La8	N1

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja procesów produkcyjnych**
Name in English: **Automation of production processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: Fundamentals of Automatic Control

SUBJECT OBJECTIVES

C1. Explain building automation systems
C2. Explain the operation of control systems
C3. Explain the rules for the application of automation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the construction of automation components
PEK_W02 - Can explain the operation of control systems
PEK_W03 - Can choose the components for the automation of the production process

II. Relating to skills:
PEK_U01 - Can apply automation components for process automation
PEK_U02 - Can program the selected control elements
PEK_U03 - Is able to operate automated manufacturing processes

III. Relating to social competences:
PEK_K01 - Recognizes the importance of team collaboration.
PEK_K02 - Can search for information regarding the various fields of technology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic concepts, building automation systems and their classification.	1
Lec2	The mathematical description of automation.	1
Lec3	Industrial control system. PLCs	2
Lec4	Aspects of safety.	1
Lec5	Network communication systems	2
Lec6	Electric drives	2
Lec7	Industrial robots	2
Lec8	Vision Systems	1
Lec9	HMI and SCADA systems	2
Lec10	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Industrial control system.	2
Lab2	Programmanle logic controllers	2
Lab3	Electric servo drives	2
Lab4	Security systems	2
Lab5	Industrial robots	2
Lab6	Vision Systems	2
Lab7	Industrial networks	2
Lab8	HMI	2
Lab9	SCADA systems	2
Lab10	Automating the process of distribution	2

Lab11	Automating the process of identification and measurement	2
Lab12	Automating the process of treatment process	2
Lab13	Automating the process of transport	2
Lab14	Automating the process of assembly	2
Lab15	Automation of continuous processes	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03,	Test
F2	PEK_U01, PEK_U02, PEK_U03,	REPORT OF LABORATORY PRACTICE
P = ŚREDNIA Z WSZYSTKICH OCEN		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Automation of production processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W04	c1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_W02	K2MBM_W04	c2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_W03	K2MBM_W04	c3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_U01	K2MBM_U13	C3	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9	N2,N3, N5
PEK_U02	K2MBM_U13	C3	LA10, LA11, LA12, LA13, LA14, LA15	N2,N3, N5
PEK_U03	K2MBM_U13	C2	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9	N2,N3, N5
PEK_K01	K2MBM_K09	C1,C2,C3	LA1-LA15	N1-N5
PEK_K02	K2MBM_K06	C1, C2, C3	Lec1-Lec10	N1-N5

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania nieniszczące wyrobów**
Name in English: **Non Destructive Testing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041202**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the basic mechanical properties of engineering materials, ordered knowledge about the types of metallic materials engineering - their construction, properties, applications and selection rules.
2. Abilities to read and interpret drawings and diagrams used in the technical documentation, abilities to do the technical documentation.

SUBJECT OBJECTIVES

C1. Getting knowledge of non-destructive testing methods used in modern technology.
C2. Getting to know the different methods of NDT: visual, liquid penetrant, magnetic-particle, ultrasonic, radiographic, etc..

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student can explain the advantages and limitations of selected methods of non-destructive testing.
PEK_W02 - Student is able to propose a method for non-destructive testing for a structural component or means of transportation(eg car, crane, container extraction, welded, pressure vessels, etc.).
PEK_W03 - Student is able to identify and assess potential risks of detected flaws.

II. Relating to skills:
PEK_U01 - Applying non-destructive testing methods in welding structures, castings and finished products during the operation.
PEK_U02 - Ability to prepare the protocol of non-destructive examinations.
PEK_U03 - Ability to do selected non-destructive testing and asses its results.

III. Relating to social competences:
PEK_K01 - Ability to explain the results of research and assess them critically.
PEK_K02 - Student can objectively evaluate arguments rationally explain them and justify his point of view using the knowledge of non-destructive testing.
PEK_K03 - Knowing the rules of team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Principles of assessment. Visual examination.	2
Lec2	Liquid penetrant testing	2
Lec3	Magnetic-particle testing	2
Lec4	Radiographic testing	2
Lec5	Ultrasonic testing of welding joints , part 1	2
Lec6	Ultrasonic testing, part II. Assessment the size of flaw by ultrasonic testing.	2
Lec7	Ultrasonic testing of spot welds using 2D arrays. Test grade.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Principles of assessment. Visual examination.	2
Lab2	Liquid penetrant testing	2
Lab3	Magnetic-particle testing	2
Lab4	Radiographic testing	2
Lab5	Ultrasonic testing of welding joints , part 1	2
Lab6	Ultrasonic testing, part II. Assessment the size of flaw by ultrasonic testing.	2
Lab7	Ultrasonic testing of spot welds using 2D arrays. Test grade.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. report preparation
N3. self study - preparation for laboratory class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	test grade
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	short test
F2	PEK_U01-PEK_U03	oral answers, laboratory report,
F3	PEK_K01-PEK_K03	participation in discussion
P = (F1+ F2+F3) /3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Non Destructive Testing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_PMS_W06, K2MBM_W05	C1, C2	lect1 - lect7	N1
PEK_U01-PEK_U03	K2MBM_U01, K2MBM_U11, K2MBM_U12	C1, C2	lab1-lab7	N2, N3
PEK_K01-PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K08	C1, C2	lab1-lab7 lect1 - lect7	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Marcin Korzeniowski tel.: 42-55 email: marcin.korzeniowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Specjalne metody łączenia**
Name in English: **Special methods of joining**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041206**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student has basic knowledge of welding processes (characteristics of methods, health and safety rules, parameters, equipment, joining technology, documentation, application);
A student has knowledge of basic mechanical properties of engineering materials - their structure, properties, applications and principles of selection;
A student has basic knowledge of thermal processes/heat treatment;
2. A student is able to distinguish basic methods of bonding;
A student is able to perform basic tests and inspections of engineering materials;
3. Students shows the ability to improve team work on strategy selection methods, aimed at optimal solving of assigned problems

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about special joining techniques by welding methods and related
C2. Acquiring an ability to choose the right joining technology and basic parameters of the process
C3. Acquiring the ability to design the bonding process of the product

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - A student knows the definitions and characteristics of special joining methods
PEK_W02 - A student knows the bonded materials obtained by using special joining methods and their typical applications
PEK_W03 - A student knows the methods of inspection/test of joints made by special bonding methods

II. Relating to skills:
PEK_U01 - A student is able to choose the right method of special joining group and define the basic parameters of the process
PEK_U02 - A student is able to propose the right joining technology for a particular product
PEK_U03 - A student is able to perform basic joints with different special methods

III. Relating to social competences:
PEK_K01 - A student shows ability to search for information and its critical analysis
PEK_K02 - A student shows the ability to team work on improving methods of strategy selection aimed to optimal solving of assigned problems
PEK_K03 - The student shows the ability of an objective evaluation of arguments, rational explanations and justifications of own position using knowledge of welding

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Application of laser technology in welding	2
Lec2	Application of electron beam in bonding, cutting, overlapping the layers and materials heat treatment	2
Lec3	Application of plasma in welding, cutting, spraying and surfacing	2
Lec4	Adhesive bonding of engineering materials	2
Lec5	Special methods of soldering and brazing of advanced materials	2
Lec6	Special methods of resistance welding	2
Lec7	Special methods of welding	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Modern applications of friction welding	2
Lab2	Plasma welding and cutting	2
Lab3	Laser welding and cutting	2
Lab4	Underwater welding	2
Lab5	Modern applications of adhesive technology	2
Lab6	Termite welding	2
Lab7	Explosion welding	3
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with use of transparencies and slides
N3. tutorials
N4. self study - preparation for laboratory class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	short test, laboratory report
F2	PEK_K01 - PEK_K03	participation in problems discussions
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Special methods of joining
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_PMS_W06	C1 - C3		N1, N4
PEK_U01 - PEK_U03	K2MBM_PMS_U04	C1 - C3		N2, N3
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K05, K2MBM_K10	C3		N2, N3

SUBJECT SUPERVISOR

dr inż. Tomasz Piwowarczyk tel.: 4255 email: tomasz.piwowarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytwarzanie kompozytów metodami odlewniczymi**
Name in English: **Manufacturing of composite materials by casting methods**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041208**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of manufacture and casting methods.
2. Basic knowledge of physical metallurgy.

SUBJECT OBJECTIVES

C1. Getting knowledge of the basic information about manufacturing methods, composite materials properties and their applications.
C2. Getting knowledge about the casting methods to produce metal matrix composite.
C3. Getting knowledge about the property test examinations included strength and wear tests.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Basic knowledge about production and application of composite materials. Knowledge of matrix types and strengthening mechanisms.
PEK_W02 - Basic knowledge about production and application of composite materials. Knowledge of matrix types and strengthening mechanisms.
PEK_W03 - Basic knowledge about strength and wear investigations of composite materials. Can define wear mechanism and metallographic observations.

II. Relating to skills:
PEK_U01 - Can use terminology related to composite materials, their manufacturing, and investigation of properties.
PEK_U02 - Can characterize selected composite materials. Can apply proper process parameters.
PEK_U03 - Can select and prepare composite components to achieve good reinforcing effect.

III. Relating to social competences:
PEK_K01 - Can think and act in a creative way.
PEK_K02 - Follows the rules and customs prevailing in academia.
PEK_K03 - Can correlate the effects of industry activity with the impact on the environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Composite materials - basic terms, groups	2
Lec2	Reinforcing mechanisms. Types of matrix-reinforcement interface.	2
Lec3	Surface phenomena, wetting of reinforcement by liquid metal, capillary phenomena, chemical reactions between composite components.	2
Lec4	Phase-reinforcing effect on crystallization of the matrix, adhesive and cohesive phenomenon.	2
Lec5	Producing methods of composite materials, in-situ and ex-situ composites.	2
Lec6	Squeeze casting, stir casting.	2
Lec7	Compocasting	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Manufacturing of porous ceramic performs to reinforce composite materials	2
Lab2	Pressure infiltration of ceramic preforms.	2
Lab3	Direct squeeze casting	2
Lab4	Production of hybrid composite materials	2
Lab5	Preparation of composite suspensions by stir casting.	2
Lab6	Centrifugal casting gradient materials.	2
Lab7	Investigations of basic properties of composite materials. Credit.	3
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. self study - self studies and preparation for examination N3. tutorials N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Lab report
F2	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Test
P = ocena średnia=(F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE
SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing of composite materials by casting methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03 PEK_K01 - PEK_K03	K2MBM_PMS_W04, K2MBM_PMS_W06	C1,C2	Lec1-Lec7	N1, N2, N3
PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	K2MBM_K10, K2MBM_PMS_U02	C2, C3	Lab1-Lab7	N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Naplocha tel.: 27-22 email: krzysztof.naplocha@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane metody kształtowania plastycznego**
Name in English: **Advanced methods of metal forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Able to design a typical process of metal forming
2. Possess a knowledge on modern engineering materials
3. Able to use of analysis methods and optimization of metal forming processes

SUBJECT OBJECTIVES

C1. Application of modern engineering materials for processes efficiency improvement
C2. Cognition of unconventional metal forming methods
C3. Application of analysis methods and optimization of metal forming processes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possess a knowledge on modern metal forming methods and their analysis
PEK_W02 - Know relations between material properties, metal forming process parameters and strain and load distributions
PEK_W03 - Able to indicate of directions of process modification with respect to efficiency

II. Relating to skills:
PEK_U01 - Able to design a modern process of metal forming, to analyze of limit conditions, to optimize of a process
PEK_U02 - Able to design tools, to choose of materials, machines and process automation methods
PEK_U03 - Able to calculate of necessary efforts of materials and tools

III. Relating to social competences:
PEK_K01 - Has awareness of the effect of method selection on environment
PEK_K02 - Able to use different information sources for decision making
PEK_K03 - Able to organize of teem working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview of limitations in metal forming processes	1
Lec2	Definition of advanced metal forming methods as e way of limits elimination	1
Lec3	Trends of metal forming process development, accuracy of parts, efficiency of processes, improvement of the process flexibility, forming of hard deformed materials, shortening of production preparation time, preservation of environment	2
Lec4	Development of materials for metal forming, automobile industry, light materials, special materials	2
Lec5	Modern tool materials	2
Lec6	Part accuracy improvement methods in sheet metal forming	2
Lec7	Progressive and transfer methods in sheet metal forming processes	2
Lec8	Part accuracy improvement methods in bulk metal forming	2
Lec9	Application of powder metallurgy for manufacturing materials and parts on specific properties	2
Lec10	Unconventional metal forming methods	2
Lec11	Enhancement of metal forming methods flexibility	2
Lec12	Numerical methods in analyze, designing and optimization of metal forming processes	2
Lec13	Engineering, dedicated FEM programs	2
Lec14	Application of physical modeling methods for metal forming processes analysis	2
Lec15	Modern machines for metal forming	2
Lec16	Control methods of metal forming processes	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Evaluation of significance and placement of risk of fracture, wrinkling and part accuracy on the base of literature	2
Proj2	Technology selection for risk minimize	2
Proj3	Elaboration of assumptions to the process project, number of operations, conception of intermediate shapes, preliminary selection of parameters, assessment of necessary machines availability	2
Proj4	Elaboration of 3D CAD model and geometry transfer to FEM program	2
Proj5	Metal forming process modeling by engineering FEM program	2
Proj6	Process parameters optimization with respect to cracking or an accuracy on the base mathematical modeling results	2
Proj7	Metal forming tools design	2
Proj8	Assessment of process efficiency in relation to typical metal forming methods	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. self study - preparation for project class
N4. tutorials
N5. self study, preparation for colloquium

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K03,	Assessment of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Richert J., Innovative methods of metal forming. AGH publishing, Krakow, 2010.
Gronostajski Z., Applied research in advanced metal forming processes. Editorial Office of Wroclaw university of Technology, Wroclaw, 2003.
Dyja H., Rheology of plastically deformed metals. Polytechnic of Czestochowa publishing.

SECONDARY LITERATURE
Boljanovic V., Sheet metal forming processes and die design New York : Industrial Press, cop. 2005.
Walsh R. A., McGraw-Hill Machining and metalworking handbook, McGraw-Hill, 2006
Rao S. S., Engineering optimization theory and practice . John Wiley & Sons. 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced methods of metal forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_PMS_W02	C1, C3	Lec1 - Lec3, Lec12, Lec14	N1, N2, N5
PEK_W02	K2MBM_PMS_W02, K2MBM_PMS_W06	C1, C3	Lec4 - Lec6, Lec8, Lec9, Lec16	N1, N2, N5
PEK_W03	K2MBM_W05, K2MBM_W06, K2MBM_W07, K2MBM_W10	C1 - C3	Lec3 - Lec15	N1, N2, N4, N5
PEK_U1 - PEK_U3	K2MBM_PMS_U01, K2MBM_U01, K2MBM_U02, K2MBM_U10, K2MBM_U20	C1 -C3	Lec1 - Lec16, Proj1 - Proj8	N1 -N4, N5
PEK_K01 - PEK_K03	K2MBM_K07, K2MBM_K08, K2MBM_K09	C1, C3	Lec1 - Lec16, Proj1 - Proj8	N1 - N5

SUBJECT SUPERVISOR

dr inż. Adam Niechajowicz tel.: 40-49 email: adam.niechajowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041211**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				120	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				4	
including number of ECTS points for practical (P) classes				4	
including number of ECTS points for direct teacher-student contact (BK) classes				2.8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of production methods of using various techniques: casting, welding, plastic forming, machining.
2. Has a basic knowledge of the principles of machines selection, equipment and tools for the implementation to various manufacturing processes.
3. Has a knowledge of the basics of the process designing.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge and skills of a critical analysis for selection the planning technology and methods to manufacture the products.
C2. Acquisition of knowledge and skills to choice suitable machines, tools and equipment of technological tooling, process parameters for the selected method of product manufacturing.
C3. Acquire the execution skills to the project of the products manufacturing process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a knowledge of the selection and planning of the products manufacturing technology.
PEK_W02 - Has a knowledge in the right selection of the execution of the manufacturing process.
PEK_W03 - Has a knowledge of the rules of designing of the technological manufacturing process.

II. Relating to skills:
PEK_U01 - Can select and plan the manufacturing technology of the products.
PEK_U02 - Can correctly evaluate the conditions and parameters of the products manufacturing technology.
PEK_U03 - Can develop and carry out the project of products manufacturing technology.

III. Relating to social competences:
PEK_K01 - Acquires the ability to care about the aesthetics of the work and the responsibility for its implementation.
PEK_K02 - Can think and act in a creative way.
PEK_K03 - Acquires a teamwork skills.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Presentation of the course. The scope and discuss how to implement and the pass the pre-final project. Edition proposals and discussion of topics of technological projects. Entering literature list.	3
Proj2	Analysis of possibilities and ways to accomplish the product depending of its construction, required performance and production volume. Presentation and discussion about the final concept of manufacturing technology.	6
Proj3	Development of technological assumptions, selection of the performance parameters, perform the necessary calculations for the selected method of manufacturing.	9
Proj4	Selection of machines, tools and equipment for realization of the agreed manufacturing process.	6
Proj5	Execution the structure of technological process, with detailed plan of selected operations, the order of basic and additional treatments, time standards, technological brochures, etc.	9
Proj6	Development of the project design documentation (assembly drawing and executive drawings). Presentation with the project defense.	12
		Total hours: 45

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. project presentation
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of the project preparation
F2	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Project defense.
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Pre-final project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_PMS_W06, K2MBM_PMS_W07, K2MBM_W05, K2MBM_W07, K2MBM_W08	C1, C2	Pr1, Pr2	N1, N3
PEK_U01 - PEK_U03	K2MBM_PMS_U04, K2MBM_PMS_U05, K2MBM_U08, K2MBM_U10	C1 -C3	Pr3 - Pr6	N1 -N3
PEK_K01 - PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K05, K2MBM_K10	C1 - C3	Pr1 - Pr6	N1 - N3

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Narzędzia do przeróbki plastycznej**
Name in English: **Tools for metal forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041215**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic concepts to metal and plastic processing.
2. Fundamentals of materials science. Materials used in the construction of machinery and equipment in plastic forming.
3. Basis of design processes in the processing of plastic.

SUBJECT OBJECTIVES

C1. To acquaint the participants with the basic construction of the equipment used in the processing of plastic.
C2. Gaining knowledge of the materials used in the construction of cold and hot working tools.
C3. To acquaint the participants with the typical design solutions used in the construction of working tools.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge of the foundations of the theory of plasticity, analytical methods development processes,
the application of mathematical modeling methods for the analysis of metal forming processes.
PEK_W02 - He has ordered knowledge of methods and techniques of organization of installation of equipment and machinery for plastic forming.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Acquires the ability to take responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification of basic technologies shaping by machining plastic. Development of cold and hot. Construction of the forming.	2
Lec2	Cold forming. The types of treatment used tool. Classification of materials used in cold forming.	2
Lec3	Forged in the heat. The types of treatment used tool. Classification of materials used in the treatment of hot forming.	2
Lec4	Design solutions for the construction working tools surgery. Heat treatment of the materials used in the construction of tools Forming.	2
Lec5	Analysis of the sample preparation process in detail plastic forming. Applied design solutions, materials and Technology for tools.	2
Lec6	Design tools for shaping metal sheets	2
Lec7	Design tools for shaping vol.	2
Lec8	Unconventional punching and forming tools.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01,	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. MARCINIAK Z.: Konstrukcja tłoczników, WNT, Warszawa 2002.
2. ZIMNIAK Z.: System wspomagania projektowania, zapewnienia jakości i diagnozowania tłoczenia blach, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005
3. Ćwiczenia laboratoryjne z budowy maszyn część II Obróbka Plastyczna pod redakcją Henryka Ziemby, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1981.
4. MAZURKIEWICZ A., KOCUR L.: Obróbka plastyczna laboratorium , Politechnika Radomska, Radom 1997.

SECONDARY LITERATURE

[1] H.J. Kleemola, M.T. Pelkkikangas, Effect of predeformation and strain path on the forming limits of steel copper and brass, Sheet Met. Ind. 63 (2) (1997) 591–599.
[2] R. Arrieux, C. Bedrin, M. Boivin, Determination of an intrinsic forming limit stress diagram for isotropic metal sheets, in: Proceedings of the 12th Biennial Congress IDDRG, 1982.
[3] A.K. Ghosh, J.V. Laukonis, The influence of strain-path changes on the formability of sheet steel, in: Proceedings of the Ninth Biennial Congress of the International Deep Drawing Research Group, Sheet Metal Forming and Energy Conservation, ASM Publication, New York, 1976.
[4] T.B. Stoughton, A general forming limit criterion for sheet metal forming, Int. J. Mech. Sci. 42 (1) (2000) 1–27.
[5] A.F. Graf,W.F. Hosford, Calculations of forming limit diagram for changing strain paths, Metall. Trans. A 24 (3) (1993) 2497–2501.
[6] A. Graf, W.F. Horsford, Effects of changing strain paths on forming limit diagrams of Al 2008–T4, Metall. Trans. A 24 (3) (1993) 2503–2512.
[7] R. Arrieux, Determination and use of the forming limit stress diagrams, J. Mater. Process. Technol. 53 (3) (1995) 47–56.
[8] R. Hill, Math. Proc. Camb. Philos. Soc. 85 (4) (1979) 179–185.
[9]. BOLJANOVIC V.: Sheet metal forming processes and die design, Industrial Press, New York 2004.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Tools for metal forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2MBM_PMS_W02, K2MBM_PMS_W06, K2MBM_PMS_W07	C1, C2, C3	Wy1-Wy8	N1, N2, N3
PEK_K01	K2MBM_K05	C1, C2, C3	Wy1-Wy8	N1,N2,N3

SUBJECT SUPERVISOR
dr inż. Maciej Zwierzchowski tel.: 21-74 email: maciej.zwierzchowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English: **MASTER THESIS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041250**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of manufacturing techniques and production systems documented by positive marks in all subjects of the first and second semesters in within the specialty Processes Machines and Manufacturing Systems
2. Can apply their knowledge. Carry out experimental research, seek an information from the literature. Speak a foreign language at the level which let to express self-opinions and write master's thesis in the field of production techniques and production systems. Can analyze the results of the research and specify the conclusions.
3. Is aware of the importance of non-technical aspects and impacts of engineering, to respect the principles of ethics and social role of technical college graduate.

SUBJECT OBJECTIVES

C1. Based on the acquired knowledge while studying, preparation of master thesis by the solution of research problem in the field of the specialty Processes Machines and Manufacturing Systems.
C2. Writing a master thesis and presentation of its achievements in relation to current information in literature.
C3. Acquisition and consolidation of independent work skills, determination of the priorities to tackle the task and awareness of responsibility for own work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a deepened and enlarged knowledge of realization the complex engineering tasks, their description, documentation and presentation.
PEK_W02 - Has a enlarged knowledge of the organization and implementation of diploma thesis as a project, which have to be managed in issues related to the specialty Processes Machines and Manufacturing Systems.
PEK_W03 - Has a basic knowledge in methodology of presenting the results of done work and background skills needed for the communicating in business engineering teamwork.

II. Relating to skills:
PEK_U01 - Can critically analyze and evaluate existing manufacturing processes, production systems and technological machines. Can work independently to realize the degree of master's thesis, using research techniques and methods known during studies.
PEK_U02 - Can acquire concrete information from the literature also in foreign languages. Can to interpret and critically evaluate the research results.
PEK_U03 - Knows how to edit a master's thesis complying with prevailing requirements of method and style of writing. Can present it orally to a wider audience using multimedia capabilities, including the occurrence to the diploma committee.

III. Relating to social competences:
PEK_K01 - As a graduate student is aware of being the next leader, who knows how to organize the work and determine the self-priorities for the others, can manage a team of people as well as work together in the group taking the different roles.
PEK_K02 - Is gaining characteristics of a person working alone, according to the principles of ethics with an awareness of the responsibility for their own work.
PEK_K03 - Acquires attention to style and form of expression of own views in native and a foreign languages, especially in English, understands the need of continuing education and developing professional skills throughout their live.

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. case study
N2. self study - self studies and preparation for examination
N3. multimedia presentation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Working in the semester, preparing master's thesis as a work.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Literature of the master's thesis topic agreed with the promoter.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MASTER THESIS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K2MBM_U03, K2MBM_U17, K2MBM_U20	C1, C2		N1 - N4
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K03, K2MBM_K10	C1 - C3		N1 - N4

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza wymiarowa w projektowaniu eksperymentu**
Name in English: **Dimensional Analysis in Experiment Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041303**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis, linear algebra.

SUBJECT OBJECTIVES

C1. Knowledge of dimensional analysisas a tool for theory of identification and experiment planning.
C2. Skill of construction of empirical mathematical models.
C3. Acqurement and consolidation of social competences contaiining emotional intelligence based on skills of co-operation in a student group in order to efficiently solve the problems. i

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of dimensional analysis in Drobot's formulation.
PEK_W02 - Knowledge of rudiments of parametrical identification.
PEK_W03 - Knowledge of rules of model similarity.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Definition of dimensional space according to Drobot.	2
Lec2	Relations between elements of dimensional space & images described in classical theory of measurement.	2
Lec3	Postulates of obiectivision & synonymity.	2
Lec4	Elements of measurement theory .	2
Lec5	Dimensional homogenity & invariability.	2
Lec6	Construction of empirical mathematical models .	2
Lec7	Dimensional transformation - so called Π-theorem.	2
Lec8	Dimensional analysisas vs theory of identification and experiment planning.	2
Lec9	Dimensional complex function.	2
Lec10	Multistage identification.	2
Lec11	Rule of correspodence.	2
Lec12	Theory of model similarity.	2
Lec13	Change of dimensional basis. Experiment planning.	2
Lec14	Testing of completeness of similarity invariants set.	2
Lec15	Presentation & disscusion of control works, Crediting.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides.
N2. report preparation.
N3. tutorials.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	Homeworks evaluation.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.W. Kasprzak, B. Lysik, M. Rybaczuk, Measurements, Dimensions, Invariant Models and Fractals, Wrocław-Lwów 2004,
2.W. Kasprzak, B. Lysik, M. Rybaczuk, Dimensional Analysis in the Identification of Mathematical Models. World Scientific Singapore, 1990,
3.Pr. zb. pod red. W. Myszki, Komputerowy system obsługi eksperymentu, WNT Warszawa 1991,
4.M. Szata, Opis rozwoju zmęczeniowego pękania w ujęciu energetycznym, Oficyna Wydawnicza PWr, Wrocław 2002.

SECONDARY LITERATURE

W. Kasprzak, B. Lysik, Analiza wymiarowa. Algorytmiczne procedury obsługi eksperymentu, WNT Warszawa 1988.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dimensional Analysis in Experiment Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03.	K2MBM_IMK_W03	C1	Lec1 - Lec15	N1, N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika materiałów-badania, modelowanie**
Name in English: **Mechanics of materials; testing and modeling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041307**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the courses: Technical Mechanics, Calculus I,
Algebra and Analytic Geometry.
2. Physics, Strength of Materials I and II
3. Student has fundamental knowledge of materials science and plastics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the structure, properties, investigation and modelling methods of selected group of advanced materials.
C2. Acquisition of skills related to constitutive equations and their identification with reference to advanced materials for mechanical constructions.
C3. Acquisition of skills related to physical fundamentals and methodology of experimental investigations aimed at determining the properties of advanced materials.
C4. Acquisition and strengthening of the social competence including emotional intelligence that is based on the ability to cooperate in a group of students, which is aimed at effective problem solving.
Responsibility, honesty and diligence in one's code of conduct; obeying the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the structure and properties of selected advanced materials,
PEK_W02 - Student knows how to describe properties of materials using constitutive models,
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods essential to determine the properties of advanced materials.

II. Relating to skills:
PEK_U01 - Student can select a material on the basis of knowledge of its properties and application in mechanical constructions,
PEK_U02 - Student can apply a body model to describe properties of a material,
PEK_U03 - Student can apply experimental verification methods to selected advanced materials.

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the strength of materials,
PEK_K03 - Student adheres to the customs and rules of academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Advanced materials. Thematic scope of the course. Classification of materials.	2
Lec2	Composites with continuous fibre for extremely strenuous constructions. Material, technology, exemplary applications.	2
Lec3	High pressure composite vessels for gaseous fuel storage. Design, manufacture, testing, applications.	3
Lec4	Testing methods of high pressure composite vessels for gaseous fuel storage	2
Lec5	Classification, structure, manufacture, application of Smart materials.	2
Lec6	Cross effects. Methods of experimental investigations, measuring apparatus, software for experiment handling.	3

Lec7	Properties of Smart materials stimulated by magnetic field. Examples of experimental investigations.	3
Lec8	Metallic glasses. Manufacture, properties, testing.	2
Lec9	Properties of the materials with martensitic phase transformation induced by plastic strain. Examples of experimental investigations.	3
Lec10	Body models; constitutive equations for selected advanced materials.	3
Lec11	Methods to identify constitutive models for Smart materials.	2
Lec12	Examples of application of Smart materials.	3
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Cyclic tests of high pressure composite vessels for gaseous fuel storage.	2
Lab2	Use of optical fibre sensors in investigations of advanced materials.	2
Lab3	Selected methods of investigation of metallic glasses.	2
Lab4	Investigation of the properties of composites subjected to complex stress states.	2
Lab5	Investigation of martensitic phase transformation induced by plastic strain.	2
Lab6	Application of magnetomechanical effects in the investigations of construction materials. Magnetovision.	2
Lab7	Application of the Thomson effect. Thermovision in the investigations of advanced materials.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	Written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K04	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics of materials; testing and modeling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_IMK_W03	C1,C2		N1,N2, N3,N4
PEK_U01-PEK_U03	K2MBM_IMK_U03	C2,C3		N1,N2
PEK_K01-PEK_K03	K2MBM_K10	C4		N1,N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika materiałów "Smart"**
Name in English: **Mechanics of Smart materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041322**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the courses: Technical Mechanics, Calculus I,
Algebra and Analytic Geometry, Physics.
2. Strength of Materials I and II
3. Student has fundamental knowledge of materials science and plastics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the structure, properties, investigation and modelling methods of selected group of Smart materials.
C2. Acquisition of skills related to constitutive equations and their identification with reference to Smart materials, particularly in the area of mechanical constructions.
C3. Acquisition of skills related to physical fundamentals and methodology of experimental investigations aimed at determining the properties of Smart materials.
C4. Acquisition and strengthening of the social competence including emotional intelligence that is based on the ability to cooperate in a group of students, which is aimed at effective problem solving.
Responsibility, honesty and diligence in one's code of conduct; obeying the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the structure and properties of selected Smart materials
PEK_W02 - Student knows how to describe properties of Smart materials using constitutive models
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods essential to determine the properties of Smart materials.

II. Relating to skills:
PEK_U01 - Student can select a material from the Smart materials group on the basis of knowledge of its properties and application in mechanical constructions,
PEK_U02 - Student can apply a body model to describe properties of a Smart material,
PEK_U03 - Student can apply experimental verification methods to selected Smart materials.

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information,
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the strength of materials,
PEK_K03 - Student adheres to the customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Cross effects; classification, structure, manufacture, application of Smart materials.	2
Lec2	Magnetorheological fluids and ferrofluids and composites based on these fluids; magnetorheological elastomers. Structure, properties and application possibilities.	2
Lec3	Magnetostrictive materials and composites based on these materials. Design of dampers, actuators and measurement systems.	2
Lec4	Magnetocaloric and electrocaloric materials and effects. Cooling systems utilizing Smart materials.	2

Lec5	Smart magnetic materials in the design of NDT measurement systems. Magnetovision and its applications.	2
Lec6	Energy Harvesting. Methods of energy acquisition from vibrations and waste heat using Smart materials.	3
Lec7	Methods of description of Smart materials. Overview of constitutive models. Elastic, pseudoelastic and magnetoelastic materials etc.	2
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Investigation of properties of the magnetorheological damper with a magnetorheological fluid and a magnetorheological composite.	2
Cl2	Determination of damping in a magnetorheological elastomer.	2
Cl3	Testing of the actuator with the "giant magnetostriction" core in the acoustic band; the so-called "playing table"	2
Cl4	Testing of the harvester which acquires electrical energy from vibrations.	2
Cl5	Determination of the properties of the harvester device which acquires electrical energy from waste heat.	2
Cl6	Use of magnetovision in experimental mechanics.	2
Cl7	"Magnetic refrigerator" demonstrator utilizing Smart materials. Testing.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. laboratory experiment
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K03	written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J. Skrzypek, Plastyczność i pełzanie, PWN, Warszawa 1986.
2. Teoria plastyczności, praca zbiorowa pod red. Wacława Olszaka, PWN 1965.
3. Opracowania własne zespołu autora kursu z zakresu wybranych materiałów zaawansowanych.

SECONDARY LITERATURE

Author's own publications (for each topic).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics of Smart materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_IMK_W03	C1	lec1-7	N1,N2,N4
PEK_U01-PEK_U03, PEK_K01-PEK_K03	K2MBM_IMK_U03, K2MBM_K01, K2MBM_K03	C2,C3,C4	cl1-7	N1,N2, N3,N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe cząstkowe**
Name in English: **Partial Differential Equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041323**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the elements of calculus and linear algebra
2. Knowledge of the elements of ordinary differential equations
3. Ability to perform calculations and analysis of the results

SUBJECT OBJECTIVES

C1. Ability to solve the equations of physics
C2. Ability to analyze the course of the processes of physical
C3. he ability to search for information and its analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge about the different types of partial differential equations and methods of solving them
PEK_W02 - Knowledge of the physical issues described partial differential equations
PEK_W03 - Knowledge allows to analyze the results

II. Relating to skills:
PEK_U01 - Ability to formulate and describe the problem
PEK_U02 - Ability to analyze the equations obtained and the use of appropriate methods of solution.
PEK_U03 - Ability to analyze the results.

III. Relating to social competences:
PEK_K01 - Ability to work independently with the use of literature
PEK_K02 - Ability to work systematically and, in particular, the consulting.
PEK_K03 - Collective ability to solve problems in the classroom

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Linear partial differential equations of the first order and second	2
Lec2	Equation of strings	2
Lec3	Wave equations	3
Lec4	Laplace equation	4
Lec5	The equation of transverse vibration of beams	2
Lec6	Test	2
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Equation of strings	2
Cl2	Wave equations	3
Cl3	Laplace equation	4
Cl4	The equation of vibration of beams	4
Cl5	Solving these equations using the equations discussed during the course	2
		Total hours: 15

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials
N3. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U02+PEK_U03	test
P = ocena z kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U02+PEK_U03	test
P = ocena z kolokwium przeprowadzonego na wykładzie		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
W. Żakowski, W. Leksiński, Mathematic part IV

SECONDARY LITERATURE
N. Matwiejew, Methods integration of ordinary differential equations

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Partial Differential Equations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teachin tool numbe

PEK_W01+PEK_W2+PEK_W3	K2MBM_IMK_W01	C1+C2+C3	Lec1-Lec6	N3
PEK_K01+PEK_K2+PEK_K3+PEK_U01+PEK_U2+PEK_U3	K2MBM_IMK_U02	C1+C2+C3	Cl1-Cl5	N1 i N2

SUBJECT SUPERVISOR

dr inż. Grażyna Ziętek tel.: 320-21-18 email: grazyna.zietek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy teorii sprężystości i plastyczności**
Name in English: **Elements of Theory Elasticity and Plasticity**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041326**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the elements of calculus and linear algebra.
2. Knowledge of the elements of strength of materials, in particular knowledge of the state of stress and strain state
3. Ability to perform calculations and analysis of the results obtained in the strength of materials.

SUBJECT OBJECTIVES

C1. Kknowledge of the theory of elasticity and acquisition, in this respect, problem-solving skills to complex stress states.
C2. Knowledge of the theory of plasticity and acquisition, in this respect, problem-solving skills to complex stress states.
C3. Acquiring the ability to formulate equations describing the state of the mechanical components.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Ordered knowledge of the theory of elasticity, particularly in the area of plane stress.
PEK_W02 - Ordered knowledge of the theory of plasticity, particularly in the area of plane stress.
PEK_W03 - Ordered knowledge of the constitutive equations used to describe the materials.

II. Relating to skills:
PEK_U01 - The ability to determine the stresses and strains in complex conditions in various designs.
PEK_U02 - The ability to formulate problems of mechanics of materials of construction.
PEK_U03 - Ability to analyze the results.

III. Relating to social competences:
PEK_K01 - Ability to work independently with the use of literature.
PEK_K02 - Ability to work systematically, in particular, participation in the consultation.
PEK_K03 - Collective ability to solve problems in the classroom.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Stress state	2
Lec2	Strain state	2
Lec3	Transformacja składowych stanu naprężenia i odkształcenia	2
Lec4	Equations of equilibrium and strain compatibility conditions.	2
Lec5	Plane stress and plane strain for elastic medium	2
Lec6	Airy stress function	2
Lec7	Elastic energy volumetric and non-volumetric.	2
Lec8	Strength hypothesis.	4
Lec9	Kinematic, isotropic and mixed hardening.	4
Lec10	Elasto-plastic torsion of prismatic bars	2
Lec11	Elasto-plastic bending of prismatic bars	2
Lec12	Viscoelastic and visciplastic models	4
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Determination of the stress tensor and the strain in the case of differently loaded components.	2
Cl2	Determinant of the principal stress and strain	2
Cl3	Analysis of various types of hardening. Determination of the relationship between stress and strain in the case of uniaxial compression and tension.	4
Cl4	Application of Airy function.	2
Cl5	Determination of the yield strength of the elastic area using the various strength hypotheses	2
Cl6	Application of fundamental equation of the theory of plasticity	2

Cl7	Elasto-plastic torsion of prismatic bars, determining the state of stress and strain	4
Cl8	Elasto-plastic bending of prismatic bars, determining the state of stress and strain.	4
Cl9	Elasto-plastic problems rotationally symmetric	2
Cl10	Bending and torsion of viscoelastic bar	4
Cl11	test	2
		Total hours: 30

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01+PEK_W2+PEK_W3	test
P = Ocena z kolokwium na ćwiczeniach		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U2+PEK_U3	test
P = ocena z kolokwium		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Walczak, The strength of materials and the foundations of the theory of elasticity and plasticity.

SECONDARY LITERATURE
J. Skrzypek, Plasticity and creep.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Elements of Theory Elasticity and Plasticity
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Tea to nur
PEK_W01+PEK_W2+PEK_W3	K2MBM_IMK_W03	C1+C2+C3	Lec1-Lec12	N1
PEK_K01+PEK_K02+PEK_K03PEK_U01+PEK_U02+PEK_U03	K2MBM_K06	C1+C2+C3	Cl1-Cl11	N1

SUBJECT SUPERVISOR

dr inż. Grażyna Ziętek tel.: 320-21-18 email: grazyna.zietek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Tribologia**
Name in English: **Tribology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041329**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 He has ordered knowledge about the types of engineering materials - metal, ceramic, polymer and composite materials.2. It has a basic knowledge of the construction, operation and use of the main components and machine assemblies.3. It has a basic knowledge of physics, chemistry, statistics.
2. Skills: 1. It can analyze the macroscopic fractures, microstructure of materials, technological drawbacks of origin, is able to determine the characteristics of the microstructure of metallic materials.2. He can choose the material on a given machine element and can explore its basic properties.
3. Competencies: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineer.2. Is aware of the importance of behavior in a professional manner and have a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. Familiar with the processes of friction, wear and lubrication of moving nodes and methods for machine control these processes in terms of minimizing their effects (special attention will be paid to the construction and technological methods of increasing the reliability and durability of sliding pairs, as well as the problem of lubrication and lubricant selection as an effective prevention of friction and wear).
C2. Understanding the impact of selected parameters of friction vector, ie, pressure, velocity slip material cooperating associations and grease on the tribological characteristics of sliding pairs. Get to know the influence of the structure of the material to abrasion and impact bushing stiffness for load distribution in the bearing friction.
C3. Show students that they can effectively counteract the negative effects of friction in the moving solid contact with real objects illustrate some of the issues discussed theoretically in the lecture.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the processes of friction, wear and lubrication of moving nodes machine.
PEK_W02 - Know the basic types of lubricants and their applications.
PEK_W03 - He knows the design and technological methods of increasing the reliability and durability of sliding pairs.

II. Relating to skills:
PEK_U01 - It can choose materials for sliding nodes and understand relationships and dependencies between the material used and its durability.
PEK_U02 - It can perform basic tests of materials used in the nodes of friction, interpret them and implement in the final node machines.
PEK_U03 - He can use the theoretical knowledge acquired friction and lubrication of the lecture and apply it in practice.

III. Relating to social competences:
PEK_K01 - It can search for information and critically analyze them.
PEK_K02 - Properly define and resolve dilemmas, adheres to the principle of professional ethics.
PEK_K03 - Able to work independently and as a team, and properly assess their own tasks and priorities of the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program and requirements. Brief history of tribology. Elastic contact of smooth bodies. The real contact of solids. The problem of the surface layer.	2
Lec2	Friction processes, their distribution and characteristics. Sliding and rolling friction. Theories of friction.	2
Lec3	Wear processes, their distribution and characteristics. Effect of pressure and sliding velocity on the friction and wear.	2
Lec4	Characteristics of materials (metal and others) on the sliding nodes and the rules for their selection. Simple and reversed pair of friction.	2

Lec5	Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2
Lec6	Grease as a construction material. Objectives lubrication. The way of obtaining o fluid friction. Distribution of lubricants. Lubricating oils and their properties.	2
Lec7	Greases, their distribution and characteristics.Their characteristics.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	1.Determining of properties of slide bearing materials.	2
Lab2	2.Determining of coefficient of static friction.	2
Lab3	3 Research of lubricity of greases using a four ball tester.	2
Lab4	4. Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	Analysis of the impact bushing stiffness for load distribution in the sliding bearing.	2
Lab6	Analysis of the impact on the structure of the material on abrasive wear (Tester T-07).	2
Lab7	Research of the frictions into screw gear.	2
Lab8	5. Study materials for the seizure.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. laboratory experiment
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_K01 - PEK_K03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Lawrowski Z.; Tribologia, Tarcie, zużywanie i smarowanie. W-a, PWN, 1993.2.Garkunov D. N.; Trybotechnika. Moskva, Mašinostroenie, 1999.3.Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.4.Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990.5. Embedded detailed instructions posted on the website: www.ikem.pwr.wroc.pl/pkmit

SECONDARY LITERATURE

1.Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag, 2000.2.Lawrowski Z.; Technika smarowania. W-a, PWN, 1987.3.Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Tribology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_IMK_W02, K2MBM_IMK_W03, K2MBM_IMK_W04, K2MBM_W05	C1	Lec1, Lec2, Lec3	N1, N2, N5
PEK_W02	K2MBM_W06, K2MBM_W08	C1	Lec6, Lec7	N1, N2, N5
PEK_W03	K2MBM_IMK_W01, K2MBM_IMK_W07, K2MBM_W05	C1	Lec4, Lec5	N1, N2, N5
PEK_U01 - PEK_U03	K2MBM_IMK_U02, K2MBM_IMK_U04, K2MBM_IMK_U06	C2, C3	Lab1 - Lab8	N3, N4, N5
PEK_K01	K2MBM_K01	C1, C2	Lec1-Lec7	N1-N5
PEK_K02-PEK_K03	K2MBM_K01, K2MBM_K03, K2MBM_K09	C3	Lec4-Lec7, Lab1-Lab7	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Matematyka stosowana - metody badań operacyjnych w inżynierii pojazdów**
Name in English: **Applied Mathematics - Operational Methods in Automotive Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041401**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the issues presented in the courses "Mathematical Analysis", "Algebra and Analytic Geometry" and "Engineering Statistics".

SUBJECT OBJECTIVES

C1. Students should obtain basic knowledge from the linear programming and the queuing theory, taking into account the aspects of their application
C2. Participants learn to formulate optimization problems in the field of management and construction, technology and systems designing. They also acquire the ability to formulate optimization problems from queuing theory.
C3. Participants obtain and consolidate social skills including emotional intelligence involving the ability to work in a group of students to solve problems effectively with regard to accountability, integrity and fairness in the proceedings

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course students are able to formulate and solve the problems in the field of linear programming and decision support. They can define queuing systems, know and apply algorithms to solve them. Participants of the course can also interpret the results of optimization as well as to analyze them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Operations research as a tool to support decision-making processes - classification decision-making processes. Methods of decision making under conditions of certainty. Linear programming (PL) - linear model of decision-making, decisions acceptable and optimal.	2
Lec2	Methods for solving PL. Graphical method of PL problems solving. Linear programming models. Formulation and solution of problems PL - interpretation of the results.	2
Lec3	Linear programming models. Simplex algorithm.	2
Lec4	Practice of material discussed during the lecture 1-3. The interpretation of the results.	2
Lec5	Duality in linear programming. Matrix calculus in solving tasks of PL. The dual problem, its measurement and interpretation. Sensitivity analysis of the optimum solution. Changes in the parameters of the objective function and the free terms of constraints. Addition or removing decision variables. Comprehensive analysis of the optimal solution.	2
Lec6	Integer Linear Programming (discrete). The method of shutoff surfaces.	2
Lec7	Practice of material discussed during the lecture 5-6. The interpretation of the results.	2
Lec8	Classical transportation models and algorithms. Transportation model with the criterion of time. Transportation model (unbalanced, with limited bandwidth routes). The problem of localization of production.	2
Lec9	Introduction to graph theory. Project management (network programming). The maximum flow in a network. Ford-Fulkerson algorithm. Decision trees. Minimum spanning tree. The shortest routes in the graph.	2
Lec10	Network Models - deterministic (CPM, PERT) and stochastic (GERT). Time and cost analysis. Gantt charts. Resource optimization in network. Salesman Problem. Little's algorithm. The knapsack problem. The production and inventory models.	2
Lec11	Practice of material discussed during the lecture 8-10. The interpretation of the results.	2

Lec12	Markov process, transition probabilities, Chapman-Kolmogorov equation. Markov processes with countable state space and discrete time, transition probability matrix, random walk process. Markov processes with countable state space and continuous time, Kolmogorov equations for the one-dimensional probability dustribution and the probability transition, the process of birth and death.	2
Lec13	Application of the mass service theory in transportation problems: basic definitions, types and classification of queuing systems, random processes of applications and service, group and multiphase service, queuing networks.	2
Lec14	Practice of material discussed during the lecture 12-13. The interpretation of the results.	2
Lec15	Final exam.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	final exam
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Hamdy A. Taha: Operations research: an introduction. Prentice Hall 1997.
[2] Frederick S. Hillier, Gerald J. Lieberman: Introduction To Operations Research, 1995.
[3] Dennis Blumenfeld: Operations Research Calculations Handbook, Second Edition, CRC Press, 2009.
[4] Donald Gross: Fundamentals of Queueing Theory, Wiley, 2009

SECONDARY LITERATURE
[1] A. Ravi Ravindran: Operations Research Applications, CRC Press, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Applied Mathematics - Operational Methods in Automotive Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W01	C1-C3	Lec1 to Lec14	N1-N3

SUBJECT SUPERVISOR

dr inż. Anna Jodejko-Pietruczuk tel.: 71 320-28-17 email: Anna.Jodejko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Budowa pojazdów i układów napędowych**
Name in English: **Energy Efficiency Design of Powertrain and Body**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041402**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of fundamentals of machine design, mechanics, mathematics and physics on the level adequate for first years of studies at Mechanical Department.
2. Competence in joining phenomenon with mathematical description.

SUBJECT OBJECTIVES

C1. Study of fundamental systems, assemblies and sub-assemblies of automotive vehicles.
C2. Understanding of relationshps between phenomenon connected with vehicle movement and respective vehicle assemblies.
C3. Understanding of development tendencies relating to particular vehicle systems, assemblies and sub-assemblies.
C4. Effort to forecast of vehicle choosen assemblies development.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Have fundamental knowledge related to building means of transport particulary cars, trucs, busses and one-track vehicles.
PEK_W02 - Have knowledge about phenomenon existing in main automotive vehicle systems.

II. Relating to skills:
PEK_U01 - Capable of analyzing relationships between requirements for means of transport and their structure.

III. Relating to social competences:
PEK_K01 - Have consciousness of practical application of knowledge achieved during studies for designing and exploatation means of road transport.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Hundred years of motorization development.	2
Lec2	Transportation systems.	2
Lec3	Systems in cars and lorries.	2
Lec4	Vehicle centre of gravity. Forces acting on vehicle during parking and movement.	2
Lec5	Collaboration between wheel and foundation. Rolling resistance.	2
Lec6	Aerodynamic resistance.	2
Lec7	Power necessary for vehicle movement.	2
Lec8	Engine map and required power.	2
Lec9	Power transmission system.	2
Lec10	Construction and functioninig of seering system.	2
Lec11	Construction and functioning of break system.	2
Lec12	Tendencies in application of new materials in automotive vehicles.	2
Lec13	Comunicational systems used in vehicles and by vehicles.	2
Lec14	Vehicle as a robot.	2
Lec15	Examination.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Safety first.	2
Lab2	Motion resistances.	2
Lab3	Investigation of steering system.	2
Lab4	Investigation of suspension system.	2
Lab5	Investigation of break system.	2
Lab6	Static and dynamic wheels balancing.	2

Lab7	Investigation of body geometry.	2
Lab8	Investigation of automobile vehicle noise.	2
Lab9	Investigation of comfort and visibility.	2
Lab10	Investigation of aerodynamic.	2
Lab11	Simultational investigation of automotive vehicles systems.	4
Lab12	FEM strength analysis of automotive vehicles.	4
Lab13	Credit for laboratory.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. laboratory experiment
N4. self study - preparation for laboratory class
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Written - oral examination.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Short written examination
F2	PEK_U01, PEK_K01	Report
F3	PEK_U01, PEK_K01	Activity during lessons.
P = 0,7F1 + 0,15F2 + 0,15F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.Mitschke Manfred: Dynamika Samochodu, WKŁ9 (in polish), also available in german Dynamik der Kraftferzeuge, Springer Verlag.

2.Kazimierz Studziński: Budowa Samochodu, WKŁ (in polish)

3. Victor Albert Walter Hillier.: Fundamentals of Motor Vehicle Technology. Nelson Thornes, 2001

4.R.K.Rajput, Text Book of Automobile Engineering, Laxmi Publications Ltd, 2007

5.Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals, SAE international, 2004

SECONDARY LITERATURE
1. William H. Crouse, Automotive Machanics, McGraw-Hill

2. Malcolm James Nunney.: Light and Heavy Vehicle Technology. Butterworth-Heinemann, 2007

3. Allan Bonnick.: Automotive Science and Mathematics. Elsevier, 2008

4. George Appel, International Correspondence Schools.: Automobile Manual Transmission Systems. International Correspondence Schools, 1970

5. Lambert M. Surhone,Miriam T. Timpledon,Susan F. Marseken.: Transmission: Transmission Mechanics, Speed, Torque, Gear Ratio, Fuel. Betascript Publishers, 2009

6.Ulrich W. Seffert, Hans Hermann Braess,Handbook of Automotive Engineering

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Energy Efficiency Design of Powertrain and Body
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W09, K2MBM_AE_W12	C1 - C3	Le 1 - Le 11	N1,N2
PEK_W02	K2MBM_AE_W09, K2MBM_AE_W12	C1-C3	Le 1 - Le 14	N1,N2
PEK_U01	K2MBM_AE_U06	C1-C3	Lab 1 - Lab 13	N3,N4,N5
PEK_K01	K2MBM_AE_K07	C1-C4	Lab 1 - lab 13	N1-N5

SUBJECT SUPERVISOR

dr hab. inż. Piotr Wrzecioniarz tel.: 71 347-79-18 email: Piotr.Wrzecioniarz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie maszyn i urządzeń**
Name in English: **Machine and Device Control Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041403**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge about basic hydraulic components.
2. Basic knowledge about fluid power control systems.
3. Basic knowledge regarding pneumatic control systems.

SUBJECT OBJECTIVES

C1. Acquire knowledge about hydraulic and electrohydraulic control systems.
C2. Acquire knowledge about proportional valves and servovalves.
C3. Acquire knowledge about pneumatic control systems
C4. Acquire knowledge about design of control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know basic hydraulic and electrohydraulic control systems.
PEK_W02 - Know the design principles of proportional valves and servovalves.
PEK_W03 - Know basic kind of pneumatic systems.

II. Relating to skills:
PEK_U01 - Able to solve the problems connecting with hydraulic and electrohydraulic control.
PEK_U02 - Able to solve questions connected with application of proportional valves and servovalves.
PEK_U03 - Able to solve basic questions connected with pneumatic control systems.

III. Relating to social competences:
PEK_K01 - Effective search of informations and it critical evaluation.
PEK_K02 - Capability to work in a team with clear distribution of obligations and effectvie solving of entrusted tasks.
PEK_K03 - Capability of proper argumentation and substantiation of own point of view.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction and definition of machine control system.	3
Lec2	Structure of hydraulic control systems.	3
Lec3	Proportional valves and servo valves, examples of application.	2
Lec4	Open and close loop control systems	2
Lec5	Electrohydraulic control systems, controllers.	2
Lec6	Examples of industrial applications of electrohydraulic control systems.	3
Lec7	Pneumatic control systems.	3
Lec8	Setup for the measurement of rpm of the crankshaft	2
Lec9	Setup for measurement of the teeth numbers in a gearbox.	2
Lec10	System for the detection of instability.	2
Lec11	System for measurement of the temperature in the sliding bearings.	2
Lec12	System for the measurement of the pressure in tires.	2
Lec13	test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Hydraulic rewerse systems.	2
Lab2	Hydraulic rapid motion systems.	2
Lab3	Hydraulic systems - in parallel and in line throttling control.	2
Lab4	Control systems in vehicle with pneumatic drive - Pneumobil.	2
Lab5	Volumetric control systems.	2
Lab6	Control system with proportional directional control valve.	2

Lab7	Load sensing control.	2
Lab8	Final laboratory - credit and mark.	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. tutorials N3. self study - preparation for laboratory class N4. report preparation N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	short test at the beginning of the class - quiz
F2	PEK_U01 - PEK_U03 PEK_K01--PEK_K03	oral answers
F3	PEK_U01 - PEK_U03 PEK_K01--PEK_K03	report from laboratory
P = 0,2F1+0,4F2+0,4F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J. Stecki, A. Garbacik: Design and Steady-state Analysis of Hydraulic Control Systems, Fluid Power Net Publications, Cracow 2002
2. J. Ivantysyn, M. Ivantsynowa: Hydrostatic Pumps and Motors, Tech Books International, 2003 - 512
3. S. Stryczek: Napędy i Sterowania Hydrauliczne, PWN Warszawa
4. W. Kollek: Podstawy projektowania napędów i sterowań hydraulicznych , P. Wr., 2004

SECONDARY LITERATURE

1. Fluid Power Focused on Applications, Conference Procedings, Aachen, 2002, 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Machine and Device Control Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_AE_W11, K2MBM_W01, K2MBM_W02, K2MBM_W04	C1-C4	Lab1 - Lab8, Lec1 - Lec12	N1.- N5.
PEK_U01, PEK_U02, PEK_U03	K2MBM_AE_U03, K2MBM_AE_U07, K2MBM_AE_U09, K2MBM_AE_U11	C1-C4	Lab1 - Lab8,	N2.- N5.
PEK_K01, PEK_K02, PEK_K03	K2MBM_AE_K02, K2MBM_AE_K07, K2MBM_AE_K08	C1-C4	Lab4	N2- N5.

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania maszyn**
Name in English: **Machinery Design Process**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041404**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to the mechanics and strength of materials.
2. Knowledge of issues related to manufacturability of a design and manufacturing technologies.

SUBJECT OBJECTIVES

C1. Acquiring of knowledge about the basics of designing of vehicle's components.
C2. Acquiring of ability to select computational models for the main components used in vehicles.
C3. Acquiring of basic skills of designing subassemblies used in vehicles and analysing of selected solutions.
C4. Acquiring of ability to organize work in a team and to fulfil own specified tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Detailed knowledge of individual and group designing.
PEK_W02 - Detailed knowledge of the existing tools used in the initial and the final stage of the designing process.
PEK_W03 - Detailed knowledge of the methods of assessment and classifying of developed concepts.

II. Relating to skills:
PEK_U01 - Management of team work as well as fulfil the assigned tasks inside the group.
PEK_U02 - Able to find information in the available literature on the techniques and methods of searching solutions in the designing process.
PEK_U03 - Formulation of guidelines for the designing process based on specific requirements and limitations.

III. Relating to social competences:
PEK_K01 - Thinjing creatively.
PEK_K02 - Making report of a carried out engineering work.
PEK_K03 - Determination of the consequences of decisions made in a team.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Formulation of designing models in the field of vehicles' construction.	4
Lec2	Methods of specifying a goal of designing of elements and assemblies of vehicles.	6
Lec3	Heuristic and algorithmic methods in vehicle's designing - theory and practice.	6
Lec4	Generation of initial solutions.	2
Lec5	Formulation of multi-criteria system for the evaluation of generated solutions. Determination of significance of the proposed criteria.	4
Lec6	Evaluation of generated project solutions.	4
Lec7	Remodelling of an own algorithm of designing of vehicle's components.	2
Lec8	Methods of popularising solutions.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	The scope of the project, rules of assessment, literature. Construction of object models (e.g. structures of: brakes, recuperation systems, steering mechanisms, etc.). Selection of the designing object.	2
Proj2	A practical usage of heuristic and algorithmic methods (morphological table, tree of solutions for own project).	2
Proj3	Synthesis of own evaluation criteria - example and practice. Classifying significance of criteria.	2
Proj4	Creating and managing initial solutions. Preliminary assessment of designing solutions.	2
Proj5	More detailed characterization of the selected pre-designed device.	2

Proj6	Preparation of technical documentation.	4
Proj7	Remodelling of an own algorithm of designing.	1
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. traditional lecture with the use of transparencies and slides
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Participation in problem discussions.
F2	PEK_W01 - PEK_W03	Final test.
P = 0,2 F1 + 0,8 F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of the project preparation.
F2	PEK_U02, PEK_U03, PEK_K02, PEK_K03	Presentation of the project.
P = 0,5 F1 + 0,5 F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Avallone E. A., Baumeister III T., Sadegh A. M. Marks' Standard Handbook for Mechanical Engineers, The McGraw-Hill Companies, 2007.
[2] Norton R. L.: Machine Design: An Integrated Approach, 3/E, Prentice Hall, 2006.
[3] Pahl G., Beitz W. et al. Engineering Design. A Systematic Approach, Springer, 2007.
[4] Ullman D. G. The mechanical design process. McGraw-Hill, 2003.

SECONDARY LITERATURE
[1] Parmley R. O. Illustrated Sourcebook of Mechanical Components, The McGraw-Hill Companies, 2000.
[2] Shigley J. E., Mischke C. R., Brown Jr. T. H. Standard Handbook of Machine Design, The McGraw-Hill Companies, 2004.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Machinery Design Process
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W09, K2MBM_W06	C1, C3	Lec1 to Lec8	N1, N2
PEK_W02	K2MBM_AE_W09, K2MBM_W06	C1, C2, C3	Lec1 to Lec8	N1, N2
PEK_W03	K2MBM_AE_W09, K2MBM_W06	C3	Lec6	N1, N2
PEK_U01	K2MBM_AE_U19, K2MBM_AE_U21, K2MBM_U14	C3, C4	Proj1 to Proj6	N3
PEK_U02	K2MBM_AE_U01, K2MBM_AE_U02	C2, C3	Proj1; Proj2	N3
PEK_U03	K2MBM_AE_U15, K2MBM_U07	C2, C3	Proj1	N1, N2, N3
PEK_K01	K2MBM_AE_K01, K2MBM_AE_K11	C1, C3	Proj1 to Proj5; Proj7	N3
PEK_K02	K2MBM_AE_K03	C3	Proj6	N3, N4
PEK_K03	K2MBM_AE_K04, K2MBM_AE_K05	C4	Proj1 - Proj5	N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Franciszek Przystupa tel.: 71 320-21-55 email: franciszek.przystupa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie układów wieloczłonowych**
Name in English: **Modelling of multibody systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041405**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the theory of machines and mechanisms
2. Ability to analyze the kinematics and kinetostatics of mechanisms

SUBJECT OBJECTIVES

C1. Understanding of building of discrete computational multibody models
C2. Understanding the principles of planning research, taking into account the working conditions (kinematic excitations, dynamic excitations, forces, torques, masses in multibody dynamic analysis of computer systems
C3. Ability to critically assess the results of simulations of machinery in computer systems for dynamic analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Ability to apply professional computer system for simulating and analyzing dynamic multibody
PEK_U02 - The ability to model the loads and the nature of work and the ability to analyze the mechanism of the results of the simulation of the multi-segment
PEK_U03 - The ability to compute the kinematics and dynamics of selected groups of mechanisms

III. Relating to social competences:
PEK_K01 - Knowledge of how to take responsibility for own work
PEK_K02 - Acquires care about the aesthetics of the work, including projects and reports

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of building a multibody models	2
Proj2	Basics of modeling mechanisms in the MD.Adams system - modeling links, kinematic pairs, kinematic excitations	3
Proj3	Basics of modeling mechanisms in the MD.Adams system - modeling loads and perform calculations and analysis of results	3
Proj4	The test of modeling multibody system	2
Proj5	Kinematic and kinetostatic analysis of linkage mechanisms - building virtual models	2
Proj6	The analysis of kinematic and dynamic properties of the linkage mechanism (project)	2
Proj7	Analysis of gears (normal, planetary and differential) - principles of construction of virtual model	2
Proj8	The analysis of kinematic and dynamic properties of the gears (project)	3
Proj9	Building models of manipulators - direct and inverse task of kinematics	3
Proj10	Simulation researches of manipulators (project)	3
Proj11	Building models of spatial mechanisms - constraints, excitations	2
Proj12	Modeling and simulations of spatial mechanisms (project)	3
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. multimedia presentation
N3. project presentation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K02	Evaluation of test
F2	PEK_U01-PEK_U03 PEK_K01-PEK_K02	The average of projects evaluation
P = 0,2*F1+0,8*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003.
2. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007.
3. MD. Adams – Reference Manual, 2008.
4. Haug E.J.: Computer Aided Kinematics and Dynamics of Mechanical Systems. Allyn and Bacon, Boston 19895.
5. Norton R., L.: Design of Machinery, An introduction to the synthesis and analysis of mechanisms of machines. WCB, McGraw-Hill, Boston, 1999.
6. Shabana A. Ahmed: Computational Dynamics, . A Wiley-Interscience Publications, NewYork, 1994.

SECONDARY LITERATURE
1. Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna wydawnicza PWr. Wrocław 1996.
2. Waldron J., Kinzel G.; Kinematics, dynamics and design of machinery, John Wiley & Sons, Inc. New York, 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modelling of multibody systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K2MBM_AE_U13	C1-C3	Proj1 to Proj12	N1-N4
PEK_K01-PEK_K02	K2MBM_AE_K03, K2MBM_AE_K05	C1-C3	Proj1 to Proj12	N1-N4

SUBJECT SUPERVISOR
dr hab. inż. Krzysztof Bałchanowski tel.: 71 320-27-10 email: jacek.balchanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania elementów i zespołów maszyn**
Name in English: **Testing of Vehicle Elements and Assemblies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041406**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			30		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes			0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the construction and principles of operation of assemblies and systems of motor vehicles, as well as specialized terminology (in English).
2. Ability to interpret the observed physical phenomena.
3. Knowledge of the techniques of development and presenting the experiment measurements results.

SUBJECT OBJECTIVES

C1. Understanding of the fundamental theories, equipment and methods of analysis of the results of measurements of selected parameters characterizing the properties and/or the performance of elements and assemblies of motor vehicles using modern experimental methods.
C2. Mastering of the practical application of the selected measurement method (selection of the measuring system scheme, the identification of the factors influencing the accuracy of the measurement, interpretation of the data).
C3. Improving the ability to team work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Ability to practical application of the representative (for selected methods of measuring mechanical quatities) measurement techniques in the area: construction of the measuring system and data acquisition.
PEK_U02 - Performing a quantitative analysis based on measurements recorded data, including those obtained by optical methods.
PEK_U03 - Formulation of conclusions based on relationships between measured parameters and functioning of the elements and assemblies of the motor vehicles.

III. Relating to social competences:

PEK_K01 - Recognizes the importance of the experimental methods application in the design and operation of vehicles.
PEK_K02 - Demonstrates the ability of self-education (preparation for laboratory classes) and presentation of their work in a foreign language.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Application of the acoustic holography in vehicle assembly testing.	2
Lab2	Determination of the temperature field parameters using thermovision.	2
Lab3	Application of the holographic interferometryfor pneumatic valve cover displacement determination or for detection of the vehicle tire defects.	2
Lab4	The sandwich construction displacement measurement using the speckle photography method.	2
Lab5	Application of the ESPI method for chassis frame's element displacement determination.	2
Lab6	Photoelastic investigation of the towing hitch model.	2
Lab7	Application of the photoelastic coating technique for suspension element testing.	2
Lab8	Application of the videoextensometer for large strains determination in rubber or rubber-metal elements of motor vehicles	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K02	entry test; F1= (W1+...+W8)/8
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01	report on the experiment; every report has to good rating (min. 3.0); F2=(S1+...+S8)/8
P = 1/4*F1+3/4*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] instructions for the laboratory classes, [2] Cloud G. L., Optical methods of engineering analysis, Cambridge University Press, 1998.[3] Sharpe, Jr., Wiliam N. (ed.), Springer Handbook of Experimental Solid Mechanics, 2008.[4] Harwood N., Cummings W. M., Mackenzie A. K.: Thermoelastic Stress Analysis, IOP Publ. Ltd., London, 1991.

SECONDARY LITERATURE

[1] Dally J.W., Riley W.F., Experimental Stress Analysis (3rd ed.), McGraw-Hill, Inc., 1991.[2]] Kobayashi Alberts (ed.), Handbook on Experimental Mechanics, Englewood Cliffs, NJ, Prentice-Hall, Inc., 1987. [3] Falzon B.G., Aliabadi M.H., Buckling and Postbuckling Structures, Imperial College Press, 2008.[4] Laermann K-H., Optical Methods in Experimental Solid Mechanics, Springer, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Testing of Vehicle Elements and Assemblies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2MBM_AE_U04, K2MBM_AE_U05	C1, C2	Lab1 to Lab8	N1-N3
PEK_K01, PEK_K02	K2MBM_AE_K10, K2MBM_AE_K11	C3	Lab1 to Lab8	N1, N3

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie materiałów inżynierskich**
Name in English: **Design of Engineering Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041408**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in such disciplines as: Materials science, Strength of materials, Manufacturing technology, processing and recycling of materials, design and examination methods of structure and properties of materials.
2. Skills in usage of technical data and specialized computer software.
3. Skills in collaboration with other users of engineering materials and specialists in the fields of design, manufacturing, processing, and application of materials.

SUBJECT OBJECTIVES

C1. Obtaining the skills in design of chemical composition and structure of engineering materials to produce products with desired mechanical and operational properties.
C2. Obtaining the skills in materials selection for technical applications.
C3. Obtaining the skills in failure analysis of materials and design of repair processes for improvement of products durability.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possessing advanced knowledge on structure- properties relationship as well as on strengthening mechanisms in materials and their practical usage for material design of products.
PEK_W02 - Knowing the fundamentals and design philosophy of modern engineering materials.
PEK_W03 - Knowing the criteria and methodology of materials selection and can participate in engineering design of products.

II. Relating to skills:
PEK_U01 - Able to design the materials structure in order to obtain the desired operational properties of product.
PEK_U02 - Able to select a material for a specific product with consideration of economical and ecological aspects.
PEK_U03 - Able to conduct the failure analysis of material and design the repair process for improvement of product durability.

III. Relating to social competences:
PEK_K01 - Possessing the collaboration skills and able to lead the research teams in engineering design process.
PEK_K02 - Conducting the research activity on materials design of products.
PEK_K03 - Possessing the skills of objective evaluation of arguments and formulation of rational conclusions concerning the use of engineering materials for different products and operational conditions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to design of engineering materials. Effect of chemical composition, processing and microstructure on properties of materials.	2
Lec2	The role and signifcance of alloy phase diagrams in design of materials.	2
Lec3	The design philosophy of modern steels for automotive industry.	3
Lec4	Strengthening mechanisms in metals and alloys - part I.	2
Lec5	Strengthening mechanisms in metals and alloys - part II.	2
Lec6	Metal matrix composites - fundamentals in design.	2
Lec7	Criteria and quantitative methods of materials selection in engineering design.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Selection of material for chosen structural component - project, part I.	2
Proj2	Design of chemical composition of steel with desired hardenability.	2
Proj3	Design of microstructure of steel in the process of heat treatment - part I.	2
Proj4	Design of microstructure of steel in the process of heat treatment - part II.	2
Proj5	Individual materials expertise combined with selection of material - part I.	2
Proj6	Individual materials expertise combined with selection of material - part II.	3
Proj7	Selection of material for chosen structural component - project, part II.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. case study
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03	short quiz, oral answers, report, discussions
F2	PEK_U01÷PEK_U03;PEK_K01-PEK_K03	defence of the project
P = 0,3F1+0,7F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.J.P. Schaffer, A. Saxena, S.D. Antolovich, T.H. Sanders, S.B. Warner: The science and design of engineering materials, WCB/McGraw-Hill, 1999; 2.M.F. Ashby: Materials Selection in Engineering Design, Pergamon Press, Oxford 1998; 3.Thomas H. Courtney: Mechanical Behaviour of Materials, 2th ed., McGraw-Hill, 2000;4.Ch. R. Brooks, A. Choudhury: Failure Analysis of Engineering Materials, McGraw-Hill, 2002.

SECONDARY LITERATURE
1.D. Henkel, A. W. Pense: Structure and properties of engineering materials, McGraw-Hill, 2002.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of Engineering Materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W06, K2MBM_AE_W18	C1	Lec1 to Lec5	N1, N2, N3
PEK_W02	K2MBM_AE_W06, K2MBM_AE_W18	C1	Lec1 to Lec3, Lec6	N1, N2, N3
PEK_W03	K2MBM_W05	C2	Lec7	N1, N3
PEK_U01	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U23	C1	Proj2 to Proj4	N2, N3
PEK_U02	K2MBM_AE_U01, K2MBM_AE_U19, K2MBM_AE_U23, K2MBM_U07	C2	Proj1; Proj7	N3
PEK_U03	K2MBM_AE_U04, K2MBM_AE_U06, K2MBM_AE_U21	C3	Proj5 to Proj6	N4
PEK_K01	K2MBM_AE_K01, K2MBM_AE_K04, K2MBM_AE_K05, K2MBM_AE_K06, K2MBM_AE_K08	C2, C3	Proj1 to Proj7	N2, N4, N5
PEK_K02	K2MBM_AE_K07, K2MBM_AE_K10, K2MBM_AE_K11	C1	Proj2 to Proj6	N2, N4, N5
PEK_K03	K2MBM_AE_K02, K2MBM_AE_K03, K2MBM_AE_K07, K2MBM_AE_U04	C2, C3	Proj1, Proj5 to Proj6, Proj7	N4, N5

SUBJECT SUPERVISOR

dr inż. Krzysztof Widanka tel.: 320-37-00 email: krzysztof.widanka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**
Name in English: **Strength of Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041409**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competences resulting from the implementation of courses Technical Mechanics, Calculus I, Algebra and Analytic Geometry, Physics. The student mastered the course material provided Strength of Materials I and II, including: know how to fix it alone statically determinate systems for simple load cases (tension, bending, torsion) and selected complex cases (stretching and bending, bending and torsion).
2. The student is able to determine the reactions of the statically determinate beams and frames. He has mastered the knowledge of selected cases of indeterminate systems (thermal stress and the tension mounting, the reactions in indeterminate beams using differential equation of deflected axis, the reaction in the indeterminate twisted rod). Knows the basic of strength theories and
complex stress state.
3. The student mastered the basics of fatigue strength. Student is able to perform basic strength tests (tension, compression, torsion, fatigue).

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on selected topics of strength of materials useful in the education of Automotive Engineering.
C2. Knowledge acquisition of the calculations of indeterminate systems using energy methods.
C3. Acquisition of knowledge in the basics of physical and experimental tests used to determine the properties of materials for the automotive and airplanes constructions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowing how to solve indeterminate systems using energy methods
PEK_W02 - Knowing selected modern methods of experimental determination of mechanical properties of materials for construction of land and air vehicles,
PEK_W03 - Knowledge of the foundations and applications of selected computational and experimental methods of strength of materials

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Isostatic and hyperstatic cases in mechanical systems. Externally and internally hyperstatic cases. Menabrea-Castigliano's theorem.	3
Lec2	Maxwella-Mohr theorem including Vereshchagin rule applied to hyperstatic issues	3
Lec3	Force method applied to hyperstatic issues	4
Lec4	Testing methods of high pressure composite vessels for gaseous fuels	2
Lec5	The basics of monitoring methods of mechanical structures in the manufacturing and operation process with the use of fiber optic systems	2
Lec6	The use of thermovision system in the study of mechanical engineering components: metallic and composite (polymeric)	2
Lec7	Application of cross effects during strength tests	3
Lec8	Methods for energy recovering from the vehicle using the materials in which there are cross effects (Energy Harvesting)	3
Lec9	Energy hypotheses of fatigue process. Methodology for determining the strain energy under cyclic loading. Cumulation of energy	2
Lec10	Cold martensitic transformation for a shape memory metals. Application possibilities in the study of strength of materials	2
Lec11	Physical properties of materials for semiactive damping	2

Lec12	Methods of testing of composite materials (longfibers) using specific samples (pipe, ring and a NOL type)	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03,	Colloquium (written test)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Dyląg Z., Jakubowicz A., Orłoś A., Strength of Materials. Part I and II. WNT.Warszawa 1996,in Polish.
2. Niezgodziński M.E., Niezgodziński T., Strength of Materials. PWN. Warszawa 2009,in Polish.
3. Timoshenko S., Strength of Materials,Part 1 and Part 2. D. van Nostrand Company (wyd. arch.).
4. Da Silva, V.D., Mechanics and Strength of Materials, Springer. 2005.

SECONDARY LITERATURE

1. Jastrzębski P., Mutermilch J., Orłowski W., Strength of Materials, Part 1 and 2,Arkady 1986, in Polish.
2. Surya Patnaik & Dale Hopkins, Strength of Materials, Elsevier. Amsterdam 2012.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of Materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02, PEK_W03	K2MBM_AE_W08	C1,C2,C3	Lec1 to Lec12	N1, N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria powierzchni**
Name in English: **Surface engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041410**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physico-chemical and mechanical properties of materials engineering; basic understanding of heat and thermo-chemical treatment, able to analyze images of macro and microstructure of engineering materials.
2. Knowledge about the types of engineering materials - their structure, properties, applications and selection.
3. Structured knowledge about manufacturing techniques.

SUBJECT OBJECTIVES

C1. Understanding the possibilities of shaping and charaterize certain physical features of the surface layer, which are important for its future exploitational characteristics.
C2. Understanding the basic techniques of: analysis of the surface layer, profilographometry and locate and analyze of surface defects.
C3. Gaining knowledge on techniques to modify the properties of the surface layer of engineering materials. In this surface machining and coating.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Able to explain, including the physico-chemical properties of metallic materials, composites and plastics, rules of the selection of materials for the operating conditions.

PEK_W02 - Definition and formulation of the surface properties of components used in automotive engineering.

PEK_W03 - Appropriate linguistic resources for specialist meaning in the field of surface engineering to communicate effectively in a professional environment.

II. Relating to skills:

PEK_U01 - Gaining the skills to conduct research in industrial practice using profilographometry and microscopic techniques.

PEK_U02 - Able to measure and analyze the reasons for cutting tool wear.

PEK_U03 - Able to select engineering materials to the operating conditions.

III. Relating to social competences:

PEK_K01 - Objective evaluation of arguments to justify and the rational explanation his own point of view, using knowledge of surface engineering.

PEK_K02 - Awarness of professional conduct on the test stand and know the main principles of safe operation of measuring devices.

PEK_K03 - Understanding the need of life long learning by knowledge updating, training and enhance skills in the field of surface engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristic properties of the surface layer (SL) of an object.	2
Lec2	The methods and measurement for 2D and 3D roughness testing.	2
Lec3	Functional features of machine and devices, technological and exploitational, surface layers.	2
Lec4	Physico-chemical properties of the surface layer of engineering materials.	2
Lec5	Methods for modifying the physical and geometrical characteristics of surface layer.	2
Lec6	Possibilities of creating surfaces with specific properties applying different methods of shaping and forming.	2
Lec7	Surface coating methods.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Flat (2D) and spatial (3D) measurements and analysis of surface micro-geometry.	2
Lab2	Measurement of the mechanical and physico-chemical properties of the selected materials.	2
Lab3	Surface measuremnt using a computerized video analysis.	2
Lab4	Superfinish surface machining.	2
Lab5	Modifying of surface layer by roller burnishing.	2

Lab6	Measurement of shape and position deviations of machine components.	2
Lab7	Surface layer analysis after WEDM.	3
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class
N3. traditional lecture with the use of transparencies and slides
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_WO2; PEK_W03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_UO2; PEK_U03PEK_K01; PEK_K02; PEK_K03	quiz
F2	PEK_U01; PEK_UO2; PEK_U03PEK_K01; PEK_K02; PEK_K03	participate in discussions problem
F3	PEK_U01; PEK_UO2; PEK_U03PEK_K01; PEK_K02; PEK_K03	laboratory report
P = 0,3F1+0,3F2+0,4F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. R.Chattopadhyay, ’Advanced Thermally Assisted Surface Engineering Processes’ Kluwer Academic Publishers, MA, USA (now Springer, NY), 2004, ISBN 1-4020-7696-7, E-ISBN 1-4020-7764-5.
2. Sanjay Kumar Thakur and R. Gopal Krishnan, ’Advances in Applied Surface Engineering’, Research Publishing Services, Singapore, 2011, ISBN 978-981-08-7922-8.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Surface engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2MBM_AE_W06, K2MBM_AE_W07	C1; C2; C3	Lec1 to Lec7	N1; N2; N3; N4
PEK_U01; PEK_U02; PEK_U03	K2MBM_AE_U05, K2MBM_AE_U12, K2MBM_AE_U19	C1; C2; C3	Lab1 to Lab7	N1; N2; N4
PEK_K01; PEK_K02; PEK_K03	K2MBM_AE_K02	C1; C2; C3	Lab1 to Lab7	N1; N2; N3; N4

SUBJECT SUPERVISOR

dr inż. Dariusz Poroś tel.: 27-91 email: dariusz.poros@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Silniki spalinowe**
Name in English: **Developing Engine Technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041411**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the theory and design of internal combustion engines.
2. Ability to conduct measurements of mechanical and electrical engineering.
3. Knowledge of technical English vocabulary associated with internal combustion engines.

SUBJECT OBJECTIVES

C1. Arrangement engineering knowledge about the design and classification of internal combustion engines.
C2. Discussion of opportunities and identify development trends of internal combustion engines, coupled with the transfer of knowledge on the combustion process and engine characteristics.
C3. Familiar with laboratory measurement techniques needed in research and development of internal combustion engines.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Depth knowledge of the design and development trends of internal combustion engines.
PEK_W02 - A knowledge of the calculation and analysis of the combustion process in internal combustion engines.
PEK_W03 - A knowledge of the characteristics of the internal combustion engine and method of their use for the development of engine design with special consideration of environmental requirements and sports.

II. Relating to skills:
PEK_U01 - Getting eco-skills and sports operation of internal combustion engines.
PEK_U02 - Able to independently organize and carry out measurements of selected engine systems and engine bench testing of the complete motor and able to correctly interpret the results of theoretical analysis and laboratory testing of internal combustion engines.
PEK_U03 - Understand the need for lifelong learning including language skills to the free discussion of matters of research and development of internal combustion engines in English.

III. Relating to social competences:
PEK_K01 - Gaining characteristics of a person operating in accordance with the principles of ethics.
PEK_K02 - Meets the rules and customs, and different methods of training by the association in an international team.
PEK_K03 - The strengthened responsibility for the work carried out and get respect for the work of another man.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview engineering knowledge of internal combustion engines - history and classification.	2
Lec2	Overview engineering knowledge of internal combustion engines – design and technology (Part One).	2
Lec3	Overview engineering knowledge of internal combustion engines - design and technology (Part Two).	2
Lec4	The first and second law of thermodynamics in combustion engines.	2
Lec5	The operating factors of the internal combustion engine.	2
Lec6	The characteristics of internal combustion engines.	2
Lec7	The study of internal combustion engines according to current regulations.	2
Lec8	The development of internal combustion engines - construction and technological activities.	2
Lec9	The development of internal combustion engines in terms of the use of alternative fuels.	2
Lec10	The development of internal combustion engines by downsizing - the global ecological effect.	2
Lec11	The development of internal combustion engines for the sport.	2
Lec12	Durability of engines.	2
Lec13	Hybridization of combustion drive systems.	2

Lec14	Development trends of internal combustion engines for example engines as "Engines of the Years".	2
Lec15	Engine news in improving the overall efficiency.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	The organization of research in laboratory studies of internal combustion engines with a discussion of the safety and health at work.	2
Lab2	Methodology of engine research - selection and calibration of the brake, connections, sensors, data sheets, etc.	2
Lab3	Dimensional measurements of selected elements of the piston-crank set and assessment of the degree of wear.	2
Lab4	Design of various fuel supply systems for spark ignition engines with the determination of the characteristics of fuel injection	2
Lab5	Design of various fuel supply systems of diesel engines with the determination of the characteristics of fuel injection.	2
Lab6	Identification of the filling ratio for combustion engine and improvement of the overall efficiency.	2
Lab7	Determination of the performance map of the internal combustion engine – tests for different load and revolution - Part One.	2
Lab8	Determination of the performance map of the internal combustion engine – tests for different load and revolution - Part Two.	2
Lab9	The performance map of the internal combustion engine - interpretation of results.	2
Lab10	The pressure measurement in the combustion chamber of the engine for different settings.	2
Lab11	Determination of the heat balance of the internal combustion engine along with the measurement of temperature fields of outside walls by thermo vision technology.	2
Lab12	Tests of the efficiency of the catalyst in the exhaust system and gas chemical analysis.	2
Lab13	Research engines fitted to vehicles on a chassis dynamometer.	2
Lab14	Rating combustion engine based on data from the OBD system under natural operating conditions.	2
Lab15	Visit in garage - engine diagnostics.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - self studies and preparation for examination
N3. laboratory experiment
N4. self study - preparation for laboratory class
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	involvement in the class (class activity)
F2	PEK_W01; PEK_W02; PEK_W03	Written exam
P = 0,2F1+0,8F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02; PEK_U03; PEK_K02	entry quiz F1=(W1+…W14)/14
F2	PEK_U01; PEK_U02; PEK_U03; PEK_K02; PEK_K03	activity in the classroom F2=(A1+…+A15)/15
F3	PEK_U01; PEK_U02; PEK_U03; PEK_K02; PEK_K03	Laboratory report (at least a satisfactory rating of each laboratory) F3=(S1+…+S15)/15
P = 0,2F1+0,2F2+0,6F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Blair G.P. Design and Simulation of four-stok enignes, SAE, Warrendale 1996
Heywood J.B. Internal Combustion Engine Fundamentals, McGraw-Hill International Editions, Singapore 1989
Sroka Z.J., Kułażyński M. Developing Engine Technology, Printpap Łódź 2011

SECONDARY LITERATURE
Janicka A., Kolanek Cz., Walkowiak W. Applied Thermodynamics – internal combustion engine Laboratory, Printpap Łódź 2011
Kułazyński M. Green Fuels, Printpap Łódź 2011
Lackner M., Winter F., Agerwal K.A. Handbook of Combustion, Willey Edition, Indianapolis 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Developing Engine Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W09, K2MBM_AE_W18	C1	Lec1; Lec2; Lec3	N1, N2
PEK_W02	K2MBM_AE_W01, K2MBM_AE_W05	C2	Lec4; lec5; lec6; Lec7	N1, N2
PEK_W03	K2MBM_AE_W09	C2	Lec5; Lec6; Lec8; Lec9 to Lec15	N1, N2
PEK_U01	K2MBM_AE_U10, K2MBM_AE_U17	C2, C3	Lab2; Lab3; Lab7 to Lab9	N3, N4, N4
PEK_U02	K2MBM_AE_U04, K2MBM_AE_U10, K2MBM_AE_U17, K2MBM_AE_U19	C3	Lab1; Lab2; Lab 4 to Lab6; Lab9 to Lab15	N3, N4, N5
PEK_U03	K2MBM_AE_U02, K2MBM_AE_U03, K2MBM_AE_U23	C1, C2	Lab1; Lab2; Lab14; Lab15	N2, N3, N4, N5
PEK_K01	K2MBM_AE_K01	C1, C3	Lab1 to Lab15	N2, N3, N5
PEK_K02	K2MBM_AE_K06	C2, C3	Lab1 to Lab15	N1, N3
PEK_K03	K2MBM_AE_K04, K2MBM_AE_K05, K2MBM_AE_K10	C3	Lab1 to Lab15	N3, N5

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Sroka tel.: 71 347-79-18 email: Zbigniew.Sroka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie dla inżynierów**
Name in English: **Management for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041412**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Lack of prerequisites

SUBJECT OBJECTIVES

C1. Understanding fundamentals of project management.
C2. Learning basic principles of being a leader.
C3. Gaining skills to raise funds for projects.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Fundamental knowledge of project management.
PEK_W02 - Knowledge of how to create and manage a project team.
PEK_W03 - Knowledge in raising funds for projects.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The project and its phases.	2
Lec2	The importance of leadership - the leader or manager?	2
Lec3	Team building - human resources in the project.	2
Lec4	Description of the problem, the concept and clarifications.	2
Lec5	Planning - Structure Plan.	2
Lec6	The schedule of the project.	2
Lec7	The project realization.	2
Lec8	Monitoring and control?	2
Lec9	Time Management.	2
Lec10	Project Quality Management.	2
Lec11	Risk analysis of the project.	2
Lec12	Budgeting Project - estimating the cost.	2
Lec13	Fundraising mechanisms of the European Union.	2
Lec14	Computer-aided project management.	2
Lec15	Project Management - a case study.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - self studies and preparation for examination
N3. problem discussion
N4. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W02	involvement in class (class activity)
F2	PEK_W01; PEK_W02; PEK_W03	Written test
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Lewis J.P.; Fundamentals of Project Management, AMACOM, New York 2002

Lewis J.P.; The Project Planning, Scheduling and Control, McGraw-Hill, New York 2001

SECONDARY LITERATURE

Peter J.; Preface to Marketing Management, Irwin, Homewood 1991

Rolstadas, A., Performance Management: A Business Process Benchmarking Approach. London: Chapman and Hall, 1995.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management for Engineers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W15	C1	lec1 to Lec12	N1, N2, N3
PEK_W02	K2MBM_AE_W16, K2MBM_AE_W17	C2	Lec2; Lec3; Lec7; Lec9; Lec15	N1, N2, N3, N4
PEK_W03	K2MBM_AE_W15	C3	Lec1; Lec11; Lec12; Lec13; Lec15	N1, N2, N4

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Sroka tel.: 71 347-79-18 email: Zbigniew.Sroka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projekt CAD/FEM**
Name in English: **CAD/FEM Project (Metals)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041413**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				120	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				4	
including number of ECTS points for practical (P) classes				4	
including number of ECTS points for direct teacher-student contact (BK) classes				2.8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in field of designing with use of CAD and strength of materials
2. Ability to work independently with a computer
3. Knowledge of technical drawing

SUBJECT OBJECTIVES

C1. Knowledge ordering concerning the engineering and design of machines and strength calculations
C2. Application of Finite Element Analysis for the construction and operation of design of vehicles
C3. Proper definition of the boundary conditions coming from the operation of the design or tested object

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Be able to design a selected part of the vehicle structure using CAD
PEK_U02 - Be able to conduct simulation of the selected element of vehicle with use of FEM
PEK_U03 - Be able to analyze the results of the simulation and to optimize the part of the vehicle in accordance to the requirements

III. Relating to social competences:
PEK_K01 - Understands the need and has an ability of lifelong learning especially in the field of engineering computer tools
PEK_K02 - Recognizes the need to improve professional, personal and social skills
PEK_K03 - Has a sense of responsibility for the work performed by your own and acquire respect for work of another and for the team work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Basic definitions and Introduction into computer aided engineering CAE	3
Proj2	Principles of constructing the physical model, system idealization, simplification use in physical models	3
Proj3	The presentation of the calculating systems - selection of the element of vehicle for the project	6
Proj4	Principles and ways of designing in innovative designing – creative designing, spatial designing and assembly design	3
Proj5	Design of the selected element	6
Proj6	The building and creating the discrete models: - shell and beam models - spatial-volume models	6
Proj7	8.Defining the external loads and material review and its properties necessary for FEM simulations used in automotive industry	3
Proj8	Conduction of the calculations	3
Proj9	Interpretation and analysis of results	3
Proj10	Modernization of the model according to the guidelines (in accordance with the analysis of the results)	6
Proj11	Final editing and analysis of results, preparation of the report	3
		Total hours: 45

TEACHING TOOLS USED

N1. multimedia presentation
N2. Calculation CAD/FEM system: CATIA, UGS - NX, ABAQUS
N3. self study - preparation for project class
N4. project presentation
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02,PEK_U03; PEK_K01; PEK_K02; PEK_K03	report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Rusiński E.: Principles of supporting structures designing of automotive vehicle. Wroclaw University of Technology publishing house 2002.

SECONDARY LITERATURE
Zienkiewicz O.C.: Finite Element Method. ARKADY, Warszawa 1972.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
CAD/FEM Project (Metals)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_AE_U01, K2MBM_AE_U13	C2, C3	Proj1 to Proj11	N2, N3, N4
PEK_U02	K2MBM_AE_U04, K2MBM_AE_U13	C1, C2, C3	Proj2; Proj6; Proj7; Proj8	N2, N4
PEK_U03	K2MBM_AE_U03, K2MBM_AE_U13	C1, C2	Proj8; Proj9; Proj10; Proj11	N2, N4, N5

PEK_K01-PEK_K03	K2MBM_AE_K04, K2MBM_AE_K05, K2MBM_AE_K11	C1, C2	Proj1 to Proj11	N1-N5

SUBJECT SUPERVISOR
dr inż. Damian Derlukiewicz tel.: 71 320-42-85 email: damian.derlukiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa - projekt CAD/FEM**
Name in English: **Flows Modeling in Automotive Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041414**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				120	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				4	
including number of ECTS points for practical (P) classes				4	
including number of ECTS points for direct teacher-student contact (BK) classes				2.8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics - the rules of behavior: mass, energy and momentum
2. Ability to work independently with a computer
3. Awareness of the need to the team work

SUBJECT OBJECTIVES

C1. Knowledge of the methodology for the fields calculation of: velocity, pressure and temperature based on the principles of conservation laws (mass, energy and momentum) using a finite volume methods for engineering problems.
C2. Knowing the loads acting on the vehicle resulting movement of the car in the air as a liquid (gas) medium and the thermal loads due to the presence of various heat sources .
C3. Ability to obtain input data (boundary and initial conditions) required to model loads acting on the vehicle or its components.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Able to simulate the selected flow for a motor vehicle or its components
PEK_U02 - Analysing the results of the simulation to determine the loads acting on the vehicle or its components
PEK_U03 - Based on analysis, able to design the elements of motor vehicles

III. Relating to social competences:
PEK_K01 - Understanding the need and ability of lifelong learning especially in the field of computer engineering tools
PEK_K02 - Recognizing the need to improve professional skills - personal and social
PEK_K03 - Responsibility for own work and the willingness to comply with the rules of team work and taking responsibility for collaborative tasks

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to computing system, user registration accounts, raising the issue of the project, the organization of the subgroups.	3
Proj2	Measurement, import or estimate the size of the input to the calculation model	3
Proj3	Construction geometry	3
Proj4	Meshing	6
Proj5	Defining a computational model in the system	3
Proj6	Definition of boundary and initial conditions for simulation	3
Proj7	Calculations carring out	3
Proj8	Postprocesing	3
Proj9	Analysis of the results	3
Proj10	Modernization of the modeled object - changes in geometry	3
Proj11	Modernization of the modeled object - computing space discretization	6
Proj12	Introduction boundary and initial conditions, perform calculations	3
Proj13	Editing and analysis of the results, editing the report	3
		Total hours: 45

TEACHING TOOLS USED

N1. multimedia presentation
N2. ANSYS-Fluent
N3. self study - preparation for project class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03; PEK_K01; PEK_K02; PEK_K03	report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Flow modeling in automotive inginering. Łódź : PRINTPAP, 2011.
Blair G.P., Design and Simulation of Four–Stroke Engines. SAE.

SECONDARY LITERATURE

Ramos J.I.: Internal Combustion Engine Modeling, Hemisphere 1989
Stiesch G.: Modeling Engine Spray and Combustion Processes, Springer, 2003
Oran E.S., Boris J.P.: Numerical simulation of reactive flow, Cambridge University Press, 2001
Fletcher C.A.J.: Computational techniques for fluid dynamics, Springer, Berlin, 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Flows Modeling in Automotive Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_AE_U08	C1, C3	Proj1 to - Proj13	N2, N3, N4
PEK_U02	K2MBM_AE_U04, K2MBM_AE_U08	C2	Proj9; Proj13	N2, N4
PEK_U03	K2MBM_AE_U08	C3	Proj2; Proj6	N2, N3
PEK_K01-PEK_K03	K2MBM_AE_K04, K2MBM_AE_K11	C1, C3	Proj1 to Proj13	N1, N2, N3, N4

SUBJECT SUPERVISOR
dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elektronika pojazdowa**
Name in English: **Electronics in car vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041415**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	15	
Number of hours of total student workload (CNPS)	60		60	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Based electronics and electrotechnics competence.
2. The ability of self working on laboratories and projects based on an elementary manual performance.
3. Ability of team work.

SUBJECT OBJECTIVES

C1. Explore of electronics systems in a vehicle.
C2. Figure of operation of car fuel control systems.
C3. Obtaining ability of based electronic circuit systems.
C4. Ability of electronic buses characterization.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - To explain of operation of vehicle network protocols.
PEK_W02 - To explain of operation of fuel control systems.
PEK_W03 - Selection of proper sensors for specyfic vehicle circuit.

II. Relating to skills:
PEK_U01 - Making validation of proper control system work.
PEK_U02 - right interpretation of data in vehicle buses.
PEK_U03 - Use a datasheets for electronics circuit.

III. Relating to social competences:
PEK_K01 - Understanding and knowing needs to life long learning, especially in electronics trends.
PEK_K02 - Awarning the importance, responsibility and the consequences of an engineer in mechanical engineering subjects in terms of responsibility for the environment, resulting from the proper operation of power control systems of internal combustion engines, which are a significant threat to the environment.
PEK_K03 - Recognizing needs of improve professional personal skills.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The architecture of electronic systems in vehicles.	4
Lec2	The microprocessor control system power supply systems of internal combustion engines.	2
Lec3	Fundamentals of microprocessor technology in automotive.	4
Lec4	Ethernet.	4
Lec5	CAN bus.	2
Lec6	LIN network and other communication protocols in vehicles.	2
Lec7	Introduction to sensors in vehicles.	2
Lec8	E-e circuit in vehicles.	4
Lec9	Vehicle lighting and HUD system.	2
Lec10	Electronic Applications for the vehicle techniques.	2
Lec11	Recycling electronics originating from vehicles.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Data acquisition of the temperature sensors of the motor vehicle.	2
Lab2	Acquisition of data from pressure sensors of the vehicle.	2
Lab3	Acquisition of data from the controller power supply.	2
Lab4	Dynamic load measurements using OBD.	4
Lab5	Dynamic load measurements via current probes.	4
Lab6	Doppler velocity measurement system.	2
		Total hours: 16

Form of classes – Project		Number of hours
Proj1	Motion sensor network topology for a vehicle.	8
Proj2	The design of the data acquisition-vehicle sensors.	7
		Total hours: 15

TEACHING TOOLS USED
N1. case study N2. laboratory experiment N3. multimedia presentation N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Participation in discussions of problem.
F2	PEK_W02	Test.
F3	PEK_W02	Laboratory reports.
P = 1/4F1+1/2F2+1/4F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Laboratory reports.
F2	PEK_U02, PEK_K02	Laboratory reports.
F3	PEK_U03, PEK_K03	Laboratory reports.
P = 1/3(F1+F2+F3)		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02	Project defense.
F2	PEK_U03	Project defense.
P = 1/2(F1+F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Wróbel R.: Trends in vehicle electronics. Wyd. PWr, Wrocław 2011.[2]Study material in hard copy and electronic version of Module_5 at the European Project Curriculum Development called CarEcology: “New Technological and Ecological Standards in Automotive Engineering”27876-IC-1-2005-1-BE-Erasmus-PROGUC-1, website http://project.iwt.kdg.be/cdcarecology.[3] Martin T.: How to Diagnose and Repair Automotive Electrical Systems. Motorbooks Workshop series.[4] Fraden J.: Handbook of Modern Sensors: Physics, Designs, and Applications. Advanced Monitors Corporation, 2003.[5] Mims F. M. III: Electronic Sensor Circuits & Projects. Master Publishing Inc., 2000.

SECONDARY LITERATURE

[1] http://elenota.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronics in car vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_AE_W09, K2MBM_AE_W10, K2MBM_AE_W11, K2MBM_AE_W12, K2MBM_W04, K2MBM_W10	C4	Lec1 to Lec11	N1 N3
PEK_U01 - PEK_U03	K2MBM_AE_U01, K2MBM_AE_U04, K2MBM_AE_U06, K2MBM_AE_U07, K2MBM_AE_U09	C2 C3	Lab1; Lab2; Lab3; Lab5; Lab6; Proj1; Proj2	N1 N2 N3 N4
PEK_K01 - PEK_K03	K2MBM_AE_K09, K2MBM_AE_K11	C1 C2 C3 C4	Lab1; Lab3; Lab4; Lab5; Lab6; Proj1; Proj2	N1 N2 N3

SUBJECT SUPERVISOR

dr inż. Radosław Wróbel tel.: 71 347-79-18 email: radoslaw.wrobel@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody badań nieniszczących we współczesnych systemach**
Name in English: **Non Destructive Evaluation in Contemporary Manufacturing Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041416**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic mechanical properties of engineering materials, about the types of metallic materials engineering - their construction, properties, applications and selection rules.
2. Abilities of reading and interpretation of drawings and diagrams used in the technical documentation, abilities to perform the technical documentation.

SUBJECT OBJECTIVES

C1. Getting knowledge of non-destructive testing methods used in modern technology.
C2. Getting knowledge about the various methods of NDT: visual, liquid penetrant, magnetic-particle, ultrasonic eddy current and radiographic examinations.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Explanation the advantages and limitations of selected methods of non-destructive testing,
PEK_W02 - Proposals of method of non-destructive testing for a structural component or in-use means of transport (eg. vehicles, cranes, container extraction, welded pressure vessels, etc.),
PEK_W03 - Abilities to identify and assess risks of detected discontinuities

II. Relating to skills:
PEK_U01 - Abilities of applying non-destructive testing methods for welds, castings and products in service,
PEK_U02 - Abilities to develop a protocol of non-destructive examinations.
PEK_U03 - Abilities to do selected methods of NTD and assess its results

III. Relating to social competences:
PEK_K01 - Explanation in a clearly way the results of research and assess them critically.
PEK_K02 - Objectively evaluation of arguments, rationally explaination and justify their own point of view using the knowledge of non-destructive testing.
PEK_K03 - Knowing the rules of team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Rules of assessment. Visual examination.	2
Lec2	Liquid penetrant testing.	2
Lec3	Magnetic powder testing	2
Lec4	X-ray , γ-ray testing	2
Lec5	Ultrasonic testing of welding joints - part I	2
Lec6	Ultrasonic examination - Part. II. Evaluation the size of flaws by ultrasound.	2
Lec7	Ultrasonic testing of spot welds by matrix array transducer. Test grade.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Wstęp. Zasady zaliczenia. Badania wizualne.	2
Lab2	Liquid penetrant testing.	2
Lab3	Magnetic powder testing	2
Lab4	X-ray , γ-ray testing	2
Lab5	Ultrasonic testing of welding joints. Evaluation the size of flaws by ultrasound.	4
Lab6	Ultrasonic testing of spot welds by matrix array transducer. Test grade.	2
		Total hours: 14

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. report preparation
N3. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01-PEK_K03	short quiz
F2	PEK_U01-PEK_U03	report based on laboratory class
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.NDT Handbook - The American Society for Nondestructive Testing, 2nd and 3rd Edition
2.Chuck H. - Handbook of Nondestructive Evaluation, 2003 by The McGraw-Hill Companies

SECONDARY LITERATURE
1. Peter J. Shull - Nondestructive Evaluation: Theory, Techniques, and Applications, Marcel Dekker, Inc.,New York 2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Non Destructive Evaluation in Contemporary Manufacturing Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_AE_W12	C1, C2	Lect1 to Lect7	N1
PEK_U01-PEK_U03	K2MBM_AE_U02, K2MBM_AE_U06	C1, C2	Lab1 to Lab6	N2, N3
PEK_K01-PEK_K03	K2MBM_AE_K03, K2MBM_AE_K06	C1, C2	Lab1 to Lab6	N2, N3

SUBJECT SUPERVISOR

dr inż. Marcin Korzeniowski tel.: 42-55 email: marcin.korzeniowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy rzeczoznawstwa samochodowego**
Name in English: **Automotive expertises**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041417**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		30
Number of hours of total student workload (CNPS)	30		30		30
Form of crediting	Crediting with grade		Crediting with grade		Crediting with grade
Group of courses					
Number of ECTS points	1		1		1
including number of ECTS points for practical (P) classes			1		1
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed subjects in Automotive Engineering: Energy Efficiency Design of Powertrain and Body, Developing Engine Technology, Trends in Electronics Vehicles, Alternative Drive Systems, Chemistry and Green Fuels.

SUBJECT OBJECTIVES

C1. Understanding the basic elements of automotive expert opinions.
C2. Awareness of need for lifelong learning due to the rapid development of automotive technology.
C3. Skills of English language in specialist vocabulary from the automotive expert opinions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - An extended knowledge in automotive engineering with particular focus on methods and measurement techniques aimed to determine the technical condition of vehicles and engines, and the cost calculation of repair of the vehicle.
PEK_W02 - A knowledge in mathematics and physics required to describe and interpret the results of studies related to the processes that happen in each vehicle and engine systems and the unusual situations as failures and road collisions.
PEK_W03 - A knowledge in project management, in particular the automotive expert projects, in-depth the legal aspects and presentation of investigation results.

II. Relating to skills:
PEK_U01 - Know how to diagnose the vehicles’ systems and internal combustion engine.
PEK_U02 - Skills to use measuring instruments and specialized software applied in the automotive expert opinions.
PEK_U03 - Acquisition of the ability to collect data on the means of transport and skills of interpretation of those data as well as self-expression in native language and English.

III. Relating to social competences:
PEK_K01 - Gaining characteristics of a person working in accordance with the principles of ethics.
PEK_K02 - Awareness of the knowledge relationships from different fields.
PEK_K03 - Acquisition of the ability to properly write technical reports while maintaining the aesthetics and the current form and style.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Automotive Expertise according to the Polish and international regulations and the role of the expert.	2
Lec2	Automotive Engineering - vehicle identification.	2
Lec3	Automotive Engineering – technical scrutiny of vehicle body.	2
Lec4	Automotive Engineering – technical scrutiny of vehicle systems: chassis (including tires), steering and braking.	2
Lec5	Automotive Engineering – technical scrutiny of the crank-piston set in internal combustion engine.	2
Lec6	Automotive Engineering - technical scrutiny of other engine systems.	2
Lec7	Automotive Engineering - technical scrutiny of the vehicle after repair.	2
Lec8	Automotive Technology - determine the scope of damage to the vehicle after the accident, theft, etc.	2
Lec9	Valuation of the vehicle – estimation of the market value, residual and total loss vehicle.	2
Lec10	Calculation repair including spare parts (Directive GVO).	2
Lec11	Traffic - laws relating to vehicles and traffic (selected items).	2
Lec12	Traffic - the safety of road users and the description of the accidents involving pedestrians.	2
Lec13	Traffic - the analysis of time-movement (spatial) incidents.	2

Lec14	Traffic - supporting systems for the reconstruction of road accidents.	2
Lec15	Methodology of preparing experts opinions in Automotive Engineering.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Vehicle identification - identification of vehicle make, model, type, VIN-number identification, registration expiration, definition of equipment, etc.	2
Lab2	Technical scrutiny for pre-registration and vehicle approval - setting requirements, equipment, vehicle inspection stations, power of scrutinizers, etc.	2
Lab3	Test of fuel consumption in the natural operating conditions and on a chassis dynamometer.	2
Lab4	Test of fuel systems for combustion engines including LPG and CNG due to compliance with the approval and technical conditions.	2
Lab5	Technical scrutiny of combustion engine due to environmental protection.	2
Lab6	Analysis of the causes of damage to the components of the crank-piston set.	2
Lab7	Tests of valve timing system.	2
Lab8	Technical scrutiny of the vehicle, together with the assessment of the quality of the paint.	2
Lab9	Finding the causes and assessment of damage to the vehicle chassis.	2
Lab10	Identification of damage to some parts of the drive system.	2
Lab11	Technical scrutiny of tires of a motor vehicle and analysis of tires damages.	2
Lab12	Rating road accident based on the provision of material related to a traffic accident (identification of incident space, setting marks on the road and vehicles, technical scrutiny of vehicles - participants of the accident, the reconstruction of the incident, offering technology repair and vehicle repairs valuation).	8
		Total hours: 30
Form of classes – Seminar		Number of hours
Sem1	Repertory of traffic theory.	2
Sem2	Traffic and safety of the participants in Poland and in the world.	2
Sem3	Today's traffic monitoring systems.	2
Sem4	Approval and evaluation of technical condition of special vehicles.	2
Sem5	Approval and evaluation of the technical condition of sports cars.	2
Sem6	Technical studies of hybrid vehicle and electric cars.	2
Sem7	Technical studies wheelers.	2
Sem8	Giving opinions antique and collector vehicles.	2
Sem9	Giving opinions vehicle SAM type (made by owner).	2
Sem10	The importance of the OBD system in automotive expertise.	2
Sem11	Modern techniques and technologies for vehicle body repairs.	2
Sem12	Modern technology and repair techniques for combustion engines.	2
Sem13	Vehicle repairs valuing systems in the world.	2
Sem14	Construction and operation of roads.	2

Sem15	Driver's psychology and physiology.	2
		Total hours: 30

TEACHING TOOLS USED
N1. multimedia presentation N2. self study - self studies and preparation for examination N3. laboratory experiment N4. self study - preparation for laboratory class N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02	involvement in the class (class activity)
F2	PEK_W01; PEK_W02; PEK_W03	Written test
P = 0,2F1+0,8F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U03	entry quiz F1=(W1+…W12)/12
F2	PEK_U01; PEK_U02	activity in the classroom F2=(A1+…+A15)/15
F3	PEK_U01; PEK_K03	Laboratory report (at least a satisfactory rating of each laboratory) F3=(S1+…+S12)/12
P = 0,2F1+0,2F2+0,6F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U03; PEK_K01	activity in the classroom F1=(A1+…+A15)/15
F2	PEK_K02; PEK_K03	Presentation (P) plus report (R) F2=(P+R)/2
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Borg K.L. Auto Mechanics: Technology and Expertise in Twentieth-Century America, JHU Press 2007
Eubanks Pedestrian Accident Reconstruction, Tucson 1994
Erjavec J. Automotive Technology: A Systems Approach, Cengage Learning Inc. 2009
Starkes J., Allard F. Cognitive Issues in Motor Expertise, (Advances in Psychology), North-Holland 1993
Kodeks Drogowy, Prawo o Ruchu Drogowym, Dz. U 2012 poz. 113 z pozn. zm

SECONDARY LITERATURE
Jegerman K. Stan nietrzeźwości, Katowice 1987
Kończykowski W. Odtwarzanie i analiza przebiegu wypadku drogowego, SRTSiRD, Warszawa 1993
Pawelec K., Diupero T. Rekonstrukcja wypadku i zdarzenia drogowego, Dom Wydawniczy ABC 2006

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Automotive expertises
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W12, K2MBM_AE_W18	C1, C2, C3	Lec2 to Lec14	N1, N2, N4, N5
PEK_W02	K2MBM_AE_W01, K2MBM_AE_W02, K2MBM_AE_W03, K2MBM_AE_W09	C1, C2, C3	Lec1 to Lec14	N1, N2
PEK_W03	K2MBM_AE_W13, K2MBM_AE_W15, K2MBM_AE_W16	C1, C3	Lec1; Lec15	N1, N2
PEK_U01	K2MBM_AE_U06, K2MBM_AE_U07, K2MBM_AE_U08, K2MBM_AE_U09, K2MBM_AE_U10, K2MBM_AE_U11, K2MBM_AE_U12, K2MBM_AE_U16, K2MBM_AE_U17, K2MBM_AE_U18	C1, C2	Lab1 to Lab12	N1, N3, N4, N5
PEK_U02	K2MBM_AE_U05	C1, C2	Lab3 to lab11	N3, N4, N5
PEK_U03	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U03, K2MBM_AE_U22, K2MBM_AE_U23, K2MBM_AE_U24	C1, C3	Sem1; Lab1; Lab2	N1, N2, N3, N4, N5
PEK_K01	K2MBM_AE_K01	C2	Lab1; Lab2; Lab12	N2, N3, N4, N5

PEK_K02	K2MBM_AE_K07	C1, C2	Sem3 to Sem10; Lab1 to Lab12	N2, N3, N4, N5
PEK_K03	K2MBM_AE_K02, K2MBM_AE_K03	C2, C3	Lab12	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Sroka tel.: 71 347-79-18 email: Zbigniew.Sroka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komunikacja dla inżynierów**
Name in English: **Communication for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041418**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Lack of prerequisites.

SUBJECT OBJECTIVES

C1. Study of basic social communication tasks.
C2. Learning basic principle of human resource management.
C3. Getting teamwork skills.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - A fundamental knowledge of working in a team and HR management.
PEK_W02 - Basic knowledge to properly communicate with the human environment, especially in conducting substantive discussions engineering subjects.
PEK_W03 - A knowledge in the field of self-presentation and presentation of work results.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of social communication - the definition, role, division.	2
Lec2	Recruitment and selection - types, forms, documents.	2
Lec3	The introduction of team members in the job place - work and rest.	2
Lec4	Negotiations.	2
Lec5	Motivation of individual employee or groups of people.	2
Lec6	Job evaluation and evaluation of the employee.	2
Lec7	Working with people with disabilities.	2
Lec8	Harassment and stalking.	2
Lec9	Addictions in the workplace.	2
Lec10	The importance of meeting places.	2
Lec11	Meaning non-verbal behaviours - body language.	2
Lec12	International Social Communication - selected examples.	2
Lec13	Elements of the promotion for individual and group (PR).	2
Lec14	Public Speaking - lectures and presentations.	2
Lec15	Human Resource Management - case study.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - self studies and preparation for examination
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W03	involvement in the class (class activity)
F2	PEK_W01; PEK_W02; PEK_W03	written test
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Armstrong M.; Human Resource Management. Strategy and Operation, Kogan Page 1996
Barker L.L.; Listening Behavior, New Orleans, SPECTRA 1990
Donaghy W.C.; The Interview: Skills and Applications, Scott, Foresman 1984
Fast J.; The Body Language, New York 1994

SECONDARY LITERATURE
Lewis S., Cooper C.L.; Work-Life Integration, Wiley, Chichester 2005
Smith M.J.; When I Say No, I feel Guilty, New York, Bantam 1985

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Communication for Engineers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W16	C1, C2, C3	Lec1 to Lec15	N1, N2, N3
PEK_W02	K2MBM_AE_W17	C2, C3	lec1; Lec11; lec13; Lec14	N1, N2, N3
PEK_W03	K2MBM_AE_W13	C2, C3	Lec1; Lec13; Lec14	N1, N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Sroka tel.: 71 347-79-18 email: Zbigniew.Sroka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041419**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					30
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes					0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should have defined subject of M.Sc. thesis and agreed supervisor.

SUBJECT OBJECTIVES

C1. Preparation for public defense of M.Sc. thesis.
C2. Preparation forpresenting finished M.Sc. thesis.
C3. To acquaint with diploma exams questions and short repetition.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is capable to present in a short form the main achievements of own work as well as to answer related questions.

III. Relating to social competences:
PEK_K01 - Has consciousness of necessity presenting in a comprehensive and concrete form the results of own work and is able to evaluate reception of the work by the audience.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Principles of organizing and crediting the seminar.	2
Sem2	Gantt chart - principles of organizing projects realized in a well defined time.	2
Sem3	Examples of realized up to now works connected with design, investigation or manufacturing from different fields of interest at Mechanical Department of Wrocław University of Technology and familiarization with examinational questions as well as short repetition.	4
Sem4	Determination of the presentation schedule for each seminar participant.	2
Sem5	Presentations of diploma works by every seminar participant.	18
Sem6	Summary and creditation of the course.	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. problem discussion
N3. multimedia presentation
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01	project presentation
F2	PEK_U01	activity and participation in problems discussion

P = 0,8F1 + 0,2F2

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
M.Sc. thesises available at person conducting seminar and in library.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_AE_U22	C1,	Sem 3	N3, N4
PEK_K01	K2MBM_AE_K03, K2MBM_AE_K08	C1- C3	Sem 1 to Sem 6	N1 do N4

SUBJECT SUPERVISOR

dr hab. inż. Piotr Wrzecioniarz tel.: 71 347-79-18 email: Piotr.Wrzecioniarz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia transportu drogowego**
Name in English: **Ecology of Road Transportation**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041420**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			45	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on field of transportation means design and operation
2. Awareness of necessity of team work and ability of technical problem solving in group

SUBJECT OBJECTIVES

C1. Understanding problems on field of ecology of road transportation
C2. Understanding vehicles production and operation via environment cause (including vehicle life-cycle)
C3. Understanding essence and principals of effective team work with engineering knowledge using material science, vehicle design and operation, ecology, recycling, legislation and logistics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has a knowledge on field of egological operation of car systems
PEK_W02 - Studen has detailed knowledge on field of vehicle life-cycle as well as EU end-of-life vehicles systems and legislations

II. Relating to skills:
PEK_U01 - Student is able to describe cause and effect relationship between vehicles production, operation, specific materials application or road infrastructure and environment
PEK_U02 - Student is able to diagnose and design complex logistic system of ELVs management
PEK_U03 - Student is able to find information, data bases and other sources and apply them in solving technical problems dealing with vehicles recycling

III. Relating to social competences:
PEK_K01 - Studen has local and global ecological awarness
PEK_K02 - Student takes care about written works aesthetics
PEK_K03 - Student develops sense of responsibility for other by team-working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Ecology of road transportation: introduction and basic definitions	2
Lec2	Automotive industry environmental impacts (direct and indirect)	2
Lec3	Engine combustion process and toxic exhausts emission. Methods of pollution reduction.	4
Lec4	Car vehicle as a source of thermal and electromagnetic radiation	2
Lec5	Noise and vibrations emission caused by transportation sector	2
Lec6	Vehicle as a wastes source	2
Lec7	End-of-life vehicle recycling	2
Lec8	Vehicle as a source of hazardous wastes	2
Lec9	Road infrastructure and environmental problems	2
Lec10	Ecodriving	2
Lec11	Mobile emission sources and the Greenhouse Effect	2
Lec12	Alternative fuels and drive systems	4
Lec13	Test	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Intoduction	2
Proj2	ELVs problem in EU choosen region	4
Proj3	Vehicle material composition	4
Proj4	Identification of ELVs management according to EU and local legislation	3
Proj5	ELVs statistic data gaining for choosen region	3

Proj6	Identification of matter, information and finance flow on field of ELVs in choosen region	3
Proj7	Number of ELVs prognosis defining for choosen region	3
Proj8	Identification of ELVs collecting and dissasembly stations for choosen region	3
Proj9	Estimation of load of collecting and dissasembly stations	3
Proj10	Recyclers pointing for choosen region	3
Proj11	ARS management problem	3
Proj12	Design of model ELVs system concept for choosen EU region	5
Proj13	Project presentation and defence	3
Proj14	Final project reciving	3
		Total hours: 45

TEACHING TOOLS USED

N1. problem exercises
N2. self study - preparation for project class
N3. project presentation
N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Written test (test and open questions)
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Grading written report
F2	PEK_U01, PEK_U02, PEK_U03	Oral defence of the project
F3	PEK_U01, PEK_U02, PEK_U03 PEK_K01-PEK_K03	Activity during class and rating team working
P = F1 x 0,6 + F2 x 0,2 + F3 x 0,2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Janicka, Kolanek, Walkowiak: "Ecology of Road Transportation", PRINTPAP Łódz, 2011,

SECONDARY LITERATURE
DAVENPORT J: The Ecology of Transportation: Managing Mobility for the Environment (Environmental Pollution), Springer, 2006
Society of Automotive Engineers, Vehicle Recycling, Regulatory, Policy, and Labeling Issues (Special Publications)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology of Road Transportation
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W05, K2MBM_AE_W09	C1	Lec1 to Lec12	N4, N2
PEK_W02	K2MBM_AE_W14	C1, C2	Lec6	N4, N1, N2
PEK_U01	K2MBM_AE_U18	C2	Proj3 to proj 12	N1, N2
PEK_U02	K2MBM_AE_U18	C1, C2	Proj2; Proj12	N1, N2
PEK_U03	K2MBM_AE_U01	C1, C2	Proj2 to Proj12	N1, N2
PEK_K01	K2MBM_AE_K09	C1, C2	Proj2 to Proj12	N4, N1, N2
PEK_K02	K2MBM_AE_K03	C3	Proj12; Proj13	N2, N3
PEK_K03	K2MBM_AE_K04	C3	Proj12; Proj13	N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Anna Janicka tel.: 71 347-79-18 email: Anna.Janicka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo pojazdu**
Name in English: **Safety of vehicle**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041421**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of vehicle body constructions
2. Knowledge of designing and manufacturing of the car components
3. The basics of physics

SUBJECT OBJECTIVES

C1. Active and passive safety
C2. Issues of driver regarding to psychology and physiology
C3. New solutions enable improve safety of traffic system

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - To define active and passive safety
PEK_W02 - To describe active safety system - ABS, ASR, BAS
PEK_W03 - To explain new solutions enable improve safety of traffic system

II. Relating to skills:
PEK_U01 - To analyze vehicle construction regarding safety
PEK_U02 - To calculate absorption of energy for crash zone
PEK_U03 - To show the improvement methods of active and passive safety

III. Relating to social competences:
PEK_K01 - Student should be responsible for own and team work
PEK_K02 - To obey principles and customs valid in university

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Safety of traffic	2
Lec2	Definitions and exampels of active safety	2
Lec3	Definitions and exampels of passive safety	2
Lec4	Psychology and physiology characteristic of driver	2
Lec5	Traffic surroundings	2
Lec6	Driver	2
Lec7	Active safety system - ABS, ASR, BAS	2
Lec8	Construction of energy absorption elements	2
Lec9	Materials apply to energy absorption elements	2
Lec10	Air bags	2
Lec11	Safety belts	2
Lec12	Biomechanics of injury	2
Lec13	Crash test	2
Lec14	Compatibile of wehicle	2
Lec15	Stability of vehicle	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Dynamic deformation of thin-wall profile	2
Lab2	Model of dynamic deformation of thin-wall profile	2
Lab3	Determnaition of energy absorption of thin-wall profile	2
Lab4	Measurement of wehicle geometry	2
Lab5	Construction of dummy	2
Lab6	Research into system of servo brakes EBS	2

Lab7	Determination of g-force during crash test.	3
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. laboratory experiment
N3. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U02 PEK_K01, PEK_K02	F1=(test1+....+test7)/7+ all test passed
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Automotive Safety Handbook, Ulrich Seiffert, Lothar Wech,2003

SECONDARY LITERATURE
ADVANCED HIGH STRENGTH STEEL (AHSS) APPLICATION GUIDELINES
http://www.ivss.se

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Safety of vehicle
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W02	K2MBM_AE_W09	C1, C2, C3	Lec1 to Lec15	N1
PEK_U01, PEK_U01, PEK_U01	K2MBM_AE_U06, K2MBM_AE_U21	C3	Lab1 to Lab7	N2, N3
PEK_K01, PEK_K02	K2MBM_AE_K05	C3	Lab1 to Lab7	N1, N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Zbigniew Gronostajski tel.: 21-73 email: zbigniew.gronostajski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English: **Master Thesis**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041450**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Getting knowledge in mechanical engineering documented positive grades form all subjects of the first and second semesters in the specialty Automotive Engineering.
2. Getting English language skills to express own opinions and to write a master’s thesis in any automotive engineering subject.

SUBJECT OBJECTIVES

C1. Self design and writing a master's thesis of the research problem in automotive engineering.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Independent realization of master's thesis, using the learned while studying design and research methods.
PEK_U02 - Right interpretation of the research results.
PEK_U03 - Getting skill of composing a thesis with prevailing standards governing the form and style of writing, and presentation of work to a wider audience, including final examination committee.

III. Relating to social competences:
PEK_K01 - Awareness of graduate as a future leader, knowing how to organize the work themselves and others, and manage a team.
PEK_K02 - Gaining features of a person working alone, according to the rules of ethics.
PEK_K03 - Getting attention to style and form of expression of own views in native language and foreign, especially in English.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	About the work must include the issue of vehicle engineering. Themes of Diploma Thesis subject arising from the thesis presented by the supervisor. Diploma thesis must include the issue of automotive engineering.	2
		Total hours: 2

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - self studies and preparation for examination

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Basic literature will result from the thesis subject.

SECONDARY LITERATURE
Chinneck J.W. How to organize your thesis, Ottawa 1999
Kevine J.S. Writing and presenting your thesis or dissertation, Michigan 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Master Thesis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_AE_U02, K2MBM_AE_U22, K2MBM_AE_U24, K2MBM_AE_U25	C1	arise the thesis topic	N1, N2
PEK_K01	K2MBM_AE_K01, K2MBM_AE_K02, K2MBM_AE_K03, K2MBM_AE_K08, K2MBM_AE_K10, K2MBM_AE_K11	C1	arise the thesis topic	N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Sroka tel.: 71 347-79-18 email: Zbigniew.Sroka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie układów wieloczłonowych**
Name in English: **Modelling of multibody systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of the theory of machines and mechanisms
3. Ability to analyze the kinematics and kinetostatics of mechanisms

SUBJECT OBJECTIVES

C1. Understanding of building of discrete computational multibody models
C2. Understanding the principles of planning research, taking into account the working conditions (kinematic excitations, dynamic excitations, forces, torques, masses in multibody dynamic analysis of computer systems
C3. Ability to critically assess the results of simulations of machinery in computer systems for dynamic analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Ability to apply professional computer system for simulating and analyzing dynamic multibody
PEK_U02 - The ability to model the loads and the nature of work and the ability to analyze the mechanism of the results of the simulation of the multi-segment
PEK_U03 - The ability to compute the kinematics and dynamics of selected groups of mechanisms

III. Relating to social competences:
PEK_K01 - Knowledge of how to take responsibility for own work
PEK_K02 - Acquires care about the aesthetics of the work, including projects and reports

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of building a multibody models	2
Proj2	Basics of modeling mechanisms in the MD.Adams system - modeling links, kinematic pairs, kinematic excitations	2
Proj3	Basics of modeling mechanisms in the MD.Adams system - modeling loads and perform calculations and analysis of results	2
Proj4	Kinematic and kinetostatic analysis of linkage mechanisms - building virtual models	2
Proj5	The analysis of kinematic and dynamic properties of the linkage mechanism (project)	2
Proj6	Analysis of gears (normal, planetary and differential) - principles of construction of virtual model	2
Proj7	The analysis of kinematic and dynamic properties of the gears (project)	2
Proj8	Building models of manipulators - direct and inverse task of kinematics	3
Proj9	Simulation researches of manipulators (project)	3
		Total hours: 20

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. multimedia presentation
N3. project presentation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02,PEK_U03, PEK_K01, PEK_K02	Evaluation of the Projects
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003. 2. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007 3. MD. Adams – Reference Manual, 2008 4. Haug E.J.: Computer Aided Kinematics and Dynamics of Mechanical Systems. Allyn and Bacon, Boston 1989 5. Norton R., L.: Design of Machinery, An introduction to the synthesis and analysis of mechanisms of machines. WCB, McGraw-Hill, Boston, 1999. 6. Shabana A. Ahmed: Computational Dynamics, . A
Wiley-Interscience Publications, NewYork, 1994.

SECONDARY LITERATURE
1. Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna wydawnicza PWr. Wrocław 1996. 2. Waldron J., Kinzel G.; Kinematics, dynamics and design of machinery, John Wiley & Sons, Inc. New York, 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modelling of multibody systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_U04	C1	Pr1 to Pr3	N2, N3
PEK_U02, PEK_U03	K2MBM_U05, K2MBM_U09	C1, C2, C3	Pr4 to Pr9	N1, N2, N3, N4
PEK_K01, PEK_K02	K2MBM_K03, K2MBM_K05	C1, C2, C3	Pr4 to Pr9	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Monika Prucnal-Wiesztort tel.: 71 320-27-10 email: Monika.Prucnal@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania maszyn**
Name in English: **Fundamentals of Machinery Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to manufacturability of a design and manufacturing technologies.
2. Basic knowledge in the field of materials science and strength of materials.

SUBJECT OBJECTIVES

C1. Acquiring of knowledge of the heuristic methods of group and the individual designing.
C2. Acquiring of skills in the field of utilization of methodological tools in the initial stage of designing and algorithmic tools in the phase of purpose specifying.
C3. Acquiring of an ability of practical application of knowledge of designing, technology and organization.
C4. Acquiring of an ability to organize work in a team and to fulfil own specified tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a detailed knowledge of individual and group designing.
PEK_W02 - Has a detailed knowledge of existing tools used in the initial and the final stage of the designing process.
PEK_W03 - Has a detailed knowledge of the methods of assessment and classifying of developed concepts.

II. Relating to skills:
PEK_U01 - Can organize work for others in a project group, as well as fulfil the assigned tasks in the group.
PEK_U02 - Can search for information in the available literature on the techniques and methods of searching solutions in the designing process.
PEK_U03 - Can formulate guidelines for the designing process based on specific requirements and limitations.

III. Relating to social competences:
PEK_K01 - Can think creatively.
PEK_K02 - Can make a report of a carried out engineering work.
PEK_K03 - Can determine the consequences of decisions made in a group in which he works.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, assessment rules and literature. Creation of models of a real problem - the process and technological ones.	2
Lec2	Utilization of methods of more detailed characterization of designing goal in widespread technical systems (e.g. brake structures, recuperative units, steering mechanisms, etc.).	2
Lec3	Practical usage of heuristic and algorithmic methods: morphological table, tree of solutions, example and own design.	2
Lec4	Synthesis - example and practice of process and system designing. Synthesis of own evaluation criteria.	2
Lec5	Organizing initial solutions. Assessment of preliminary designing solutions.	2
Lec6	Detailing of selected - pre-designed device or system	2
Lec7	Selection of models - functional and analytical. Initial calculations.	2
Lec8	Documentation of the project.	2
Lec9	Remodelling of an own algorithm of designing.	2
Lec10	Methods of popularising solutions. Summary of the lectures and additional explanations.	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Scope of the project, rules of assessment, literature. Construction of object models (e.g. structures of: brakes, recuperation systems, steering mechanisms, etc.). Selection of the designing object.	2
Proj2	A practical usage of heuristic and algorithmic methods (morphological table, tree of solutions for own project).	1

Proj3	Synthesis of own evaluation criteria - example and practice. Classifying significance of criteria.	1
Proj4	Creating and managing initial solutions. Preliminary assessment of designing solutions. More detailed characterization of the selected pre-designed device.	2
Proj5	Preparation of technical documentation.	4
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Final test. Participation in problem discussions.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of the project preparation. Presentation of the project.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Dietrich M. (red), Fundamentals of Machinery Design, PWN, Warszawa, editions after 2000 (in Polish).
[2] Dziama A. Methodology of Machinery Design, PWN, Warszawa, 1985 (in Polish).
[3] Góralski A. (red), Task, Method, Solution: Technics of Creative Thinking, WNT, Warszawa, 1977 (in Polish).
[4] Pahl G., Beitz W.: Engineering Design, WNT, Warszawa 1984 (in Polish).
[5] Skarbiński M., Skarbiński J.: Manufacturability of Machinery Design. PWN Warszawa 1982 (in Polish).

SECONDARY LITERATURE
[1] Dziama A. et al. (red),Fundamentals of Machinery Design, PWN, Warszawa, 2002 (in Polish).
[2] Kurmaz L. et al. Fundamentals of Machinery Design, PWN, Warszawa, after 2000 (in Polish).
[3] Kurmaz L. et al. Fundamentals of Machinery Design, PWN, Warszawa, after 2000 (in Polish).
[4] Norton R. L.: Machine Design: An Integrated Approach. 3/E. Prentice Hall, 2006.
[5] Pahl G., Beitz W. et al. Engineering Design. A Systematic Approach. Springer, 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machinery Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W06	C1	Lec1 - Lec10	N1, N2
PEK_W02	K2MBM_W06	C2	Lec1 - Lec10	N1, N2
PEK_W03	K2MBM_W06	C1, C2	Lec4, Lec5	N1, N2
PEK_U01	K2MBM_U14	C2, C4	Proj1 - Proj6	N3
PEK_U02	K2MBM_U01	C3	Proj2	N3
PEK_U03	K2MBM_U07	C2, C3	Proj1	N2, N3
PEK_K01	K2MBM_K10	C1, C2	Proj1 - Proj4	N3
PEK_K02	K2MBM_K03	C3	Proj5	N3, N4
PEK_K03	K2MBM_K05	C4	Proj1 - Proj4	N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Franciszek Przystupa tel.: 71 320-21-55 email: franciszek.przystupa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie maszyn i urządzeń**
Name in English: **Machines and devices control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of electronics, electrotechnics, automatics and the most common used control systems.
2. Student possess basic knowledge of calsic mechanics and fluid mechanics.
3. Student possess basic knowledge of consrtuction of simple hydraulic systems and components: pumps, motors, cylinders and valves.

SUBJECT OBJECTIVES

C1. Get knowledge and skills in area of construction and working and application principle of automatics devices (sensors, controllers, actuators, operator panel) and software in machines and devices.
C2. Acquaint students with working principle of electrohydraulic components with continous operation (proportional valves and servovalves) and its application in hydraulic drive systems.
C3. Acquaint students with control and regulations techniques selected parameters of hydraulic drive systems especiallyspeed of hydraulic actuator.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student schould be able to explane design rules, programm and starting the most common used machines control systems.
PEK_W02 - In the result of lesson student schould be able to explane design rules of machines equipped with hydraulic and electrohydraulic drive.
PEK_W03 - In the result of lesson student schould be able to call and describe advanced automatics systems equipped with different kinds of regulators.

II. Relating to skills:
PEK_U01 - In the result of lesson student schould be able to select apptioprate components machines control systems and programm control device to propertly realize specified functions.
PEK_U02 - In the result of lesson student schould be able to design and build hydraulic and electrohydraulic systems performing defined functions.
PEK_U03 - In the result of lesson student schould be able to prepare to operation electrohydraulic device and plan and execute tests. On the basis of tests results student schould be able to formulate appriopriate conclusions.

III. Relating to social competences:
PEK_K01 - Student can cooperate and work in the group during building hydraulic and electrohydraulic systems and during report preparation.
PEK_K02 - Student can plan and execute tests during laboratory.
PEK_K03 - Student can propertly identify and solve problems during program control systems and building hydraulic and electrohydraulic systems. Student can formulate appriopriate conclusions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Structure and types of control systems. Sensors, their typer, properties and examples.	1
Lec2	Requirements for automation systems, reliability and availability, MTBF	1
Lec3	Industrial controllers, modes of control systems working. PLC controllers, their constructions, operation, programming and application examples.	2
Lec4	Safety acpects in machines and devices, compatibility requirements, statements and standards, examples of sefety devices. Systems of industrial communication and dispersed control systems.	1
Lec5	Numerical control systemsCNC, their construction and operation, displacements measurement in CNC machine tool, functions of selected CNC systems assemblies, interpolation, position regulation, possibilities of NC programs generation, standard STEP-NC.	2
Lec6	Electrical servodrives (NC axies): analog and digital, their properties and examples. Linear direct drives.	2
Lec7	Control RC systems of industrial robots. Construction and types of industrial robots. Methods of industrial robots programming.	1
Lec8	Human-machine interfaces HMI, their functions, signals, symbols, requirements, control panels and HMI examples. Superior control systems, vizualizations systems and SCADA control systems.	1

Lec9	Methods of speed control of hydraulic actuator.	2
Lec10	Proportional valves as control components in systems.	1
Lec11	Hydraulic regulators and proportional directional control valves.	1
Lec12	Logic valves in proportional technique.	1
Lec13	Load-sensing - systems, efficiencies.	1
Lec14	Controllers and regulators in hydraulic systems.	2
Lec15	Regulation systems with electrohydraulic servovalves.	1
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Sensors in automation systems.	1
Lab2	Examples of logic systems.	1
Lab3	Construction of sequence control system.	1
Lab4	Continous regulation systems, controlles sets selection and regulation quality tests.	2
Lab5	Programming controllers freely programmed PLC.	2
Lab6	Numerical control systems of CNC machines tool.	2
Lab7	RC control systems of industrial robots.	1
Lab8	Reversible systems.	1
Lab9	Fast movement systems.	1
Lab10	Throttle-serial speed control of hydraulic actuator.	2
Lab11	Throttle-parallel speed control of hydraulic actuator.	1
Lab12	Volumetric speed control of hydraulic actuator.	1
Lab13	Hydraulic actuator control with proportional directional control valve.	2
Lab14	Hydraulic actuator control with Load-sensing directional control valve.	1
Lab15	Position regulation system with electrohydraulic servovalve.	1
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. work at test stands for programm machines control devices.
N5. work at electrohydraulic test stand for student's individual systems building.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02, PEK_U03	oral response for practical verification of design, programm and building control systems.
F2	PEK_U03	report
F3	PEK_U01, PEK_U02; PEK_K01-PEK_K03	student's activity note.
P = (2F1+F2+F3)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Presentation – slides for lectures (electronic version),
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Tomasiak E.: Hydraulic and pneumatic drives and control (in polish). Wydawnictwo Polit. Slaskiej, Gliwice, 2001
Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.
Kosmol J.: Automation of machine tool and machining (in polish). WNT, 2000.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.
Norvelle F. D.: Electrohydraulic control systems. Prentice-Hall INC, New Jersey 2000.

SECONDARY LITERATURE

Legierski T., Wyrwał J., Kasprzyk J., Hajda J.: Programming PLC controllers (in polish). WNT, 1998.
Palczak E.: Dynamics of hydraulic components and systems (in polish). Wydawnictwo Ossolineum, Wrocław, 1999.
Honczarenko J.: Industrial robots: construction and application (in polish). WNT, 2004.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Machines and devices control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W04	C1 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N1
PEK_W02	K2MBM_W06	C2 C3	Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N1
PEK_W03	K2MBM_W04	C1 C3	Lec6 Lec11 Lec13 Lec14 Lec15	N1
PEK_U01	K2MBM_U13	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N2 N3 N4
PEK_U02	K2MBM_U09, K2MBM_U13	C2 C3	Lab8 Lab9 Lab10 Lab11 Lab13 Lab14	N3 N5
PEK_U03	K2MBM_U05, K2MBM_U11	C2 C3	Lab1 Lab4 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N5
PEK_K01	K2MBM_K03, K2MBM_K04, K2MBM_K10	C2 C3	Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N5
PEK_K02	K2MBM_K05, K2MBM_K10	C2 C3	Lab1 Lab4 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N4 N5
PEK_K03	K2MBM_K06, K2MBM_K10	C1 C2 C3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N4 N5

SUBJECT SUPERVISOR

dr hab. inż. Zygmunt Kudźma tel.: 71 320-45-99 email: zygmunt.kudzma@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika analityczna**
Name in English: **Analytical Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042005**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	10			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differential and integral calculus)
2. Linear algebra (matrices, determinants), geometry, trigonometry
3. Mechanics I and mechanics II in range of study stage I

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of Lagrangian mechanics in the dynamics of mechanical holonomic systems (for systems with constrains depending and not depending from time). Knowledge of vibration analysis of linear holonomic conservative systems with many degrees of freedom.
C2. Knowledge of the dynamics of a rigid body in case of the spherical rotation about a fixed point. The using in to the gyroscope (in approximate theory range). Elementary knowledge of the theory of mass collisions (elastic and inelastic collision)
C3. Ability to independently analyze complex mechanical systems with a holonomic constrains which are not depend on time to determine : differential equations of movement, natural vibration frequency spectrum, the modal matrix. The ability of dynamic analysis of rigid bodies in case of the spherical rotation about a fixed point and gyroscope.
C4. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and socjety

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can define a discrete mechanical holonomic system and its possible and virtual displacements. He knows the fundamental problem of dynamics. He knows the classification of dynamical systems in respect of the constrain types. He knows the general equation of dynamics and the principle of virtual work.
PEK_W02 - He knows the notion of generalized coordinates and configuration space of a dynamical system. He knows the concept of generalized forces (active and inertia). He knows the Lagrange’s equations of the first and second kind.
PEK_W03 - He knows the variational interpretation of virtual displacements, the central equation of the dynamics and the Hamilton’s principle. He has an elementary knowledge of gyroscopic systems and collision theory.

II. Relating to skills:
PEK_U01 - He is able to apply the virtual work principle and d'Alembert’s principle for holonomic systems
PEK_U02 - He can derive the differential equations of motion of discrete dynamical systems by using Lagrange’s equations and by using the energy conservation law for conservative holonomic systems.
PEK_U03 - He can calculate the spectrum of natural frequencies and can determine the modal matrix for discrete conservative linear systems. He is able to analyze the dynamics of the gyro using the approximate theory (gyroscopic moment and reaction forces in the supports). He can calculate the collision coefficients in inelastic collision.

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify
own point of view.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Curriculum. Requirements. Examples of dynamic systems. Constrains and their types, classification systems for the sake of the constrain types (holonomic systems), possible velocities and possible displacements.	2
Lec2	The fundamental problem of dynamics, virtual displacement, the notion of ideal constraints, the general equation of dynamics, the virtual work principle.	2
Lec3	The dynamic general equation for the rotational and planar motion of rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples). Generalized forces. Configuration space. Lagrange’s equations (of II type).	2
Lec5	Lagrange’s equations (cont. examples, applications). Lagrangian.Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	2
Lec6	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes. Harmonically forced vibration, frequency characteristics, an example of oscillation analysis of two- degree- of- freedom system.	2
Lec7	The dynamics of a rigid body in general motion: the orientation, the recognition issue. Kinematics and dynamics of rigid body in case the spherical rotation about a fixed point (reminder of the course Mechanics II), the angular momentum in the general movement.	2
Lec8	The dynamic equations for general motion of rigid body (Euler's equation).	2
Lec9	Gyroscope (approximate theory).	2
Lec10	Variational approach of Lagrangian mechanics.	2
		Total hours: 20
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements. Solving of static problems by using a principle of virtual work	2
Cl2	Solving of dynamic problems by using a dynamic general equation (d'Alembert’ s principle).	2
Cl3	Derivation of motion differential equations based on the energy conservation law and Lagrange’s equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl4	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl5	Final test	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	written and oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. B. Gabryszewska, A. Pszonka, "Mechanics", part II, kinematics and dynamics, Wrocław University of Technology, 1988;
2. J. Zawadzki, W. Siuta, "General Mechanics", PWN, Warsaw, 1971;
3. B. Skalmierski, "Mechanics", PWN, Warsaw, 1982;
4. M. Lunn, A First Course in Mechanics, Oxford Science Publications, 1991

SECONDARY LITERATURE

1. M. Kulisiewicz St. Piesiak, "Methodology of modeling and identification of mechanical dynamical systems", WUT. , 1994;

2 J. Leyko, "General Mechanics", WNT, Warsaw, 1980;

3 J. Giergiel, "General Mechanics", WNT, Warsaw, 1980

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analytical Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_W01, K2MBM_W02	C1, C2	Lec 1 to Lec 10	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K2MBM_U02, K2MBM_U04	C3	Cl 1 to Cl 4	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K06	C4	Cl 1 to Cl 4	N1,N2, N3,N4

SUBJECT SUPERVISOR

dr inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie materiałów inżynierskich**
Name in English: **Design of Engineering Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in such disciplines as: Materials science, Strength of materials, Manufacturing technology, processing and recycling of materials, design and examination methods of structure and properties of materials.
2. Skills in usage of technical data and specialized computer software.
3. Skills in collaboration with other users of engineering materials and specialists in the fields of design, manufacturing, processing, and application of materials.

SUBJECT OBJECTIVES

C1. Obtaining the skills in design of chemical composition and structure of engineering materials to produce products with desired mechanical and operational properties.
C2. Obtaining the skills in materials selection for technical applications.
C3. Obtaining the skills in failure analysis of materials and design of repair processes for improvement of products durability.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possesses advanced knowledge on structure- properties relationship as well as on strengthening mechanisms in materials and their practical usage for material design of products.
PEK_W02 - Knows the fundamentals and design philosophy of modern engineering materials.
PEK_W03 - Knows the criteria and methodology of materials selection and can participate in engineering design of products.

II. Relating to skills:
PEK_U01 - Able to design the materials structure in order to obtain the desired operational properties of product.
PEK_U02 - Able to select a material for a specific product with consideration of economical and ecological aspects.
PEK_U03 - Able to conduct the failure analysis of material and design the repair process for improvement of product durability.

III. Relating to social competences:
PEK_K01 - Possesses the collaboration skills and able to lead the research teams in engineering design process.
PEK_K02 - Possesses the skills of objective evaluation of arguments and formulation of rational conclusions concerning the use of engineering materials for different products and operational conditions.
PEK_K03 - Is prepared to conduct the research on materials design of products.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to design of materials. Effect of chemical composition, processing and microstructure on the properties of materials.	2
Lec2	The role and significance of alloy phase diagrams in design of materials.	1
Lec3	Strengthening mechanisms in metals and alloys - theory and practice.	3
Lec4	Metal matrix composites - fundamentals in design.	2
Lec5	Criteria and quantitative methods of materials selection in engineering design.	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Selection of material for chosen structural component - project - part I.	2
Proj2	Design of chemical composition of steel with desired hardenability.	2
Proj3	Design of microstructure of steel in the process of heat treatment - part I.	2
Proj4	Design of microstructure of steel in the process of heat treatment - part II.	2
Proj5	Selection of material for chosen structural component - project- part II.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - preparation for project class
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	Test
P = P=F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03	short test, oral answers, report, discussion
F2	PEK_U01÷PEK_U03; PEK_K01-PEK_K03	defence of project
P = 0,3F1+07F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
O. Wyatt, Introduction to Materials engineering; M.F. Ashby, Selection of Materials in Engineering Design, G.E. Totten, Steel Heat Treatment; W. Dudzinski, Structural Materials in Machine Construction

SECONDARY LITERATURE
M.F. Ashby, D. Jones, Engineering Materials 2; W.F, Hosford, Physical Metallurgy

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of Engineering Materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_W05, K2MBM_W10	C1, C2	Lec1÷Lec5	N1, N2, N3
PEK_U01 - PEK_U03	K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C1, C2, C3	Pr1÷Pr5	N1, N2, N3, N4
PEK_K01	K2MBM_K03, K2MBM_K06, K2MBM_K07, K2MBM_K09, K2MBM_K10	C2, C3	Pr1÷Pr5	N1, N2, N4, N5

SUBJECT SUPERVISOR

dr inż. Krzysztof Widanka tel.: 320-37-00 email: krzysztof.widanka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria powierzchni**
Name in English: **Surface engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042007**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students should have a well-established expertise in manufacturing, especially machining treatments, as well as a basic understanding of measurements of geometric and surface.
2. Students should have a well-established knowledge of the technical drawing, mathematics, physics and materials science.
3. The student should be able to overall planning of the experiment and solve simple technical problems.

SUBJECT OBJECTIVES

C1. To provide knowledge about the possibilities of shaping and describing certain geometric and physical characteristics of the surface layer.
C2. Presentation of the influence of physical characteristics of the surface layer on its future, performance characteristics and the ability to modify the functional properties of the surface layer.
C3. Presentation of the ways to measure the geometrical and physical characteristics of the surface layer.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students should define the surface layer and its main features physical attributes and geometry.
PEK_W02 - Students should know the ability to modify the characteristics of the surface layer due to the expected performance characteristics.
PEK_W03 - Students should know the basic methods of coating.

II. Relating to skills:
PEK_U01 - The student should be able to analyze data from the literature, planning experiments and analyzing the results.
PEK_U02 - Students should have the ability to analyze and describe the physical and geometrical characteristics of the surface layer and the influence of these characteristics by modifying the operating characteristics of the surface layer.
PEK_U03 - The student should be able to use the devices for measuring the physical geometry and the surface layer of the object.

III. Relating to social competences:
PEK_K01 - Students should be able to work in a group and be aware of the responsibility of the collective work.
PEK_K02 - Students should understand the need for continuous learning and increasing their knowledge and skills with the changing technical and social considerations.
PEK_K03 - Students should be aware of coexistence and relations of knowledge and skills in many fields of science.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristic properties of the surface layer (SL) of an object	2
Lec2	The ways and test methods and measurement SL 2D and 3D roughness	2
Lec3	Functional features of the surface in operation of machinery and equipment. Methods for modifying the physical and geometrical characteristics of SL with chip and chipless methods.	2
Lec4	Methods for modifying the physical and geometrical characteristics of SL with chipless methods. The correlation between physical attributes and geometric properties of the SL and its functional features	2
Lec5	Coating	1
Lec6	Colloquium	1
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Analysis of surface changes in the machining process I	2
Lab2	Analysis of surface changes in the machining process II	2
Lab3	Measurement of shape and position of machine parts	2
Lab4	Application of wavelet analysis, fractal and FFT to describe the condition of the surface	2
Lab5	Mathematical modeling of surface structures	2

	Total hours: 10

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. laboratory experiment N3. tutorials N4. self study - preparation for laboratory class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F2	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F3	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F4	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F5	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
P = (F1+F2+F3+F4+F5)/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Burakowski T., Wierzchoń T, tytuł: Inzynieria powierzchni, wydawnictwo: WNT, Warszawa 2005

SECONDARY LITERATURE

1. Oczos K., Lubimov V., tytuł: Struktura geometryczna powierzchni. Podstawyklasyfikacji., wydawnictwo: Oficyna Wydawnicza Politechniki Rzeszowskiej, rok: 2003
2. Wieczorowski M., Cellary A., Chajda J., tytuł: Przewodnik po pomiarach nierównosci powierzchni czyli o chropowatości i nie tylko, wydawnictwo: Zakład WydawniczyM-Druk, Poznan, rok: 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Surface engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2MBM_W08	C1; C2; C3	Lec1 - Lec5	N1; N3; N5
PEK_U01; PEK_U02; PEK_U03	K2MBM_U05, K2MBM_U08, K2MBM_U11	C1; C2; C3	La1 - La5	N2; N4
PEK_K01; PEK_K02; PEK_K03	K2MBM_K05, K2MBM_K06, K2MBM_K07	C1; C2; C3	La1 - La5	N2; N4

SUBJECT SUPERVISOR

dr inż. Maciej Kowalski tel.: 41-81 email: maciej.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania elementów i zespołów maszyn**
Name in English: **Testing of Elements and Assemblies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			20		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has ordered knowledge of mathematics and the laws of physics, mechanics.
2. Student is able to use and retrive information from the literature and the Internet.

SUBJECT OBJECTIVES

C1. Knowledge of research methods used in solid mechanics.
C2. Knowledge of test equipment and measuring.
C3. Knowledge of registration and processings of measurement results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can choose the right measurement method based on the test piece of machinery and carry out a measurement.
PEK_U02 - Student can prepare a report and discussion the results.

III. Relating to social competences:
PEK_K01 - Student is able to think and act creatively.
PEK_K02 - Student is able to work on tasks independently and in groups.
PEK_K03 - Student understands the need and knows the possibility of lifelong learning.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Shadows methods in machine elements investigations.	3
Lab2	Holographic interferometry application in displacements measurements of machine elements.	3
Lab3	Speckle photography application in solids investigations.	3
Lab4	Application of photoelasticity method in experimental design of machine elements.	3
Lab5	Determine of fluid velocity distribution using laser method.	3
Lab6	Strain gage method application in machines testing.	3
Lab7	Mark	2
		Total hours: 20

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. laboratory experiment
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_U02, PEK_K01, PEK_K02, PEK_K03	Lab exercise reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Orłoś Z., Doświadczalna analiza odkształceń i naprężeń, PWN, Warszawa 1977 (in Polish).
Szczepiński W., Metody doświadczalne mechaniki ciała stałego, PWN, Warszawa1984 (in Polish).
Będziński R., Biomechanika inżynierska. Zagadnienia wybrane, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997 (in Polish).
Roliński Z., Tensometria oporowa: podstawy teoretyczne i przykłady zastosowań, WNT, Warszawa 1981 (in Polish).

SECONDARY LITERATURE

Roliński Z., Tensometria oporowa: podstawy teoretyczne i przykłady zastosowań, WNT, Warszawa 1981 (in Polish).
J.W. Dally, Experimental Stress Analysis, College House Enterprises Llc, 2005.
Beckwith T.G., Mechanical Measurements, Prentice Hall, 1995.
Rastogi K., Optical Measurement Techniques and Applications., Artech House, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Testing of Elements and Assemblies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2MBM_U02, K2MBM_U05, K2MBM_U11, K2MBM_U12, K2MBM_U14	C1, C2, C3		N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K10	C1, C2, C3		N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Sylwia Szotek tel.: 71 320-29-83 email: Sylwia.Szotek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zintegrowane systemy wytwarzania**
Name in English: **Integrated manufacturing systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possess a knowledge on methods and technique of manufacture and industrial engineering
2. Able to design a process of manufacture by machining and chip-less methods
3. Possess a knowledge on CAD, CAM CAPP systems, able to use CAD/CAM programs

SUBJECT OBJECTIVES

C1. Cognition of informatics systems of an enterprise and a sense of well-ordered flow of part information
C2. Cognition of advanced, engineering techniques and tools allowing to resolve of problems, manufacturing system improvement and rules their integration
C3. Cognition of informatics platforms used for manufacturing process integration

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define tasks of informatics subsystem for manufacturing processes by machining ad chip-less methods
PEK_W02 - Able to select of proper programs aiding of engineering, assuring information flow consistency
PEK_W03 - Able to indicate sources of manufacture disturbances and efficient organizing of the process

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Know role of man in integrated manufacturing systems
PEK_K02 - Able to teem working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scale of production, sources of manufacture disturbances, importance of efficient process organization	1
Lec2	Activity fields of the enterprise and related specific informatics sub systems	1
Lec3	Subsystems of manufacturing, aims and task of integration, connection of inhomogeneous components as a whole for improvement of effectiveness of production course in disturbances and variable conditions of manufacture	1
Lec4	Conception of computer integrated manufacture, platforms of integration	1
Lec5	Data flow between CAD and CAM systems. Methods of aiding of design and technology records defined rules of integrated product model creation, comprising design and technological features	1
Lec6	Informatics architecture of integrated system of manufacture, informatics strategy, CIM, integration of technical and organizational features aiming efficient product manufacture	2
Lec7	Integration of CAX systems as base for integration systems of manufacture	1
Lec8	Process planing (CAPP) in the frame of integrated systems	2
Lec9	Integrated design and concurrent engineering, the role in manufacturing preparation time shortening, common features, differences	1
Lec10	Specific features of chip-less methods in CAD/CAM and CAPP systems, the role of external CAE systems and expert systems	2
Lec11	Linear and batch production, methods of production smoothness ensure, synchronization and balance of production, manufacturing nests and Flexible manufacturing systems	1
Lec12	Integrated CAD/CAM/CAE programs, designing and product live cycle management (PLM)	2
Lec13	Enterprice models, visualization of information flow	2
Lec14	Business and engineering areas integration, problems with exchange of different type of information, development of exchange information on product systems, standard IS95.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. tutorials
N4. self study, preparation for colloquium

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_K	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Griffin R. W., Management footing of organizations, PWN, Warszawa 2007.
Pająk E., Production managemet. Product, technology, organization., PWN, Warszawa
Lisowski E., Axiomatization and integration of designing tasksTech. PK publishing, Krakow, 2007
E. Chlebus; CAX computer techniques in engineering. WNT 2000.
Kasprzak T. (ed.), Reference models in business management, Difin, Warszawa 2005,

SECONDARY LITERATURE
Hobbs, Chris. A practical approach to WBEM / CIM management / Boca Raton [etc.] : Auerbach, cop. 2004.
Walsh R. A., tytuł: McGraw-Hill machining and metalworking handbook,
McGraw-Hill, 2006
Talavage, Joseph. Flexible manufacturing systems in practice : applications, design, and simulation / New York ; Basel : Marcel Dekker, 2010.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Integrated manufacturing systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W03	K2MBM_W04, K2MBM_W06, K2MBM_W07, K2MBM_W09	C1, C3	Lec1 - Lec3, Lec11 - Lec14	N1, N2, N3
PEK_W02	K2MBM_W05, K2MBM_W06, K2MBM_W07	C1 - C3	Lec4, Lec5 - Lec10, Lec12, Lec13	N1, N2, N3
PEK_K01-PEK_K02	K2MBM_K04, K2MBM_K10	C1 - C3		N1, N2, N3,

SUBJECT SUPERVISOR

dr inż. Adam Niechajowicz tel.: 40-49 email: adam.niechajowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria ruchu pojazdów**
Name in English: **Theory of vehicle movement**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		10
Number of hours of total student workload (CNPS)	60		30		30
Form of crediting	Examination		Crediting with grade		Crediting with grade
Group of courses					
Number of ECTS points	2		1		1
including number of ECTS points for practical (P) classes			1		1
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The ability to carry out mathematical calculations and knowledge of the physical laws known in higher education institutes of technology
2. The ability to group work, the ability to conduct research and use of basic measuring equipment
3. Has the ability to independently solve the tasks of design, interpretation of results and preparation of proposals /conclusions

SUBJECT OBJECTIVES

C1. The aim of the course is to broaden the knowledge of vehicle movement theory. The student becomes familiar with the types of land transportation vehicles of their principles of operation of the application. Students can draw the energy balance of movement, knows and is able to calculate the thermal motion of various wheeled and tracked vehicles. He can discuss the different vehicle suspension systems and understands the concept of stability.
C2. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology. Purchasing responsibility for own work and group.
C3. The aim of the course is to analyze individual problem of transportation in rail traffic, and the acquisition of practical knowledge in the design of the railway traffic

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - student is able to explain the functional diagrams wheeled and tracked vehicles, carry out a comparative analysis, familiar areas of their application
PEK_W02 - student is able to define and describe the mechanics of the movement of the wheels meningeal and how to move different categories of vehicles, to make a balance of power. Student distinguishes phenomena occurring during linear motion and curvilinear
PEK_W03 - he student is able to explain and compare the impact of different chassis structures the stability of the vehicle. Recognizes different suspension systems of vehicles both tracked and wheeled. It also has a knowledge of the operation of vehicles.
II. Relating to skills:
PEK_U01 - student can obtain information from the literature and to interpret them in terms of issues related to the theory of motion wheeled and tracked vehicles
PEK_U02 - student is able to analyze the results of the experiment and verify them with the literature and to interpret and formulate conclusions
PEK_U03 - student is able to calculate the energy costs of selected transport vehicles
III. Relating to social competences:
PEK_K01 - student is able to make decisions as a responsible engineer transport taking into account their impact on the environment
PEK_K02 - student is responsible for self and group work
PEK_K03 - student is aware of the legal action taken as an engineer

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Types of transport in land transport vehicles - functional diagrams, basic concepts of traffic engineering unconventional, analogies bionic	2
Lec2	chassis systems of wheeled vehicles - Functional diagrams, application areas, comparative analysis	2
Lec3	Mechanical movement of the wheel - turning, traction-slip, driven inhibition	2
Lec4	Differentials and No Spin- kinematics and dynamics	2

Lec5	Rectilinear motion - motion resistance, traction calculation for different substrates, the balance of power	2
Lec6	Curvilinear motion - side drift tires, the impact of the abolition of the rolling resistance and adhesion, oversteer, understeer, resistance to motion, impact on vehicle motion ESP	2
Lec7	Multi-axis drives Issues - non-compliance, kinematic, circulating power, the balance of power	2
Lec8	Braking - the kinetic energy of the vehicle, braking traction to surfaces, braking distance, control systems skidding when braking	2
Lec9	The stability of wheeled vehicles of various chassis structures systems, static stability, dynamic, passive and active safety systems; Suspension systems for wheeled transport vehicles - aspects of operational stability, driver comfort	2
Lec10	Integrated chassis tracked vehicles - Functional diagrams, application areas, comparative analysis; Caterpillars steel and elastomer - construction defects ways to bring the advantages of drive tracks	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Classes organizational procedures for obtaining laboratory safety, laboratory presentation of content, and perform this topic: Stability experimental invastigation in wheeled l vehicles	2
Lab2	Operational tests of wheel load distribution and kinematic parameters and dynamic of tyres vehicles	2
Lab3	Experimental research process of articulated vehicle snaking	2
Lab4	The study of kinematics and resistance of an articulated vehicle turning on a wheeled chassis	2
Lab5	Research vehicle braking efficiency	2
		Total hours: 10
Form of classes – Seminar		Number of hours
Sem1	Effect of the center of gravity for rolling stability vehicles, anti-lock braking systems on motorcycles, Braking distance, deceleration, gear selection manual /mechanic gearbox.	2
Sem2	The braking force division between the vehicle axles, braking of the tractor-trailer sets. Resistance of movement of the vehicle. Air resistance, rolling resistance, grading resistance; resistance of inertia	2
Sem3	Moments of stabilization in the steering and undercarriage; measure the cross-roll suspension systems, anti-lock braking system, Electronic stability the path of movement of the vehicle.	2
Sem4	Effect of a passenger car tire design for traction vehicle; coefficient of adhesion and method of measurement, determination of the center of gravity of the vehicle.	2
Sem5	Gradeability, vehicle speed limit on the curve; Determination of collision speed based on their deformation.	2
		Total hours: 10

TEACHING TOOLS USED
N1. multimedia presentation N2. traditional lecture with the use of transparencies and slides N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	Wy1-Wy10	written-oral exam
P = ocena z egzaminu		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	La1-La5	short test, oral response, the report
P = ocena średnia z pozytywnych ocen z zajęć		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	Sem1-Sem5	presentation of a speech, participate in discussions of problem
P = ocena z wygłoszonego referatu z uwzględnieniem udziału w dyskusjach		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Dudziński P., Theorie der Lenksysteme fur industrielle Radfahrzeuge, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2007
2. Mitschke M., Dynamika samochodu. Tom I. Napęd i hamowanie, WKiŁ, Warszawa, 1987
3. Arczyński S., Mechanik ruchu samochodu, WNT, Warszawa, 1994
4. Siłka W., teoria ruchu samochodu, WNT Warszawa, 2002
5. Prochowski L., Mechanika ruchu, WKIŁ, Warszawa, 2005
6. Madej J., Teoria ruchu pojazdów szynowych, Oficyna Wydawnicza Politechniki Warszawskiej, Wrocław, 2005
7. Andrzejewski R., Dynamika pneumatycznego koła jezdnego, WNT Warszawa, 2010

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory of vehicle movement
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W01	C1		N1, N2
PEK_W02	K2MBM_KE_W02	C1		N1, N2
PEK_W03	K2MBM_KE_W09	C1		N1, N2
PEK_U01	K2MBM_KE_U01	C2		N1, N3
PEK_U02	K2MBM_U14	C2		N1, N3
PEK_U03	K2MBM_KE_U02	C2, C3		N1, N2, N3
PEK_K01	K2MBM_K01, K2MBM_K03	C2, C3		N1, N2, N3
PEK_K02	K2MBM_K04, K2MBM_K05	C1, C2, C3		N1, N2, N3
PEK_K03	K2MBM_K09	C1, C2, C3		N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Dynamika maszyn roboczych i pojazdów**
Name in English: **Dynamics of working machines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042103**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10	20	
Number of hours of total student workload (CNPS)	60		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of analytical mechanics, linear algebra and differential equations confirmed by completion of relevant courses at university level
2. Has basic knowledge of drive systems for machinery and vehicles
3. Has basic knowledge of the theory of vehicle movement

SUBJECT OBJECTIVES

C1. Consolidate and increase knowledge of the dynamic phenomena occurring in the working machines and vehicles
C2. Acquire skills to solve engineering problems related to the dynamics of working machines and vehicles
C3. To gain the habit of caring about the aesthetics of the work, including projects and reports, and consolidate the awareness of second-degree graduate, as a future leader

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has consolidated and expanded knowledge of dynamics of systems with one degree of freedom, many degrees of freedom and continuous
PEK_W02 - has expanded and consolidated knowledge of ways to minimize vibrations and the dynamics of working machines
PEK_W03 - has expanded and consolidated knowledge of vehicle dynamics

II. Relating to skills:
PEK_U01 - is able to apply the appropriate computational methods and appropriate computer programs for vibration analysis and dynamic phenomena in mechanical devices
PEK_U02 - is able to shape and modify the dynamic properties of working machines and vehicles according to the needs
PEK_U03 - is able to plan and carry out experiments for identifying some dynamic properties of various working machines and vehicles

III. Relating to social competences:
PEK_K01 - has expanded the competence in care about the aesthetics of the work, including projects and reports
PEK_K02 - has consolidated the awareness of second-degree graduate, as a future leader

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Dynamics of mechanical linear systems with one degree of freedom	2
Lec2	Dynamics of mechanical linear systems with finite amount of degrees of freedom. Reduction of continuous systems to systems with few degrees of freedom.	2
Lec3	Classical and operational modal analysis	2
Lec4	Nonlinear dynamics - selected issues	1
Lec5	Classical methods of vibration isolation. Tuned mass damper	2
Lec6	Stochastic description of road surfaces irregularities	1
Lec7	Vertical dynamics of vehicles	2
Lec8	Longitudinal vehicle dynamics	2
Lec9	Dynamics and vibration in powertrain systems of vehicles and working machines	2
Lec10	Mitigation and damping of noxious vehicle movements	2
Lec11	Selected problems the dynamics of cranes	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Experimental determination of the moments of inertia of machines and their components	2
Lab2	Identification of the dynamic model of crane girder with use of classical experimental modal analysis	2

Lab3	Testing of dynamic effects in the steering system of industrial vehicle	2
Lab4	Testing of a dynamic properties of pneumatic nonlinear vibroisolation system	2
Lab5	Testing of a effectiveness load sway damping system for overhead crane	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Analysis of the work of a given crane and familiarization with a norms refer to dynamic calculations of this type of machines	2
Proj2	Building a simple mathematical model that allows approximate analysis of selected dynamic phenomena occurring during the operation of a given crane	2
Proj3	Building a crane simulation model that takes into account, inter alia, rope flexibility and stiffness of the rail-wheel contact	2
Proj4	Simulation studies of selected dynamic phenomena occurring during crane operation. Interpretation of the results with respect to current standards	2
Proj5	Simulation studies of the impact of applied solutions on dynamics of virtual crane	2
Proj6	Analysis of construction and operating conditions of given industrial wheeled vehicle. Familiarization with selected standards referring to the dynamics of this type of machines	2
Proj7	Building a simple mathematical model that allows approximate analysis of selected dynamic phenomena occurring during the operation given industrial vehicle	2
Proj8	Building the simulation model of given industrial wheeled vehicle	2
Proj9	Simulation studies of selected phenomena and dynamic characteristics of an object such as: snaking, angular oscillations and dynamic stability	2
Proj10	Simulation studies the impact on the dynamics of the test vehicle different structural changes	2
		Total hours: 20

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for project class
N3. self study - preparation for laboratory class
N4. traditional lecture with the use of transparencies and slides
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	test

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U03, PEK_K01÷PEK_K02	short tests, laboratory reports
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02÷PEK_U03, PEK_K01÷PEK_K02	rating developed models and reports from the undertaken calculations and analysis
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bereś W.: Dynamika pojazdów i maszyn roboczych ciężkich. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1983r.[2] Giergiel J.: Drgania Mechaniczne. Wydawnictwo AGH, Kraków 2000r.

SECONDARY LITERATURE

[1] Uhl T.: Komputerowo wspomagana identyfikacja modeli konstrukcji mechanicznych. WNT, Warszawa 1997r.
[2] Kaliski S.: Drgania i fale. PWN, Warszawa 1986r.[3] Randall R. B., Tech B.: Frequency Analysis. Brüel and Kjær 1987r.[4] Dudek D.: Elementy dynamiki maszyn górnictwa odkrywkowego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1994r.[5] Dudziński Piotr: „Lenksysteme für Nutzfahrzeuge - Theorie und Praxis”, Springer 2005r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dynamics of working machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W02	C1	Lec1÷Lec4	4, 5
PEK_W02	K2MBM_KE_W02	C1	Lec5, Lec9, Lec11	4, 5
PEK_W03	K2MBM_KE_W02	C1	Lec6÷Lec10	4, 5
PEK_U01	K2MBM_KE_U01	C2	Pr1÷Pr10	2, 5
PEK_U02	K2MBM_KE_U01	C2	Pr5, Pr10	2, 5
PEK_U03	K2MBM_KE_U01	C2	La1÷La5	1, 3, 5
PEK_K01	K2MBM_K03	C3	La1÷La5, Pr1÷Pr10	5
PEK_K02	K2MBM_K07	C3	Pr1÷Pr10	2, 5

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Problemy smarowania i zużywania maszyn**
Name in English: **Lubrication and wear problems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a structured understanding of the physical and physicochemical processes occurring in the tribological nodes .2. It has a basic knowledge of the mechanics of continuous media, including the basics of fluid mechanics and flow issues.
2. Skills: 1 It has the ability to apply fundamental fluid mechanics for the fluid flow and its use in art.
3. Social competence: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineering, including its impact on the environment and the associated responsibility for their decyzje.2.Potrafi think in an entrepreneurial manner.

SUBJECT OBJECTIVES

C1. Acquire advanced theoretical knowledge of tribological wear and its type.
C2. Detailed understanding of the types of lubricants, their tribological properties and rheology.
C3. Gaining an ability to select the type and amount of lubricant to lubrication friction and knowledge of the fundamentals of circuit design and environmental aspects of lubrication lubrication assemblies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has detailed knowledge of the tribological wear of materials used in the nodes of friction.
PEK_W02 - He has detailed knowledge of lubricants, their tribological properties and rheology.
PEK_W03 - He has detailed knowledge of the ways of lubricating oils and greases plastic and basic knowledge on lubrication system design.

II. Relating to skills:
PEK_U01 - He can select materials for friction nodes.
PEK_U02 - He can choose the type and amount of lubricant to friction nodes.
PEK_U03 - He can design a simple installation lubrication and define the basic parameters that will determine its reliable functioning.

III. Relating to social competences:
PEK_K01 - He can think and act creatively.
PEK_K02 - It can objectively evaluate the arguments rationally explain and justify their own point of view, using the knowledge gained during lectures and laboratory exercises.
PEK_K03 - It can work, search for information and critically analyze them, both individually and collectively.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Terms and organization of classes, framework programs, the terms of credit. Introduction to lubrication and wear in the construction and operation of machinery. Terms: adhesion of the surface layer, the surface free energy. Work of adhesion.	2
Lec2	Types and characteristics of lubricants. Properties and application of lubricants. The testing of lubricants (including lubricity, mechanical stability, service life and thermal stability).	2
Lec3	Basic rheology of lubricants. Capillary and rotational rheometry. Rheological greases steady flow conditions and with the use of methods for dynamic oscillation. Linear viscoelasticity.	2
Lec4	Methods of lubrication. Selection of the type and amount of lubricant for the lubrication of friction. Process automation lubrication. Construction of central lubrication systems. Examples of applications for central lubrication systems in various industries. Basic design of lubrication.	2
Lec5	Final test.	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Measurement of density and viscosity of lubricating oils. Determination of the viscosity index of lubricating oils.	2
Lab2	Lubrication of slioding bearings. Determination of the frictional characteristics of the cross slide bearing. Evaluation of the impact of oil viscosity on the process of hydrodynamic lubrication.	2

Lab3	Measuring the degree of penetration of lubricating greases and study the rheological properties of lubricating greases (compilation flow curves, determination of yield stress).	2
Lab4	Studies on impact of length, diameter and shape of circular pipe pressure drop in lubricants arts.	2
Lab5	Research on the influence of the wall material for the formation of a boundary layer greases in the lubricant.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class
N5. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_K01 - PEK_K03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Krawiec S. Kompozycje smarów plastycznych i stałych w procesie tarcia stalowych węzłów maszyn. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011. [2] Płaza S., Fizykochemia procesów tribologicznych. Wydawnictwo Uniwersytetu Łódzkiego, Łódz 1997. [3] Bartz W., J., Schmierfette, Renningen-Malmsheim, expert-Verlag, 2000. [4] Bartz W., J.,Getriebe-schmierung. Ehningen bei Bóblingen, expert-Verlag 1989. [5] Czarny R., Smary plastyczne. Wydawnictwo Naukowo-Techniczne, Warszawa 2004. [6] Czarny R., Systemy centralnego smarowania maszyn i urządzeń. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000. [7] Wysocki M., Systemy smarownicze w przemyśle ciężkim. Wydawnictwo Śląsk, Katowice 1971. [8] Laboratory manuals available on the website of the Department PKMiT.

SECONDARY LITERATURE

[1] Froischteter G. B, Trilisky K. K., Ishchuk Yu. L., Stupak P. M., Rheological and thermophysical properties of greases. Gordon & Breach Science Publishers, Londyn 1989. [2] Ishchuk Yu. L., Lubricating grease manufacturing technology. New Age International Limited Publishers, New Delhi 2005. [3] Ferguson J., Kembłowski R., Reologia stosowana płynów. Wydawnictwo Marcus, Łódź 1995. [4] Matras Z., Transport reologicznie złożonych cieczy nienewtonowskich w przewodach. Wydawnictwo Politechniki Krakowskiej, Kraków 2001. [5] Garkunov D. N., Tribotechnika. Masinostroenie, Moskva 1985. [6] Kosteckij B. I., Trenie, smazka i iznos w masinach. Izdatelstvo Technika, Kiev 1970. [7] Lawrowski Z., Tribologia - tarcie, zużywanie i smarowanie. Wydawnictwo Naukowe PWN, Warszawa 1993. [8] Płaza S., Margielewski L., Celichowski G., Wstęp do tribologii i tribochemia. Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Lubrication and wear problems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W03, K2MBM_W05, K2MBM_W08	C1	Lec1	N1, N2, N3
PEK_W02	K2MBM_KE_W03, K2MBM_W05	C2	Lec2, Lec3	N1, N2, N3
PEK_W03	K2MBM_KE_W03, K2MBM_KE_W06, K2MBM_W05	C3	Lec4	N1, N2, N3
PEK_U01 - PEK_U03	K2MBM_KE_U03, K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C1, C2, C3	Lab1 - Lab5	N3, N4, N5
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K07, K2MBM_K10	C1, C2, C3	Lab1 - Lab5, Lec1 - Lec5	N1 - N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Stanisław Krawiec tel.: 71 320-40-56 email: Stanislaw.Krawiec@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Synteza układów mechanicznych**
Name in English: **SYNTHESIS OF MECHANICAL SYSTEMS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042106**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in mathematical analysis and classical mechanics.
2. Knowledge of fundamental the theory of mechanisms and machines.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge allowed to choice of the optimal kinematic scheme of a mechanism - designed to fulfill the specified requirements.
C2. Skill in geometrical synthesis ofchosen linkages and cam mechanisms.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of forms of mechanisms’ structure notation.
PEK_W02 - Knowledge of fundamental methods of type synthesis of kinematic systems.
PEK_W03 - Knowledge of fundamental methods of gepmetrical synthesis of kinematic systems.

II. Relating to skills:
PEK_U01 - Student is able to create set of mechanism schemes.
PEK_U02 - Student is able to carry out geometrical synthesis of linkage mechanism.
PEK_U03 - Student is able to design cam mechanisms.

III. Relating to social competences:
PEK_K01 - Purchasing care about the aesthetics of the work, including projects and reports.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Forms of mechanisms’ structure notation.	1
Lec2	Methods of type synthesis, set of possible solutions creation.	3
Lec3	Criteria and selection of optimal structure solution.	2
Lec4	Methods of dimensional synthesis of linkages mechanisms.	2
Lec5	Synthesis of mechanisms with higher pairs.	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Methods of notation of topology (test and project).	2
Proj2	Type synthesis. Making of possible sets of the solutions (test).	2
Proj3	Type synthesis cont. Selection for optimal solution (project).	2
Proj4	Dimensional synthesis of linkages mechanisms (test and project).	2
Proj5	Synthesis of mechanisms with higher pairs.	2
		Total hours: 10

TEACHING TOOLS USED

N1. problem lecture
N2. traditional lecture with the use of transparencies and slides
N3. problem exercises
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	exam
P = ocena z egzaminu		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	tests, project discussion
P = średnia ocen z kartkówek i projektów		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
SYNTHESIS OF MECHANICAL SYSTEMS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_KE_W04	C1-C2	L1-L5	N1-N2
PEK_U01-PEK_U03	K2MBM_KE_U04	C1-C2	Pr1-Pr5	N3-N4
PEK_K01	K2MBM_K03	C1-C2	L1-L5, Pr1-Pr5	N1-N4

SUBJECT SUPERVISOR

dr inż. Sławomir Wudarczyk tel.: 71 320-27-10 email: Slawomir.Wudarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza stanów ustalonych i nieustalonych układów hydraulicznych**
Name in English: **Analysis stable and transient states of hydraulic systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042124**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics. Basic knowledge of the construction of hydrostatic and pneumatic power systems, knowledge about relations present in this type of power systems.
2. Knowledge of the principle of operation, construction, basic parameters and the role the individual components in hydrostatic or pneumatic power system.
3. Ability to formulate conclusions based on its observations and laboratory tests. Willingness extend knowledge of a more complete description of the phenomena occurring in hydraulic and pneumatic systems.

SUBJECT OBJECTIVES

C1. To acquaint students with extended and more complete mathematical description of systems taking into account the dynamic phenomenas occurring in the hydraulic and pneumatic power systems. Provide students with the mathematical description and the real waveforms of the basic parameters of power systems, demonstrate the convergence of the results obtained from the presented mathematical models with the results recorded during the test of real systems.
C2. To acquaint students with extended descriptions of individual components of hydraulic and pneumatic systems. Presentation of the dynamic characteristics of selected system components. Pointed the corelation and description of the interaction between system components together with an indication characteristic dynamic correlations of those connections. Indication of the risks and benefits of presence of the dynamic phenomena in the hydrostatic and pneumatic power systems as well as the acquisition of skills of preventing the occurrence of adverse dynamic effects.
C3. Exercise team working skills and to formulate written conclusions based on laboratory experiment. Identify the phenomenas based on selected and measured characteristic values of hydraulic and pneumatic systems or components.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student can describe the dynamic interactions in hydraulic and pneumatic systems. Can describe the impact of dynamic phenomena in these systems. Student be able to list, identify the cause and source of the differences in the operation of systems working in steady and unsteady conditions. Student be able to define the benefits and risks of dynamic interactions occurring during work in the unsteady conditions.
PEK_W02 - The student can describe the dynamic interactions in hydraulic and pneumatic systems. Can describe the impact of dynamic phenomena in these systems. Student be able to list, identify the cause and source of the differences in the operation of systems working in steady and unsteady conditions. Student be able to define the benefits and risks of dynamic interactions occurring during work in the unsteady conditions.
PEK_W03 - The student can described by mathematical models of the hydraulic and pneumatic systems working in steady and unsteady state. The student on the design stage uses mathematical models mentioned above to identify the risks resulting from dynamic interactions in the system.

II. Relating to skills:
PEK_U01 - The student analyzes the performance, characteristics, and the impact of the different components of hydraulic and pneumatic systems on the character of the work of the whole system. The student performs laboratory testing of individual components, which results are the part of the written reports.
PEK_U02 - The student analyzes the character of the work of the example hydraulic and pneumatic systems. The student independently identifies the state of the system and determines the extent to which the volatility of the selected parameter this state persists. Student, based on the results of the experiment, independently draws conclusions.
PEK_U03 - Student analizuje, na podstawie teoretycznej wiedzy zdobytej na wykładach, rodzaju i charakteru zjawisk zachodzących w elementach i całych systemów hydraulicznych i pneumatycznych, które są badane w laboratorium. Na podstawie wyników doświadczalnych sprawdzenia wiedzy teoretycznej, formułując wnioski w pisemnym sprawozdaniu.

III. Relating to social competences:
PEK_K01 - A student takes part in the work of the group of students, the goal of which is the joint planning and proper perform of a laboratory experiment.
PEK_K02 - Students practice skills to present the results of their work in writing and orally.
PEK_K03 - The student independently makes the selection and compiled the acquired theoretical knowledge with the results of a laboratory experiment.

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Introduction, presentation of the lecture content, requirements and forms of the completion. Pulsation flow and pressure - the sources , the reduction of the pressure pulsation amplitudes.	2
Lec2	The methods of calculation and modeling of unsteady flow in the hydraulic lines.	2
Lec3	Basic concepts describing the condition of the elements and the whole hydraulic system. The principle of models construction for lumped and distributed parameters.	2
Lec4	The steady operating status of hydraulic components (pumps, motors, valves) - ideal and real characteristics.	2
Lec5	Indicators describing the dynamic quality of the component of the hydraulic system.	2
Lec6	The steady operating status of the hydrostatic transmission - the ideal and the real characteristics.	2
Lec7	The dynamic models of the hydraulic valves.	2
Lec8	Analysis of the simplifying assumptions impact on the accuracy of the representation actual object by the model.	2
Lec9	Methods of shaping hydraulic transient processes. Methods to prevent the adverse effects caused by transition phases in the machine with hydrostatic power system.	2
Lec10	Completion of the course.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab3	Experimental identification of the pressure pulsation components in the hydraulic system.	2
Lab4	Experimental identification of the pressure pulsation components in the hydraulic system.	2
Lab5	Mitigation method of the start phase of the hydrostatic system using the proportional valve.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for laboratory class
N4. laboratory experiment
N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	oral response, participation in problems discussions
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	laboratory reports, participation in problems discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Tomasiak E.,The drives and controls systems of the hydraulic and pneumatic, Wydawnictwo Polit. Slaskiej, Gliwice 2001, (in Polish)
2.Tomczyk J.,The dynamic models of components and systems of the hydrostatic drives, Wydawnictwa Naukowo-Techniczne, Warszawa 1999, (in Polish)
3. Palczak E., The dynamic of the hydraulic components and systems, Wydawnictwo Ossolineum, Wrocław 1999, (in Polish)
4. Stryczek S., Hydrostatic drive, Wydawnictwa Naukowo-Techniczne, Warszawa 1992, (in Polish)

SECONDARY LITERATURE
1. Pizon A.,Hydraulic and electro-hydraulic control and regulation systems, Wydawnictwa Naukowo-Techniczne, Warszawa 1987, (in Polish)
2. Kollek W., Basics of the designing hydraulic drives and controls, Oficyna Wydawnicza Polit. Wrocławskiej, Wrocław 2004, (in Polish)
3. Osiecki A., The hydrostatic drive of machines, Wydawnictwa Naukowo-Techniczne, Warszawa 2004, (in Polish)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analysis stable and transient states of hydraulic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_KE_W02, K2MBM_KE_W07	C1, C2	Lec1÷Lec9	N1, N2
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_KE_U02	C3	Lab1÷Lab5	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie hydraulicznych układów napędowych**
Name in English: **Hydraulic drive systems control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042126**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of classic mechanics and fluid mechanics.
2. Student possess basic knowledge of hydraulic components of drive systems: pumps, motors, cylinders, valves.
3. Student possess basic knowledge of construction and design of simple hydraulic systems.

SUBJECT OBJECTIVES

C1. Acquaint students with proportional technique - its applications, properties and limitations.
C2. Acquaint students with control and regulations methods selected parameters of hydraulic systems.
C3. Acquaint students with advanced hydrostatic systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student has extended knowledge of description of more advanced hydraulic components like proportional valves and servovalves.
PEK_W02 - In the result of lesson student has extended knowledge of explanation advanced control and regulation methods of selected hydraulic systems parameters.
PEK_W03 - In the result of lesson student has extended knowledge of description of advanced hydraulic and electrohydraulic systems.

II. Relating to skills:
PEK_U01 - In the result of lesson student is able to bulid hydraulic and electrohydraulic systems and analyse its working principle.
PEK_U02 - In the result of lesson student is able to preper to work hydraulic device or electrohydraulic and plan and execute measurements of selected parameters. On the basis of measurements results student is able to formulate appropriate conclusions.
PEK_U03 - In the result of lesson student is able to design device with hydraulic or electrohydraulic system according to specified requirements.

III. Relating to social competences:
PEK_K01 - Student can cooperate in group during hydraulic and electrohydraulic system building and report preparation.
PEK_K02 - Student can plan measurements during laboratory and report preparate.
PEK_K03 - Student correctly identyfi and solve problems with hydraulic and electrohydraulic system building. Student formulate appropriate conclusions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements.	1
Lec2	Control and regulation methods in hydrostatic systems.	2
Lec3	Technique of hydraulic proportional control.	1
Lec4	Working principle and characteristics of directional control valves with proportional control.	1
Lec5	Working principle and characteristics of flow regulators and pressure valves with proportional control.	1
Lec6	Logic valves in proportional technique.	1
Lec7	Electrohydraulic servovalves.	1
Lec8	Hydrostatic systems of position regulation.	2
Lec9	Hydrostatic systems of force or torque regulation.	2
Lec10	Load-sensing systems in machines with hydrostatic drive.	1
Lec11	Load-sensing systems with fixed displacement pump.	1
Lec12	Load-sensing systems with variable displacement pump.	1
Lec13	Controllers in hydraulic systems.	2
Lec14	Volumetric control and regulation.	2
Lec15	Pump capacity regulation for Q = const., p = const., N = const.	1

		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory range presentation, check form, requirements.	1
Lab2	Throttle-serial regulation of hydraulic actuator speed.	2
Lab3	Throttle-parallel regulation of hydraulic actuator speed.	1
Lab4	Control and regulation throttle methods comparison.	2
Lab5	Application of proportional reliefe valve.	1
Lab6	Experimental test for critical frequency for system with proportional directional control valve.	1
Lab7	Tests of position regulation system with electrohydraulic servovalve.	1
Lab8	Check.	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	oral response for practical veryfication of design and buliding of systems.
F2	PEK_U02	report
F3	PEK_U01 PEK_U03	student's activity note

P = (2F1+F2+F3)/4

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Tomasiak E.: Hydraulic and pneumatic drives and control (in polish). Wydawnictwo Polit. Slaskiej, Gliwice, 2001
Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.
Norvelle F. D.: Electrohydraulic control systems. Prentice-Hall INC, New Jersey 2000.

SECONDARY LITERATURE

Palczak E.: Dynamics of hydraulic components and systems (in polish). Wydawnictwo Ossolineum, Wrocław,1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydraulic drive systems control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W05, K2MBM_KE_W07	C1 C2	Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9	N1
PEK_W02	K2MBM_KE_W05, K2MBM_KE_W07	C1 C2 C3	Lec2 Lec5 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N1
PEK_W03	K2MBM_KE_W05, K2MBM_KE_W07	C3	Wy8 Wy9 Wy10Wy11 Wy12 Wy14Wy15	N1
PEK_U01	K2MBM_U13	C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6	N3 N4
PEK_U02	K2MBM_U05, K2MBM_U11	C1 C2 C3	Lab2 Lab3 Lab4 Lab6 Lab7	N2 N3 N4
PEK_U03	K2MBM_U14	C3	Lab2 Lab3 Lab5	N3 N4
PEK_K01	K2MBM_K04, K2MBM_K05, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6	N3 N4
PEK_K02	K2MBM_K03, K2MBM_K05, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab6 Lab7	N2 N3 N4
PEK_K03	K2MBM_K06, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab5Lab6 Lab7	N2 N3 N4

SUBJECT SUPERVISOR
dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Uszczelnienia i techniki uszczelniania**
Name in English: **Seals and sealing technique**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042127**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge in areas related to the basics of the machine design.
2. The knowledge of the principles of operation and basic design of hydraulic and pneumatic systems.
3. Basic knowledge of plastics materials.

SUBJECT OBJECTIVES

C1. Acquainting students with the present sealing technology level, mode of action, construction of various types of technical seals. Presentation the directions of development.
C2. Presentation of the problems that occur during the design, installation and exploatation of technical sealings. Presentation of the example seals selection process of the various types of seals. Preparing students to make knowingly and proper selection and exploatation of technical seals.
C3. Acquiring skills for the identification and description of phenomenas occurring in the seals, doing an independent determination of the seal condition based on the description of external appearance and selected parameters of the seal and making the determination of suitability for further exploitation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to define the characteristics of the seals used in the technique and describe their mode of use.
PEK_W02 - The student defines the basic parameters and the use of standard technical seals, also can make differentiation and identification of the seals.
PEK_W03 - The student is able to select the the correct type of seal to the requirements of a particular application while explaining and describing the working conditions of selected seal.

II. Relating to skills:
PEK_U01 - The student is able analyze the phenomenon occurring during the seal exploitation, so that acquires the ability to control and describe the condition of the seal.
PEK_U02 - The student is able to prepare and conduct a laboratory experiment indicates the technical condition of the seal.
PEK_U03 - The student has the ability to decide on authorization to exploitation or exchange the seal on the basis of analysis of the seal technical condition.

III. Relating to social competences:
PEK_K01 - The student taking part in the work of a team of students which aim is to interpret the laboratory results based on theoretical knowledge.
PEK_K02 - Students gain the ability to link theoretical knowledge with the results of the experiment, and the formulation of a coherent conclusions.
PEK_K03 - Student presents conclusions formulated on the basis of their knowledge and the results of the laboratory tests and provide their justification of the group with teacher.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	To acquaint students with the scope of the lecture, the terms of credit, and subject literature. The function of seals in the machine design.	2
Lec2	Presentation of the basic requirements for technical seals. Classification of the technical seals. Leak testing.	2
Lec3	Fundamentals of correct sealing selection, process analysis, examples of correct application.	2
Lec4	Static seals, description, principle of operation, classification, materials, applications.	2
Lec5	Seals of the rotational movement, description, principle of operation, classification, the basic parameters, materials, applications.	2
Lec6	Examples of the selection processes of rotational movement seals. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec7	Seals of the reciprocating movement, description, principle of operation, classification, parameters, materials, applications.	2
Lec8	Examples of the seals selection process of the piston rod and piston in the pneumatic actuator. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2

Lec9	Presentation of the directions of development of the seals. New trends in sealing technology.	2
Lec10	Completion of the course.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	Examination of the impact the gap width on the flow rate and pressure difference.	2
Lab3	Examination of the impact the direction of movement the piston rod on the forces measure on the seal contact area.	2
Lab4	Examination of the impact of pressure difference on the frictional force occurring in the packing set seals of the piston rod.	2
Lab5	Examination of the impact moving speed on the frictional force measure on the seal contact area.	2
		Total hours: 10

TEACHING TOOLS USED

N1. laboratory experiment
N2. traditional lecture with the use of transparencies and slides
N3. report preparation
N4. tutorials
N5. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	oral response, participation in problems discussions
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01÷PEK_U03 PEK_K01÷PEK_K03	laboratory reports, oral response, participation in problems discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. L. A. Kondakow: The hydraulic seals, WNT 1975, (in Polish)
2. E. Mayer: The face seals, WNT 1970, (in Polish)
3. Seals and sealing thenbook, 2nd Edition, Trade and Technical Press Ltd., 1985 Anglia,
4. Poradnik: The thematic inserts about seals in the journal "Hydraulics and Pneumatics", (in Polish)

SECONDARY LITERATURE

1. Proceedings of the Conference "Seals and Sealing Technology", SIMP Wroclaw
   magazine "Pneumatics and Hydraulics", (in Polish)
2. H. Ebertshäuser: Dichtungen in der Fluidtechnik Resch Verlag, München 1987,
3. F.W. Reuter: Dichtungen in der Verfahrenstechnik Resch Verlag, München 1987.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Seals and sealing technique
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W07	C1	Lec1÷Lec3, Lec9	N2, N4
PEK_W02, PEK_W03	K2MBM_KE_W07	C2	Lec4÷Lec8	N2, N4
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K09, K2MBM_KE_U06	C3	Lab1÷Lab5	N1, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-27-00 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria urządzeń transportu przemysłowego**
Name in English: **Engineering of industrial transport devices**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042130**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of solid mechanics, machine design basics, and theory of mechanisms and propulsion systems
2. Ability to read drawings and diagrams in the technical documentation for machinery and industrial transport systems, and the ability to sketch diagrams presenting schemes of simple load-carrying structures and mechanisms of machines
3. The ability to use a spreadsheet program and make 2D drawings using CAD

SUBJECT OBJECTIVES

C1. Gain basic knowledge about the structure, function, and code-based principles behind calculations for industrial transport systems. C1.1. Knowledge of basic forms and construction features of load-carrying structures, as well as propulsion mechanisms for industrial transport systems of cyclic (cranes), and continuous (conveyors) operations, respectively. C1.2. Knowledge of the code parameters governing the conditions of use of cranes and their connection with the relevant technical requirements to ensure that operating characteristics are met.
C2. C2 Gain basic knowledge and skill in the analytical description and calculation of code-based exploitation parameters as wel as technical and operating parameters of industrial transport equipment. C2.1. Creating schemes for load-carrying structures and mechanisms of devices for industrial transportation and their load systems, appropriate for their given conditions of use. C2.2. Ability to carry out calculations of basic parameters to satisfy assumed technical and operating conditions for cranes and conveyors. C2.3. Skill in calculation and selection of typical parts and components of cranes and conveyors
C3. Awareness of the inter-relationship between types of structures, design features and technical parameters of industrial transport equipment and conditions for use of these devices

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic structure and design features of load-carrying structures and propulsion systems for industrial transport equipment with cyclic (cranes) and continuous (conveyors) operations, respectively.
PEK_W02 - Has knowledge of the code parameters governing the use of cranes and the relationship to the relevant technical parameters to ensure the required operating characteristics for these devices are met.

II. Relating to skills:
PEK_U01 - Can create diagrams of load-carrying structures and mechanisms in industrial handling equipment, together with their load systems appropriate to the given conditions of their use.
PEK_U02 - Can calculate basic technical and operating parameters for cranes and conveyors, appropriate to the given conditions for their use

III. Relating to social competences:
PEK_K01 - Is aware of the interconnections between the types of structures, design features and technical parameters of industrial transport equipment and conditions for use of these devices
PEK_K02 - Recognizes the linkages adequate knowledge of mathematics, mechanics, electrical engineering and electronics engineering used in the industrial transport devices

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic structural and operational features of a cyclic (cranes) and continuous (conveyors) operating industrial transport devices i.t.d., review of their structures, major parts and components, examples of design solutions	2
Lec2	Basic technical and operational parameters of the i.t.d., principles of standardization and evaluation criteria for intensive use, the duty exploitation groups of cranes	2

Lec3	Principles of calculation and classification of the code-based operating conditions for cranes	2
Lec4	Rules for the selection of the form and the structural development of the major nodes in load-carrying structures and mechanisms of cranes	2
Lec5	Rules for load calculation and strength checks for load-carrying structures and mechanisms of cranes, according to European standards	2
Lec6	Rules for selection of structure type and structural development of major carrying joints and mechanisms-drive nodes of conveyors	2
Lec7	Rules for loads and proof calculations of major load-carrying joints and mechanisms-drive nodes of conveyors	2
Lec8	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with flat horizontal movement	2
Lec9	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with flat vertical movement	2
Lec10	Methods and systems of control for cranes and conveyors	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Analysis of the operating conditions for a given crane and calculation of its code-based classification parameters, determination of crane technical parameters to ensure meeting its required operating characteristics	2
Proj2	Determination of the load-carrying structure and propulsion system for a given crane, development of computational schemes for indicated superstructure subassembly and propulsion system, code-based loads calculations for specified components of the crane	2
Proj3	For a selected crane, determination of the most important nodes for safety of the load-carrying structure and propulsion system, initial selection of typical elements of the specified subassembly of the crane propulsion system, design sketches of the selected nodes in the load-carrying structure and propulsion system.	2
Proj4	The calculation of the maximum overload for the selected elements of a given crane propulsion system subassembly in its transient periods of work, and validation of the typical elements selection	2
Proj5	Analysis of conveyor operational conditions and initial calculation of technical parameters to satisfy these conditions, determination of the structure of the conveyor drive system, initial selection of typical elements of the conveyor drive subassembly, execution of a design sketch of a selected node of this subassembly	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02 PEK_K	Answers during design presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Piątkiewicz A., Sobolski R. – Cranes. WNT Warsow 1977

[2] Goździecki M., Świątkiewicz H. – Conveyors. WNT Warsow 1978

SECONDARY LITERATURE

[1] Vershoof J. - Cranes. Design, Practice and Maintenance. Professional Engineering Publishing Limited, London &Bury St. Edmonds 2000r.

[2] Gładysiewicz L. – Belt conveyors. Theory and calculations. Publ. Wroclaw University of Technology 2003r.

[3] European Standard EN13001-1:2007 - Crane safety. General design. Part 1. General principles and requirements

[4]European Standard EN13001-2:2007 - Crane safety. General design. Part 2. Load effects.

[5] Catalogues of unified components of cranes and conveyors offered by firms: FAMAK, DEMAG, ABUS, KONE CRANES, AUMUND

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Engineering of industrial transport devices

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W09	C1	Lec1	N1, N2, N3
PEK_W02	K2MBM_KE_W09	C1	Lec2 to Lec10	N1, N2, N3, N4
PEK_U01	K2MBM_U01, K2MBM_U07	C2	Proj2	N2, N3, N4
PEK_U02	K2MBM_U01, K2MBM_U07	C2	Proj1, Proj3, Proj4, Proj5	N2, N3, N4
PEK_K01, PEK_K02	K2MBM_K06	C3	Lec1 to Lec10, Proj1 to Proj5	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Eugeniusz Grabowski tel.: 71 320-28-89 email: Eugeniusz.Grabowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy hybrydowe w pojazdach i maszynach roboczych**
Name in English: **Hybrid drives in working machines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042131**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a knowledge in a frame of earth working machines and vehicles driving systems. Student is aware of solved putted into use on environmental. Student has an advanced knowledge in a frame of mathematics and phisics.
2. It has an advanced knowledge of the design of control algorithms. He knows the proper terminology. It has a basic knowledge of the principles of operation of electronic components.
3. Can use measuring devices and measuring devices. Able to work in groups in various roles, and to develop and formulate conclusions.

SUBJECT OBJECTIVES

C1. The aim of the course is to expand knowledge of the design and operating principles powertrains including hybrids. The student is able to design control systems for hybrid systems working machines, known traction characteristics of selected vehicles.
C2. The course aims to raise awareness of the range of dynamic phenomena, experimental research. It can acquire, also with foreign literature and materials to use them.
C3. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has extended knowledge of the terminology associated with the operation of propulsion systems including hybrid
machines and work vehicles;
PEK_W02 - has the knowledge necessary to carry out a proper selection of individual elements in hybrid drive systems and to formulate and solve related problems;
PEK_W03 - explains the mechanism of energy loss during the transformation and transmission of energy and chooses the control algorithm of the hybrid system.

II. Relating to skills:
PEK_U01 - able to develop a simple plan of experimental research, carry the experiment, and to formulate conclusions
PEK_U02 - able to design a propulsion system so as to obtain its brief foredesing action
PEK_U03 - be able to specify a path for power and estimate the power flow dissipation in the proposed drive system

III. Relating to social competences:
PEK_K01 - know the range of having own knowledge and own skills and understands the need for continuous training and professional development;
PEK_K02 - indevidually initiates and takes a simple research tasks;
PEK_K03 - can indyvidually search the literature and also in foreign languages.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of the propulsion system, hybrid types and propulsion systems, single and multi-source power systems.	2
Lec2	Primary and secondary sources of energy: electrical, mechanical, hydraulical, fue -calorific value. Fuel cells. The efficiency of energy processed. Power converters for AC and DC operated from vehicles.	2
Lec3	A detailed overview of the energy storage. The problems and limitations associated with it. Resistance and power consumption while moving.	2
Lec4	Structure parallel hybrid powertrain. The choice of elements and calculations.	2

Lec5	The structure of serial hybrid drive systems. The choice of elements and calculations.	2
Lec6	Structures mixed hybrid propulsion systems. The choice of elements and calculations	2
Lec7	Propulsion systems of "mild", selection of components and calculations. Non-conventional propulsion systems equipment and vehicles.	2
Lec8	Computational method for selecting the individual components of hybrid powertrains. Problems associated with the delivery of energy recovered to the source. The amount and efficiency of energy recuperation based on the cycle of the vehicle.	2
Lec9	The recuperative braking wheeled vehicles. Problems with receiving energy and preserving the direction of motion. Construction of hybrid brakes.	2
Lec10	Modeling of hybrid drive systems for wheeled vehicles. Modeling of sources and receivers of energy.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Performance testing of the propulsion system overhead traveling crane.	2
Lab2	Study the possibility of accumulation of energy in the hydrostatic drive system loader excavated arm bucket.	2
Lab3	Accumulation and recuperation of energy in the inertial propulsion system.	2
Lab4	Energy efficiency of the bucket filling process of earth working vehicle.	2
Lab5	Hydrostatic driving system experimental test.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03 PEK_K01,02	final test
P = kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03 PEK_K03	report on laboratory exercises, short tests
P = średnia ocen pozytywnych ze sprawozdań i kartkówek z ćwiczeń laboratoryjnych		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1 "Electric and hybrid vehicles Design Fundamentals", Husain, I., CRC PRESS, 2011
2 "Fundamentals of hybrid vehicle drives," Szumanowski A Warsaw-Radom, 2000
3 "Hybrid Electric Vehicles Design", Szumanowski A., Institute for Sustainable Technologies NRI / 2006
4 "The accumulation of energy in vehicles", Szumanowski A., optics, 1984
5 "Motor vehicles with electric and hybrid", K. Michalowski, Ocioszyński J., optics, Warsaw 1989
6 "Alternative fuels and vehicle propulsion systems", J. Diaper Merkisz I., Publisher University of Technology, Poznan, 2006
7 "Electric vehicles", Poplawski E. optics, Warsaw, 1994
8 "Energy efficient powertrains working machines", Ocioszyński J., Publishing House of Warsaw University of Technology, Warsaw, 1994
9 "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Second Edition", M. Ehsani, Y. Gao, CRC PRESS, 2009
10th "Propulsion systems for hybrid vehicles," Miller JM, The Institution of Electrical Engineers, 2003
11th "Electric Vehicle Technology Explained", Larminie J., Lowry, J., Wiley, 2003
12th "The rationalization of labor power system of a passenger car using fuzzy logic", PhD thesis Korniak J., supervisor: prof. Assoc. Mr Rojek.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hybrid drives in working machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W01, K2MBM_KE_W04, K2MBM_KE_W09	C1	Le1-Le7	N1, N3
PEK_W02	K2MBM_KE_W01, K2MBM_KE_W04	C2	Le8-Le10	N1, N3

PEK_W03	K2MBM_KE_W09	C1, C2	La1-La5	N1, N3
PEK_U01	K2MBM_KE_U01	C3	Le1-Le10	N1, N3
PEK_U02	K2MBM_KE_U06	C3	La1-La5	N2
PEK_U03	K2MBM_U01, K2MBM_U05	C3	La1-La5	N2
PEK_K01	K2MBM_K10	C1, C2, C3	Le1-Le10	N1, N3
PEK_K02	K2MBM_K02, K2MBM_K09	C1, C2, C3	Le1-Le10	Wy1-Wy10
PEK_K03	K2MBM_K04, K2MBM_K05	C3	La1-La5	N2

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy mechatroniczne w pojazdach i maszynach roboczych**
Name in English: **Mechatronics systems in industrial vehicles and machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042132**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of automation confirmed by completion of relevant course at university level
2. Has basic knowledge of the theory of machines and mechanisms

SUBJECT OBJECTIVES

C1. To gain knowledge of the structure, programming and operation of mechatronic systems working machines and vehicles
C2. To gain skills of experimental research and diagnostics of mechatronic systems of working machines and vehicles
C3. To gain and consolidate awareness of links between knowledge of mechanics, electronics and computer science and awareness of the responsibility for the work

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of sensors used in working machines and vehicles
PEK_W02 - has basic knowledge of controllers and communication standards used in working machines and industrial vehicles
PEK_W03 - has knowledge of structure and principles of operation of the typical mechatronic systems used in working machines and industrial vehicles

II. Relating to skills:
PEK_U01 - is able to carry out experimental research and diagnostics of a typical industrial vehicle mechatronic system
PEK_U02 - is able carry out experimental research and diagnostics of a typical mechatronic system of crane

III. Relating to social competences:
PEK_K01 - is aware of and understanding the relationship between knowledge of mechanics, electronics and computer science
PEK_K02 - is aware of the responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Sensors in mechatronic systems of working machines and vehicles. Temperature sensors. Proximity transducers	2
Lec2	Sensors in mechatronic systems of working machines and vehicles. Sensors of linear and angular displacement. Speed and acceleration sensors	2
Lec3	Sensors in mechatronic systems of working machines and vehicles. Sensors for measurement of forces, moments, pressures and flows	2
Lec4	Controllers and operator panels in mechatronic systems of working machines and vehicles and their programming	2
Lec5	Typical communication standards used in control systems of vehicles and working machines	2
Lec6	Navigation systems used in industrial vehicles	2
Lec7	Automatic systems for excavating and loading of crushed material	2
Lec8	Advanced automation systems supporting the process of positioning of manipulators of earthmoving machines	2
Lec9	Automation of storage and transhipment processes	2
Lec10	Overview of automation systems used in cranes	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Selection of elements and programming of the control system of working machine manipulator	2
Lab2	Examination of jib crane monitoring system	2
Lab3	The investigation of the new generation's mechatronic steering system for articulated vehicle	2

Lab4	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab5	Experimental studies of a robot used for ropeway's rope diagnostics	2
		Total hours: 10

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03,PEK_K01÷PEK_K02	laboratory reports, short tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r.[2] Dudziński P.: Lenksysteme für Nutzfahrzeuge - Theorie und Praxis. Springer, 2005r.[3] Czabanowski R.: Sensory i systemy pomiarowe. Oficyna Wydawnicza Politechniki Wrocławskiej, 2010r.

SECONDARY LITERATURE

[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki iMagazynowania, 1998r.[2] Zimmermann W., Schmidgall R.: Magistrale danych w pojazdach. WKiŁ, 2008[3] PLUS+1 GUIDE - User Manual. Sauer-Danfoss 2012r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronics systems in industrial vehicles and machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec1÷Lec3	2, 5
PEK_W02	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec4÷Lec5	2, 5
PEK_W03	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec6÷Lec10	2, 5
PEK_U01	K2MBM_KE_U06	C2	La1, La3, La5	1, 2, 3, 4
PEK_U02	K2MBM_KE_U06	C2	La2, La4	1, 2, 3, 4
PEK_K01	K2MBM_K06	C3	Lec1÷Lec10, La1÷La5	1, 2, 3, 4, 5
PEK_K02	K2MBM_K05	C3	La1÷La5	1

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja procesów produkcyjnych**
Name in English: **Automation of production processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		20		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: Fundamentals of Automatic Control

SUBJECT OBJECTIVES

C1. Explain building automation systems
C2. Explain the operation of control systems
C3. Explain the rules for the application of automation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the construction of automation components
PEK_W02 - Can explain the operation of control systems
PEK_W03 - Can choose the components for the automation of the production process

II. Relating to skills:
PEK_U01 - Can apply automation components for process automation
PEK_U02 - Can program the selected control elements
PEK_U03 - Is able to operate automated manufacturing processes

III. Relating to social competences:
PEK_K01 - Recognizes the importance of team collaboration.
PEK_K02 - Can search for information regarding the various fields of technology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic concepts, building automation systems and their classification.	1
Lec2	The mathematical description of automation.	1
Lec3	Industrial control system. PLCs	1
Lec4	Aspects of safety.	1
Lec5	Network communication systems	1
Lec6	Electric drives	1
Lec7	Industrial robots	1
Lec8	Vision Systems	1
Lec9	HMI and SCADA systems	1
Lec10	Test	1
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Industrial control system.	2
Lab2	Programmanle logic controllers	2
Lab3	Electric servo drives	2
Lab4	Electric servo drives	2
Lab5	Industrial robots	2
Lab6	Vision Systems	2
Lab7	Industrial networks	2
Lab8	HMI and SCADA	2
Lab9	Automating the process of treatment process	2
Lab10	Automating the process of transport	2

	Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03,	Test
F2	PEK_U01, PEK_U02, PEK_U03,	REPORT OF LABORATORY PRACTICE
P = ŚREDNIA Z WSZYSTKICH OCEN		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legierski T., Wyrwał J., Kasprzyk J., Hajda J., tytuł: Programowanie sterownikówPLC,Kosmol J., tytuł: Automatyzacja obrabiarek i obróbki skrawaniem, WNT, rok: 2000Jakuszewski R.: Programowanie systemów SCADA. WPK J. Skalmierskiego, Gliwice 2002 Solnik W. ; Zajda Z.:Komputerowe sieci przemysłowe Profibus DP i MPI, Oficyna WydawniczaPolitechniki Wrocławskiej, Wrocław 2005

SECONDARY LITERATURE

Barczyk J., Automatyzacja procesów dyskretnych, WPW 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Automation of production processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W04	c1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_W02	K2MBM_W04	c2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_W03	K2MBM_W04	c3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_U01	K2MBM_U13	c3	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9, LA10	N2,N3, N5
PEK_U02	K2MBM_U13	c3	LA2, LA4, LA5, LA8, LA9, LA10	N2,N3, N5
PEK_U03	K2MBM_U13	c2	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9, LA10	N2,N3, N5
PEK_K01	K2MBM_K09	C1,C2,C3	LA1-LA15	N1-N5
PEK_K02	K2MBM_K06	C1,C2,C3	Lec1-Lec10	N1-N5

SUBJECT SUPERVISOR

dr inż. Rafał Więcławek tel.: 36-96 email: rafal.wieclawek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Specjalne metody łączenia**
Name in English: **Special methods of joining**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042206**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student has basic knowledge of welding processes (characteristics of methods, health and safety rules, parameters, equipment, joining technology, documentation, application);
A student has knowledge of basic mechanical properties of engineering materials - their structure, properties, applications and principles of selection;
A student has basic knowledge of thermal processes/heat treatment;
2. A student is able to distinguish basic methods of bonding;
A student is able to perform basic tests and inspections of engineering materials;
3. Students shows the ability to improve team work on strategy selection methods, aimed at optimal solving of assigned problems

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about special joining techniques by welding methods and related
C2. Acquiring an ability to choose the right joining technology and basic parameters of the process
C3. Acquiring the ability to design the bonding process of the product

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - A student knows the definitions and characteristics of special joining methods
PEK_W02 - A student knows the bonded materials obtained by using special joining methods and their typical applications
PEK_W03 - A student knows the methods of inspection/test of joints made by special bonding methods

II. Relating to skills:
PEK_U01 - A student is able to choose the right method of special joining group and define the basic parameters of the process
PEK_U02 - A student is able to propose the right joining technology for a particular product
PEK_U03 - A student is able to perform basic joints with different special methods

III. Relating to social competences:
PEK_K01 - A student shows ability to search for information and its critical analysis
PEK_K02 - A student shows the ability to team work on improving methods of strategy selection aimed to optimal solving of assigned problems
PEK_K03 - The student shows the ability of an objective evaluation of arguments, rational explanations and justifications of own position using knowledge of welding

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Application of laser technology in welding	2
Lec2	Application of electron beam in bonding, cutting, overlapping the layers and materials heat treatment	2
Lec3	Application of plasma in welding, cutting, spraying and surfacing	2
Lec4	Special methods of soldering and brazing of advanced materials	2
Lec5	Special methods of resistance welding	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Modern applications of friction welding	2
Lab2	Plasma welding and cutting	2
Lab3	Underwater welding	2
Lab4	Termite welding, explosion welding	2
Lab5	Modern applications of adhesive technology	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. tutorials
N4. self study - preparation for laboratory class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	short test, laboratory report
F2	PEK_K01 - PEK_K03	participation in problems discussions
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
PILARCZYK J.: Procesy spajania, Poradnik Inżyniera Spawalnika, tom I i II, WNT, Warszawa 2003 i 2005.
FERENC K.: Spawalnictwo, WNT Warszawa, 2007.
NOWACKI J., CHUDZIŃSKI M., ZMITROWICZ P.: Lutowanie w budowie maszyn, WNT, Warszawa 2007.
KLIMPEL A.: Spawanie zgrzewanie i cięcie metali. Technologie, WNT, Warszawa 1999.

SECONDARY LITERATURE
BUKAT K., HACKIEWICZ H.: Lutowanie bezołowiowe, Wyd. BTC, 2007.
PAPKAŁA h.: Zgrzewanie oporowe metali, Wyd. KaBe, 2003.
BRANDENBURG A.: Kleben metallischer Werkstoffe, DVS-Verlag GmbH, Düsseldorf 2001.
GODZIMIRSKI J.: Wytrzymałość doraźna konstrukcyjnych połączeń klejowych, WNT, Warszawa 2002.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Special methods of joining
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_PMS_W06	C1 - C3	lec1-7	N1, N4
PEK_U01 - PEK_U03	K2MBM_PMS_U04	C1 - C3	lab1-7	N2, N3
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K05, K2MBM_K10	C3	lab1-7	N2, N3

SUBJECT SUPERVISOR

dr inż. Tomasz Piwowarczyk tel.: 4255 email: tomasz.piwowarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytwarzanie kompozytów metodami odlewniczymi**
Name in English: **Manufacturing of composite materials by casting methods**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042208**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of manufacture and casting methods.
2. Basic knowledge of physical metallurgy.

SUBJECT OBJECTIVES

C1. Getting knowledge of the basic information about manufacturing methods, composite materials properties and their applications.
C2. Getting knowledge about the casting methods to produce metal matrix composite.
C3. Getting knowledge about the property test examinations included strength and wear tests.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Basic knowledge about production and application of composite materials. Knowledge of matrix types and strengthening mechanisms.
PEK_W02 - Basic knowledge about production and application of composite materials. Can select composite components for proper application.
PEK_W03 - Basic knowledge about strength and wear investigations of composite materials. Can define wear mechanism and metallographic observations.

II. Relating to skills:
PEK_U01 - Can use terminology related to composite materials, their manufacturing, and investigation of properties.
PEK_U02 - Can characterize selected composite materials. Can apply proper process parameters.
PEK_U03 - Can select and prepare composite components to achieve good reinforcing effect.

III. Relating to social competences:
PEK_K01 - Can think and act in a creative way.
PEK_K02 - Follows the rules and customs prevailing in academia.
PEK_K03 - Can correlate the effects of industry activity with the impact on the environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Composite materials- basic terms, groups.	2
Lec2	Strengthening mechanisms. Types of matrix-reinforcement interface.	2
Lec3	Surface phenomena, wetting of reinforcement by liquid metal, capillary phenomena, chemical reactions between composite components.	2
Lec4	Producing methods of composite materials, in-situ and ex-situ composites.	2
Lec5	Squeeze casting, stir casting. Exam	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Manufacturing of porous ceramic performs to reinforce composite materials	2
Lab2	Pressure infiltration of ceramic preforms.	2
Lab3	Production of hybrid composite materials	2
Lab4	Preparation of composite suspensions by stir casting.	2
Lab5	Centrifugal casting gradient materials. Credit	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Jerzy Sobczak, Kompozyty metalowe, 2001; Józef Śleziona, Podstawy technologii kompozytów, 1998; Izabela Hyla, Józef Śleziona, Kompozyty. Elementy mechaniki i projektowania, 2004; Ochelski Stanisław, Metody doświadczalne mechaniki kompozytów konstrukcyjnych

SECONDARY LITERATURE
Janusz Braszczyńsk, KRYSTALIZACJA ODLEWÓW; Zbigniew Konopka, METALOWE KOMPOZYTY ODLEWANE, 2011

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing of composite materials by casting methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03 PEK_K01 - PEK_K03	K2MBM_PMS_W04, K2MBM_PMS_W06	C1,C2	Lec1-Lec5	N1, N2, N3
PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	K2MBM_K10, K2MBM_PMS_U02	C2, C3	Lab1-Lab5	N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Naplocha tel.: 27-22 email: krzysztof.naplocha@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane metody kształtowania plastycznego**
Name in English: **Advanced methods of metal forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Able to design a typical process of metal forming
2. Possess a knowledge on modern engineering materials
3. Able to use of analysis methods and optimization of metal forming processes

SUBJECT OBJECTIVES

C1. Application of modern engineering materials for processes efficiency improvement
C2. Cognition of unconventional metal forming methods
C3. Application of analysis methods and optimization of metal forming processes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possess a knowledge on modern metal forming methods and their analysis
PEK_W02 - Know relations between material properties, metal forming process parameters and strain and load distributions
PEK_W03 - Able to indicate of directions of process modification with respect to efficiency

II. Relating to skills:
PEK_U01 - Able to design a modern process of metal forming, to analyze of limit conditions, to optimize of a process
PEK_U02 - Able to design tools, to choose of materials, machines and process automation methods
PEK_U03 - Able to calculate of necessary efforts of materials and tools

III. Relating to social competences:
PEK_K01 - Has awareness of the effect of method selection on environment
PEK_K02 - Able to use different information sources for decision making
PEK_K03 - Able to organize of teem working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview of limitations in metal forming processes	1
Lec2	Definition of advanced metal forming methods as e way of limits elimination	1
Lec3	Trends of metal forming process development, accuracy of parts, efficiency of processes, improvement of the process flexibility, forming of hard deformed materials, shortening of production preparation time, preservation of environment	1
Lec4	Development of materials for metal forming, automobile industry, light materials, special materials	2
Lec5	Modern tool materials	2
Lec6	Progressive and transfer methods in sheet metal forming processes	1
Lec7	Application of powder metallurgy for manufacturing materials and parts on specific properties	2
Lec8	Unconventional metal forming methods	2
Lec9	Enhancement of metal forming methods flexibility	1
Lec10	Numerical methods in analyze, designing and optimization of metal forming processes	2
Lec11	Engineering, dedicated FEM programs	1
Lec12	Modern machines for metal forming	2
Lec13	Control methods of metal forming processes	2
		Total hours: 20
Form of classes – Project		Number of hours

Proj1	Evaluation of significance and placement of risk of fracture, wrinkling and part accuracy on the base of literature	1
Proj2	Elaboration of assumptions to the process project, number of operations, conception of intermediate shapes, preliminary selection of parameters, assessment of necessary machines availability	2
Proj3	Elaboration of 3D CAD model and geometry transfer to FEM program	2
Proj4	Metal forming process modeling by engineering FEM program	2
Proj5	Metal forming tools design	2
Proj6	Assessment of process efficiency in relation to typical metal forming methods	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. self study - preparation for project class
N4. tutorials
N5. self study, preparation for lecture class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K03,	Assessment of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Richert J., Innovative methods of metal forming. AGH publishing, Krakow, 2010.
Gronostajski Z., Applied research in advanced metal forming processes. Editorial Office of Wroclaw university of Technology, Wroclaw, 2003.
Dyja H., Rheology of plastically deformed metals. Polytechnic of Czestochowa publishing.

SECONDARY LITERATURE

Boljanovic V., Sheet metal forming processes and die design New York : Industrial Press, cop. 2005.
Walsh R. A., McGraw-Hill Machining and metalworking handbook, McGraw-Hill, 2006
Rao S. S., Engineering optimization theory and practice . John Wiley & Sons. 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced methods of metal forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_PMS_W02	C1, C3	Lec1 - Lec3, Lec10,	N1, N2, N5
PEK_W02	K2MBM_PMS_W02, K2MBM_PMS_W06	C1, C3	Lec4, Lec5, Lec7, Lec13,	N1, N2, N5
PEK_W03	K2MBM_W05, K2MBM_W06, K2MBM_W07, K2MBM_W10	C1 - C3	Lec3 - Lec12	N1, N2, N4, N5
PEK_U1 - PEK_U3	K2MBM_PMS_U01, K2MBM_U01, K2MBM_U02, K2MBM_U10, K2MBM_U20	C1 -C3	Lec1 - Lec13, Proj1 - Proj6	N1 -N5
PEK_K01 - PEK_K03	K2MBM_K07, K2MBM_K08, K2MBM_K09	C1, C3	Lec1 - Lec13, Proj1 - Proj6	N1 - N5

SUBJECT SUPERVISOR

dr inż. Adam Niechajowicz tel.: 40-49 email: adam.niechajowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042211**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				120	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				4	
including number of ECTS points for practical (P) classes				4	
including number of ECTS points for direct teacher-student contact (BK) classes				2.8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of production methods of using various techniques: casting, welding, plastic forming, machining.
2. Has a basic knowledge of the principles of machines selection, equipment and tools for the implementation to various manufacturing processes.
3. Has a knowledge of the basics of the process designing.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge and skills of a critical analysis for selection the planning technology and methods to manufacture the products.
C2. Acquisition of knowledge and skills to choice suitable machines, tools and equipment of technological tooling, process parameters for the selected method of product manufacturing.
C3. Acquire the execution skills to the project of the products manufacturing process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a knowledge of the selection and planning of the products manufacturing technology.
PEK_W02 - Has a knowledge in the right selection of the execution of the manufacturing process.
PEK_W03 - Has a knowledge of the rules of designing of the technological manufacturing process.

II. Relating to skills:
PEK_U01 - Can select and plan the manufacturing technology of the products.
PEK_U02 - Can correctly evaluate the conditions and parameters of the products manufacturing technology.
PEK_U03 - Can develop and carry out the project of products manufacturing technology.

III. Relating to social competences:
PEK_K01 - Acquires the ability to care about the aesthetics of the work and the responsibility for its implementation.
PEK_K02 - Can think and act in a creative way.
PEK_K03 - Acquires a teamwork skills.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Presentation of the course. The scope and discuss how to implement and the pass the pre-final project. Edition proposals and discussion of topics of technological projects. Entering literature list.	3
Proj2	Analysis of possibilities and ways to accomplish the product depending of its construction, required performance and production volume. Presentation and discussion about the final concept of manufacturing technology.	6
Proj3	Development of technological assumptions, selection of the performance parameters, perform the necessary calculations for the selected method of manufacturing.	6
Proj4	Selection of machines, tools and equipment for realization of the agreed manufacturing process.	3
Proj5	Execution the structure of technological process, with detailed plan of selected operations, the order of basic and additional treatments, time standards, technological brochures, etc.	6
Proj6	Development of the project design documentation (assembly drawing and executive drawings). Presentation with the project defense.	6
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. project presentation
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of the project preparation
F2	PEK_W01 - PEK_W03, PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Project defense.
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Pre-final project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_PMS_W06, K2MBM_PMS_W07, K2MBM_W05, K2MBM_W07, K2MBM_W08	C1, C2	Pr1, Pr2	N1, N3
PEK_U01 - PEK_U03	K2MBM_PMS_U04, K2MBM_PMS_U05, K2MBM_U08, K2MBM_U10	C1 - C3	Pr3 - Pr6	N1 - N3
PEK_K01 - PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K05, K2MBM_K10	C1 - C3	Pr1 - Pr6	N1 - N3

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Narzędzia do przeróbki plastycznej**
Name in English: **Tools for metal forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042215**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic concepts to metal and plastic processing.
2. Fundamentals of materials science. Materials used in the construction of machinery and equipment in plastic forming.
3. Basis of design processes in the processing of plastic.

SUBJECT OBJECTIVES

C1. To acquaint the participants with the basic construction of the equipment used in the processing of plastic.
C2. Gaining knowledge of the materials used in the construction of tools for cold and hot forming.
C3. To acquaint the participants with the typical design solutions used in the construction of working tools.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He has knowledge of the foundations of the theory of plasticity, analytical methods development processes, application of mathematical modeling methods for the analysis of metal forming processes

PEK_W02 - He has ordered knowledge of methods and techniques of organization of installation of equipment and machines

II. Relating to skills:

III. Relating to social competences:

PEK_K01 - Acquires the ability to take responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification of basic technologies shaping by plastic forming. Development of cold and hot. Construction equipment for plastic processing.	2
Lec2	Cold forming. The types of treatment used tool. Classification of materials used in cold forming.	2
Lec3	Forged in the heat. The types of treatment used tool. Classification of materials used in the treatment of hot forming.	2
Lec4	Design solutions for the construction working tools. Heat treatment of materials used in construction working tools.	2
Lec5	Analysis of the sample preparation process in the forming of the workpiece. Solutions will design, material and technology for tools.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01,	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. BOLJANOVIC V.: Sheet metal forming processes and die design, Industrial Press, New York 2004.
2. MARCINIAK Z.: Konstrukcja tłoczników, WNT, Warszawa 2002.
3. ZIMNIAK Z.: System wspomagania projektowania, zapewnienia jakości i diagnozowania tłoczenia blach, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005
4. Ćwiczenia laboratoryjne z budowy maszyn część II Obróbka Plastyczna pod redakcją Henryka Ziemby, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1981.
5. MAZURKIEWICZ A., KOCUR L.: Obróbka plastyczna laboratorium , Politechnika Radomska, Radom 1997.

SECONDARY LITERATURE

[1] H.J. Kleemola, M.T. Pelkkikangas, Effect of predeformation and strain path on the forming limits of steel copper and brass, Sheet Met. Ind. 63 (2) (1997) 591–599.
[2] R. Arrieux, C. Bedrin, M. Boivin, Determination of an intrinsic forming limit stress diagram for isotropic metal sheets, in: Proceedings of the 12th Biennial Congress IDDRG, 1982.
[3] A.K. Ghosh, J.V. Laukonis, The influence of strain-path changes on the formability of sheet steel, in: Proceedings of the Ninth Biennial Congress of the International Deep Drawing Research Group, Sheet Metal Forming and Energy Conservation, ASM Publication, New York, 1976.
[4] T.B. Stoughton, A general forming limit criterion for sheet metal forming, Int. J. Mech. Sci. 42 (1) (2000) 1–27.
[5] A.F. Graf,W.F. Hosford, Calculations of forming limit diagram for changing strain paths, Metall. Trans. A 24 (3) (1993) 2497–2501.
[6] A. Graf, W.F. Horsford, Effects of changing strain paths on forming limit diagrams of Al 2008–T4, Metall. Trans. A 24 (3) (1993) 2503–2512.
[7] R. Arrieux, Determination and use of the forming limit stress diagrams, J. Mater. Process. Technol. 53 (3) (1995) 47–56.
[8] R. Hill, Math. Proc. Camb. Philos. Soc. 85 (4) (1979) 179–185.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Tools for metal forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2MBM_PMS_W02, K2MBM_PMS_W06, K2MBM_PMS_W07	C1, C2, C3	W1-W5	N1,N2,N3
PEK_K01	K2MBM_K05	C1, C2, C3	W1-W5	N1,N2,N3

SUBJECT SUPERVISOR
dr inż. Maciej Zwierzchowski tel.: 21-74 email: maciej.zwierzchowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English: **MASTER THESIS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042250**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of manufacturing techniques and production systems documented by positive marks in all subjects of the first and second semesters in within the specialty Processes Machines and Manufacturing Systems
2. Can apply their knowledge. Carry out experimental research, seek an information from the literature. Speak a foreign language at the level which let to express self-opinions and write master's thesis in the field of production techniques and production systems. Can analyze the results of the research and specify the conclusions.
3. Is aware of the importance of non-technical aspects and impacts of engineering, to respect the principles of ethics and social role of technical college graduate.

SUBJECT OBJECTIVES

C1. Based on the acquired knowledge while studying, preparation of master thesis by the solution of research problem in the field of the specialty Processes Machines and Manufacturing Systems.
C2. Writing a master thesis and presentation of its achievements in relation to current information in literature.
C3. Acquisition and consolidation of independent work skills, determination of the priorities to tackle the task and awareness of responsibility for own work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a deepened and enlarged knowledge of realization the complex engineering tasks, their description, documentation and presentation.
PEK_W02 - Has a enlarged knowledge of the organization and implementation of master thesis as a project, which have to be managed in issues related to the specialty Processes Machines and Manufacturing Systems.
PEK_W03 - Has a basic knowledge in methodology of presenting the results of done work and background skills needed for the communicating in business engineering teamwork.

II. Relating to skills:
PEK_U01 - Can critically analyze and evaluate existing manufacturing processes, production systems and technological machines. Can work independently to realize the degree of master's thesis, using research techniques and methods known during studies.
PEK_U02 - Can acquire concrete information from the literature also in foreign languages. Can to interpret and critically evaluate the research results.
PEK_U03 - Knows how to edit a master's thesis complying with prevailing requirements of method and style of writing. Can present it orally to a wider audience using multimedia capabilities, including the occurrence to the diploma committee.

III. Relating to social competences:
PEK_K01 - As a graduate student is aware of being the next leader, who knows how to organize the work and determine the self-priorities for the others, can manage a team of people as well as work together in the group taking the different roles.
PEK_K02 - Is gaining characteristics of a person working alone, according to the principles of ethics with an awareness of the responsibility for their own work.
PEK_K03 - Acquires attention to style and form of expression of own views in native and a foreign languages, especially in English, understands the need of continuing education and developing professional skills throughout their live.

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. case study
N2. self study - self studies and preparation for examination
N3. multimedia presentation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Working in the semester, preparing master's thesis as a work.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Literature of the master's thesis topic agreed with the promoter.

SECONDARY LITERATURE

1. Kozłowski R.: Praktyczny sposób pisania prac dyplomowych; Wolters Kluwer Polska sp. z o.o. 2009;
2. Kalita C.: Zasady pisania licencjackich i magisterskich prac badawczych; Poradnik dla studentów; Wyd. ARTE 2011
3. Kevine J. S.; Writing and presenting your thesis or dissertation; Michigan 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MASTER THESIS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_PMS_W01, K2MBM_PMS_W02, K2MBM_PMS_W03, K2MBM_PMS_W04, K2MBM_PMS_W05, K2MBM_PMS_W06, K2MBM_PMS_W07	C1 - C3		N1, N2, N4
PEK_U01 - PEK_U03	K2MBM_PMS_U01, K2MBM_PMS_U02, K2MBM_PMS_U03, K2MBM_PMS_U04, K2MBM_PMS_U05	C1, C2		N1 - N4
PEK_K01 - PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K05, K2MBM_K07, K2MBM_K09, K2MBM_K10	C1 - C3		N1 - N4

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza wymiarowa w projektowaniu eksperymentu**
Name in English: **Dimensional Analysis in Experiment Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042303**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis, linear algebra.

SUBJECT OBJECTIVES

C1. Knowledge of dimensional analysisas a tool for theory of identification and experiment planning.
C2. Skill of construction of empirical mathematical models.
C3. Acqurement and consolidation of social competences contaiining emotional intelligence based on skills of co-operation in a student group in order to efficiently solve the problems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of dimensional analysis in Drobot's formulation.
PEK_W02 - Knowledge of rudiments of parametrical identification.
PEK_W03 - Knowledge of rules of model similarity.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Definition of dimensional space according to Drobot.	1
Lec2	Relations between elements of dimensional space & images described in classical theory of measurement.	1
Lec3	Postulates of obiectivision & synonymity.	1
Lec4	Elements of measurement theory.	1
Lec5	Dimensional homogenity & invariability.	1
Lec6	Construction of empirical mathematical models .	1
Lec7	Dimensional transformation - so called Π-theorem.	2
Lec8	Dimensional analysisas vs theory of identification and experiment planning.	2
Lec9	Dimensional complex function.	1
Lec10	Multistage identification.	1
Lec11	Rule of correspodence.	1
Lec12	Theory of model similarity.	2
Lec13	Change of dimensional basis. Experiment planning.	2
Lec14	Testing of completeness of similarity invariants set.	1
Lec15	Presentation & disscusion of control works, Crediting.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides.
N2. report preparation.
N3. tutorials.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	Homeworks evaluation.
P = f1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.W. Kasprzak, B. Lysik, M. Rybaczuk, Measurements, Dimensions, Invariant Models and Fractals, Wrocław-Lwów 2004,
2.W. Kasprzak, B. Lysik, M. Rybaczuk, Dimensional Analysis in the Identification of Mathematical Models. World Scientific Singapore, 1990,
3.Pr. zb. pod red. W. Myszki, Komputerowy system obsługi eksperymentu, WNT Warszawa 1991,
4.M. Szata, Opis rozwoju zmęczeniowego pękania w ujęciu energetycznym, Oficyna Wydawnicza PWr, Wrocław 2002.

SECONDARY LITERATURE

W. Kasprzak, B. Lysik, Analiza wymiarowa. Algorytmiczne procedury obsługi eksperymentu, WNT Warszawa 1988.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dimensional Analysis in Experiment Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03.	K2MBM_IMK_W03	C1	Lec1 - Lec15	1,2,3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria niezawodności**
Name in English: **Reliability Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042305**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in operation, statistics, engineering design

SUBJECT OBJECTIVES

C1. Acquaint students with problems dealing with analysis and assessment of mechanical object reliability.
C2. Ability of rational management in machine operation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows relations and dependecies among processes observed in operation as well as failing process

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Data sources about reliability and safety of machines	2
Lec2	Methodology of data statistical processing. Instructions to reliability testing program.	2
Lec3	Informatic systems aided reliability testing. Analysis and interpretation of test results.	2
Lec4	Application of test results in operation management.	2
Lec5	Structure reliability. Design with probabilistic characteristics.	2
Lec6	Basics in structural reliability modelling using simulation	2
Lec7	Analitical methods in reliability: block diagrams (complex systems)	2
Lec8	Analitical methods in reliability: FTA	2
Lec9	Analitical methods in reliability: FMEA	2
Lec10	Analitical methods in reliability: FMEA	2
Lec11	Multistate systems: Markov processes	2
Lec12	Basics in simulation of reliability assessment. Variable generating of given probability dsitribution.	2
Lec13	Basics in simulation of reliability assessment. Algorithms of simple programs. Programming (Basics),	2
Lec14	Basics in simulation of reliability assessment. Results analysis and conclusions.	2
Lec15	Testing of simulation applications	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	exam
P = p		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Poradnik niezawodności. Podstawy matematyczne. Red. Migdalski J. Wydawnictwo WEMA, Warszawa 1982.
Inżynieria niezawodności. Poradnik. Red. Migdalski J. Akademia Techniczno- Rolnicza, Ośrodek Badania Jakości Wyrobów „ZETOM”. Bydgoszcz, Warszawa 1992.
The Reliability of Mechanical Systems. Red. Davidson J. Mechanical Engineering Publications Limited for The Institution of Mechanical Engineers. London 1994.

SECONDARY LITERATURE

Polska Norma PN-93/N-050191. Słownik terminologiczny elektryki. Niezawodność, jakość usługi.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Reliability Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_IMK_W04	C1	Lec1-Lec15	N1

SUBJECT SUPERVISOR

dr hab. inż. Marek Młyńczak tel.: 71 320 38 17 email: marek.mlynczak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika materiałów -badania, modelowanie**
Name in English: **Mechanics of materials; testing and modeling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042307**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the courses: Technical Mechanics, Calculus I,
Algebra and Analytic Geometry
2. Physics, Strength of Materials I and II
3. Student has fundamental knowledge of materials science and plastics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the structure, properties, investigation and modelling methods of selected group of advanced materials.
C2. Acquisition of skills related to constitutive equations and their identification with reference to advanced materials for mechanical constructions.
C3. Acquisition of skills related to physical fundamentals and methodology of experimental investigations aimed at determining the properties of advanced materials.
C4. Acquisition and strengthening of the social competence including emotional intelligence that is based on the ability to cooperate in a group of students, which is aimed at effective problem solving.
Responsibility, honesty and diligence in one's code of conduct; obeying the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the structure and properties of selected advanced materials,
PEK_W02 - Student knows how to describe properties of materials using constitutive models,
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods essential to determine the properties of advanced materials.

II. Relating to skills:
PEK_U01 - Student can select a material on the basis of knowledge of its properties and application in mechanical constructions,
PEK_U02 - Student can apply a body model to describe properties of a material,
PEK_U03 - Student can apply experimental verification methods to selected advanced materials.

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the strength of materials,
PEK_K03 - Student adheres to the customs and rules of academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Advanced materials. Thematic scope of the course. Classification of materials.	1
Lec2	Composites with continuous fibre for extremely strenuous constructions. Material, technology, exemplary applications.	2
Lec3	High pressure composite vessels for gaseous fuel storage. Design, manufacture, testing, applications.	2
Lec4	Testing methods of high pressure composite vessels for gaseous fuel storage	2
Lec5	Classification, structure, manufacture, application of Smart materials.	1
Lec6	Cross effects. Methods of experimental investigations, measuring apparatus, software for experiment handling.	2

Lec7	Properties of Smart materials stimulated by magnetic field. Examples of experimental investigations.	2
Lec8	Metallic glasses. Manufacture, properties, testing.	2
Lec9	Properties of the materials with martensitic phase transformation induced by plastic strain. Examples of experimental investigations.	2
Lec10	Body models; constitutive equations for selected advanced materials.	2
Lec11	Methods to identify constitutive models for Smart materials.	1
Lec12	Examples of application of Smart materials.	1
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Cyclic tests of high pressure composite vessels for gaseous fuel storage.	2
Lab2	Use of optical fibre sensors in investigations of advanced materials.	2
Lab3	Selected methods of investigation of metallic glasses.	2
Lab4	Investigation of the properties of composites subjected to complex stress states. Investigation of martensitic phase transformation induced by plastic strain.	2
Lab5	Application of magnetomechanical effects in the investigations of construction materials. Magnetovision.	1
Lab6	Application of the Thomson effect. Thermovision in the investigations of advanced materials.	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	Written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K04	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics of materials; testing and modeling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_IMK_W03	c1,c2		1,3,4
PEK_U01-PEK_U03	K2MBM_IMK_U03	c2,c3		1,2
PEK_K01-PEK_K03	K2MBM_K10	c4		1,2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Problemy smarowania i zużywania maszyn**
Name in English: **Lubrication and wear problems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM042320**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a structured understanding of the physical and physicochemical processes occurring in the tribological nodes .2. It has a basic knowledge of the mechanics of continuous media, including the basics of fluid mechanics and flow issues.
2. Skills: 1 It has the ability to apply fundamental fluid mechanics for the fluid flow and its use in art.
3. Social competence: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineering, including its impact on the environment and the associated responsibility for their decyzje.2.Potrafi think in an entrepreneurial manner.

SUBJECT OBJECTIVES

C1. Acquire advanced theoretical knowledge of tribological wear and its type.
C2. Detailed understanding of the types of lubricants, their tribological properties and rheology.
C3. Gaining an ability to select the type and amount of lubricant to lubrication friction and knowledge of the fundamentals of circuit design and environmental aspects of lubrication lubrication assemblies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has detailed knowledge of the tribological wear of materials used in the nodes of friction.
PEK_W02 - He has detailed knowledge of lubricants, their tribological properties and rheology.
PEK_W03 - He has detailed knowledge of the ways of lubricating oils and greases plastic and basic knowledge on lubrication system design.

II. Relating to skills:
PEK_U01 - He can select materials for friction nodes.
PEK_U02 - He can choose the type and amount of lubricant to friction nodes.
PEK_U03 - He can design a simple installation lubrication and define the basic parameters that will determine its reliable functioning.

III. Relating to social competences:
PEK_K01 - He can think and act creatively.
PEK_K02 - It can objectively evaluate the arguments rationally explain and justify their own point of view, using the knowledge gained during lectures and laboratory exercises.
PEK_K03 - It can work, search for information and critically analyze them, both individually and collectively.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Terms and organization of classes, framework programs, the terms of credit. Introduction to lubrication and wear in the construction and operation of machinery.	2
Lec2	Tribological wear. Terms: adhesion of the surface layer, the surface free energy. Work of adhesion.	2
Lec3	Types and characteristics of lubricants. Properties and application of lubricants. The testing of lubricants (including lubricity, mechanical stability, service life and thermal stability).	2
Lec4	Basic rheology of lubricants. Capillary and rotational rheometry. Rheological greases steady flow conditions and with the use of methods for dynamic oscillation. Linear viscoelasticity.	2
Lec5	Methods of lubrication. Selection of the type and amount of lubricant for the lubrication of friction.	2
Lec6	Process automation lubrication. Construction of central lubrication systems. Examples of applications for central lubrication systems in various industries.	2
Lec7	Basic design of lubrication. The environmental aspects of lubrication assemblies.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Test of resistance to abrasive wear of the materials used in the nodes of friction.	2

Lab2	Measurement of density and viscosity of lubricating oils. Determination of the viscosity index of lubricating oils.	2
Lab3	Lubrication of slioding bearings. Determination of the frictional characteristics of the cross slide bearing. Evaluation of the impact of oil viscosity on the process of hydrodynamic lubrication.	2
Lab4	Determining the properties of lubricating greases.	2
Lab5	Measuring the degree of penetration of lubricating greases and study the rheological properties of lubricating greases (compilation flow curves, determination of yield stress).	2
Lab6	Research on the influence of the wall material for the formation of a boundary layer greases in the lubricant.	2
Lab7	Studies on impact of length, diameter and shape of circular pipe pressure drop in lubricants arts.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class
N5. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_K01 - PEK_K03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Krawiec S. Kompozycje smarów plastycznych i stałych w procesie tarcia stalowych węzłów maszyn. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011. [2] Płaza S., Fizykochemia procesów tribologicznych. Wydawnictwo Uniwersytetu Łódzkiego, Łódz 1997. [3] Bartz W., J., Schmierfette, Renningen-Malmsheim, expert-Verlag, 2000. [4] Bartz W., J.,Getriebe-schmierung. Ehningen bei Bóblingen, expert-Verlag 1989. [5] Czarny R., Smary plastyczne. Wydawnictwo Naukowo-Techniczne, Warszawa 2004. [6] Czarny R., Systemy centralnego smarowania maszyn i urządzeń. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000. [7] Wysocki M., Systemy smarownicze w przemyśle ciężkim. Wydawnictwo Śląsk, Katowice 1971. [8] Laboratory manuals available on the website of the Department PKMiT.

SECONDARY LITERATURE
[1] Froischteter G. B, Trilisky K. K., Ishchuk Yu. L., Stupak P. M., Rheological and thermophysical properties of greases. Gordon & Breach Science Publishers, Londyn 1989. [2] Ishchuk Yu. L., Lubricating grease manufacturing technology. New Age International Limited Publishers, New Delhi 2005. [3] Ferguson J., Kembłowski R., Reologia stosowana płynów. Wydawnictwo Marcus, Łódź 1995. [4] Matras Z., Transport reologicznie złożonych cieczy nienewtonowskich w przewodach. Wydawnictwo Politechniki Krakowskiej, Kraków 2001. [5] Garkunov D. N., Tribotechnika. Masinostroenie, Moskva 1985. [6] Kosteckij B. I., Trenie, smazka i iznos w masinach. Izdatelstvo Technika, Kiev 1970. [7] Lawrowski Z., Tribologia - tarcie, zużywanie i smarowanie. Wydawnictwo Naukowe PWN, Warszawa 1993. [8] Płaza S., Margielewski L., Celichowski G., Wstęp do tribologii i tribochemia. Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Lubrication and wear problems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_IMK_W08	C1	Lec1, Lec2	N1, N2, N3
PEK_W02	K2MBM_IMK_W08	C2	Lec3, Lec4	N1, N2, N3
PEK_W03	K2MBM_W05, K2MBM_W06	C3	Lec5, Lec6, Lec7	N1, N2, N3
PEK_U01 - PEK_U03	K2MBM_IMK_U07, K2MBM_U01, K2MBM_U05, K2MBM_U07	C1, C2, C3	Lab1 - Lab7	N3, N4, N5
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K03, K2MBM_K05, K2MBM_K06	C1, C2, C3	Lab1 - Lab7, Lec1-Lec7	N1 - N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Stanisław Krawiec tel.: 71 320-40-56 email: Stanislaw.Krawiec@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika materiałów "Smart"**
Name in English: **Mechanics of Smart materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042322**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10	10			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the courses: Technical Mechanics, Calculus I,
Algebra and Analytic Geometry, Physics.
2. Strength of Materials I and II
3. Student has fundamental knowledge of materials science and plastics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the structure, properties, investigation and modelling methods of selected group of Smart materials.
C2. Acquisition of skills related to constitutive equations and their identification with reference to Smart materials, particularly in the area of mechanical constructions.
C3. Acquisition of skills related to physical fundamentals and methodology of experimental investigations aimed at determining the properties of Smart materials.
C4. Acquisition and strengthening of the social competence including emotional intelligence that is based on the ability to cooperate in a group of students, which is aimed at effective problem solving.
Responsibility, honesty and diligence in one's code of conduct; obeying the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the structure and properties of selected Smart materials
PEK_W02 - Student knows how to describe properties of Smart materials using constitutive models
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods essential to determine the properties of Smart materials.

II. Relating to skills:
PEK_U01 - Student can select a material from the Smart materials group on the basis of knowledge of its properties and application in mechanical constructions
PEK_U02 - Student can apply a body model to describe properties of a Smart material,
PEK_U03 - Student can apply experimental verification methods to selected Smart materials.

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information,
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the strength of materials,
PEK_K03 - Student adheres to the customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Cross effects; classification, structure, manufacture, application of Smart materials.	2
Lec2	Magnetorheological fluids and ferrofluids and composites based on these fluids; magnetorheological elastomers. Structure, properties and application possibilities.	2
Lec3	Magnetostrictive materials and composites based on these materials. Design of dampers, actuators and measurement systems.	2
Lec4	Magnetocaloric and electrocaloric materials and effects. Cooling systems utilizing Smart materials.	1

Lec5	Smart magnetic materials in the design of NDT measurement systems. Magnetovision and its applications.	1
Lec6	Energy Harvesting. Methods of energy acquisition from vibrations and waste heat using Smart materials.	1
Lec7	Methods of description of Smart materials. Overview of constitutive models. Elastic, pseudoelastic and magnetoelastic materials etc.	1
		Total hours: 10

Form of classes – Classes		Number of hours
Cl1	Investigation of properties of the magnetorheological damper with a magnetorheological fluid and a magnetorheological composite.	2
Cl2	Determination of damping in a magnetorheological elastomer.	2
Cl3	Testing of the actuator with the "giant magnetostriction" core in the acoustic band; the so-called "playing table"	2
Cl4	Testing of the harvester which acquires electrical energy from vibrations.	1
Cl5	Determination of the properties of the harvester device which acquires electrical energy from waste heat.	1
Cl6	Use of magnetovision in experimental mechanics.	1
Cl7	"Magnetic refrigerator" demonstrator utilizing Smart materials. Testing.	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. laboratory experiment
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K03	written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE
Author's own publications (for each topic).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics of Smart materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K2MBM_IMK_W03	C1		N1,N2,N4
PEK_U01-PEK_U03, PEK_K01-PEK_K03	K2MBM_IMK_U03, K2MBM_K01, K2MBM_K03	C2,C3,C4		N1,N2, N3,N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe cząstkowe**
Name in English: **Partial Differential Equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042323**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10	10			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the elements of calculus and linear algebra
2. Knowledge of the elements of ordinary differential equations
3. Ability to perform calculations and analysis of the results

SUBJECT OBJECTIVES

C1. Ability to solve the equations of physics
C2. Ability to analyze the course of the physical processes
C3. The ability to search for information and its analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge about the different types of partial differential equations and methods of solving them.
PEK_W02 - Knowledge of the physical problems described by partial differential equations
PEK_W03 - Knowledge allows to analyze the results

II. Relating to skills:
PEK_U01 - Ability to identify and describe the problem
PEK_U02 - Ability to analyze the equations obtained and the use of appropriate methods of solution
PEK_U03 - Ability to analyze the results

III. Relating to social competences:
PEK_K01 - Ability to work independently with the use of literature
PEK_K02 - Ability to work systematically and, in particular, the consulting
PEK_K03 - Collective ability to solve problems in the classroom

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	1. Linear partial differential equations of first order and second.	2
Lec2	2. Equation of string	2
Lec3	3. Wave equation	2
Lec4	5. Laplace equation.	2
Lec5	Test.	2
		Total hours: 10

Form of classes – Classes		Number of hours
Cl1	1. Equation of string.	2
Cl2	2. Wavw equation.	2
Cl3	3. Laplace equation.	2
Cl4	4. The equation for beam bending vibration	2
Cl5	5. Solving these equations using the equations discussed during the course.	2
		Total hours: 10

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials
N3. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEKU01+PEKU02+PEKU03	test
P = ocena z kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U2+PEK_U3	test
P = ocena z kolokwium przeprowadzonego na wykładzie		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
W. Żakowski, W. Leksiński, Mathematic, part IV

SECONDARY LITERATURE
N. Matwiejew, Methods integration of ordinary differential equations

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Partial Differential Equations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teachin tool numbe

PEK_W01+PEK_W2+PEK_W3	K2MBM_IMK_W01	C1+C2+C3	Lec1=Lec5	N3
PEK_K01+PEK_K2+PEK_K3+PEK_U01+PEK_U2+PEK_U3	K2MBM_IMK_U02	C1+C2+C3	Cl1-Cl5	N1 i N2

SUBJECT SUPERVISOR

dr inż. Grażyna Ziętek tel.: 320-21-18 email: grazyna.zietek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy teorii sprężystości i plastyczności**
Name in English: **Elements of Theory Elasticity and Plasticity**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042326**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	20			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowlege of elements of the mathematical analysis and the lineal algebra.
2. The knowlege of elements of the strenght of materials, and particularly of the knowledge concerning of the stress and strain state.
3. The skill of the calculations and analyses of received results in the area of the strenght of materials.

SUBJECT OBJECTIVES

C1. The achivement of the knowledge from the area of the theory of the elasticity and the purchase, in this range, the skill of the problem solving for complex stress states.
C2. The achivementt of the knowledge from the area of the theory of the plasticity and the purchase, in this range, the skill of the problem solving for complex stress states.
C3. The achivement of skills of formulating of equations describing the mechanical state of elements of construction.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The orderly knowledge from the theory of the elasticity, particularly in the area of the plane stress state .
PEK_W02 - The orderly knowledge from the theory of the plasticity, particularly in the area of the plane stress state
PEK_W03 - The orderly knowledge conserning of constitutive equations applied to description of structural materials

II. Relating to skills:
PEK_U01 - The skill of finding of stress and strain in complex states in the different kind constructions.
PEK_U02 - The skill of formulating of problems in area of the mechanics os structural material.
PEK_U03 - The skill of analyzing of obtained results.

III. Relating to social competences:
PEK_K01 - The skill of the individual works with the utilization of the literature.
PEK_K02 - The skill of the systematical works, and particularly the participation in consultations.
PEK_K03 - The skill of the collective problem solving during lecture.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Stress state	2
Lec2	Strain state	2
Lec3	Transformation of of stress and strain state elements.	2
Lec4	Equations of equilibrium and strain compatibility conditions.	2
Lec5	The plate state of stress and strain for elastic medium	2
Lec6	Criteria for initial yield.	2
Lec7	Kinematic, isotropic and mixed hardening.	4
Lec8	Elasto-plastic torsion of prismatic bar.	2
Lec9	Elasto-plastic banding of prismatic bar.	2
		Total hours: 20
Form of classes – Classes		Number of hours
Cl1	Determining of stress and strain tensors in the case of differently loaded of elements of construction.	2
Cl2	Determining of principal stress and strain.	2
Cl3	The analysis of the different kind of the hardening. Determining of the dependence between the stress and strain in the case of the uni-axial compression and the tension.	4
Cl4	Determining of the permissible stress using different yield criteria.	2
Cl5	Elasto-plastic torsion of prismatic bars, determining the state of stress and strain.	4

Cl6	Elasto-plastic bending of prismatic bars, determining the state of stress and strain.	4
Cl7	Test.	2
		Total hours: 20

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials
N3. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01+PEK_W2+PEK_W3	test
P = Ocena z kolokwium na ćwiczeniach		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U2+PEK_U3	test
P = ocena z kolokwium		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Walczak, The strength of materials and the foundations of the theory of elasticity and plasticity

SECONDARY LITERATURE
J. Skrzypek, Plasticity and creep.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Elements of Theory Elasticity and Plasticity
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Tea t nu
PEK_W01+PEK_W2+PEK_W3	K2MBM_IMK_W02	C1+C2+C3	Lec1-Lec9	
PEK_K01+PEk_K02+PEK_K03+PEK_U01+PEK_U02+PEK_U03	K2MBM_K06	C1+C2+C3	Cl1-Cl7	N

SUBJECT SUPERVISOR

dr inż. Grażyna Ziętek tel.: 320-21-18 email: grazyna.zietek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Tribologia**
Name in English: **Tribology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042329**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 He has ordered knowledge about the types of engineering materials - metal, ceramic, polymer and composite materials.2. It has a basic knowledge of the construction, operation and use of the main components and machine assemblies.3. It has a basic knowledge of physics, chemistry, statistics.
2. Skills: 1. It can analyze the macroscopic fractures, microstructure of materials, technological drawbacks of origin, is able to determine the characteristics of the microstructure of metallic materials.2. He can choose the material on a given machine element and can explore its basic properties.
3. Competencies: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineer.2. Is aware of the importance of behavior in a professional manner and have a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. Familiar with the processes of friction, wear and lubrication of moving nodes and methods for machine control these processes in terms of minimizing their effects (special attention will be paid to the construction and technological methods of increasing the reliability and durability of sliding pairs, as well as the problem of lubrication and lubricant selection as an effective prevention of friction and wear).
C2. Understanding the impact of selected parameters of friction vector, ie, pressure, velocity slip material cooperating associations and grease on the tribological characteristics of sliding pairs. Get to know the influence of the structure of the material to abrasion and impact bushing stiffness for load distribution in the bearing friction.
C3. Show students that they can effectively counteract the negative effects of friction in the moving solid contact with real objects illustrate some of the issues discussed theoretically in the lecture.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the processes of friction, wear and lubrication of moving nodes machine.
PEK_W02 - Know the basic types of lubricants and their applications.
PEK_W03 - He knows the design and technological methods of increasing the reliability and durability of sliding pairs.

II. Relating to skills:
PEK_U01 - It can choose materials for sliding nodes and understand relationships and dependencies between the material used and its durability.
PEK_U02 - It can perform basic tests of materials used in the nodes of friction, interpret them and implement in the final node machines.
PEK_U03 - He can use the theoretical knowledge acquired friction and lubrication of the lecture and apply it in practice.

III. Relating to social competences:
PEK_K01 - It can search for information and critically analyze them.
PEK_K02 - Properly define and resolve dilemmas, adheres to the principle of professional ethics.
PEK_K03 - Able to work independently and as a team, and properly assess their own tasks and priorities of the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program and requirements. Brief history of tribology. Elastic contact of smooth bodies. The real contact of solids. The problem of the surface layer.	2
Lec2	Friction and wear processes, their distribution and characteristics. Sliding and rolling friction. Theories of friction. Effect of pressure and sliding velocity on the friction and wear.	2
Lec3	Characteristics of materials (metal and others) on the sliding nodes and the rules for their selection. Simple and reversed pair of friction. Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2

Lec4	Grease as a construction material. Objectives lubrication. The way of obtaining o fluid friction. Distribution of lubricants. Lubricating oils and their properties. Greases, their distribution and characteristics.	2
Lec5	Final test.	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	1.Determining of properties of slide bearing materials.	2
Lab2	2.Determining of coefficient of static friction.	2
Lab3	3 Research of lubricity of greases using a four ball tester.	2
Lab4	4. Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	5. Study materials for the seizure.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. laboratory experiment
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_K01 - PEK_K03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Lawrowski Z.; Tribologia, Tarcie, zużywanie i smarowanie. W-a, PWN, 1993.2.Garkunov D. N.; Trybotechnika. Moskva, Mašinostroenie, 1999.3.Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.4.Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990.5. Embedded detailed instructions posted on the website: www.ikem.pwr.wroc.pl/pkmit

SECONDARY LITERATURE

1.Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag, 2000.2.Lawrowski Z.; Technika smarowania. W-a, PWN, 1987.3.Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Tribology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_IMK_W01, K2MBM_IMK_W02, K2MBM_W05	C1	Lec1, Lec2	N1, N2, N5
PEK_W02	K2MBM_IMK_W07, K2MBM_W05, K2MBM_W06	C1	Lec4	N1, N2, N5
PEK_W03	K2MBM_IMK_W03, K2MBM_IMK_W04, K2MBM_IMK_W07	C1	Lec3	N1, N2, N5
PEK_U01 - PEK_U03	K2MBM_IMK_U02, K2MBM_IMK_U04, K2MBM_IMK_U06, K2MBM_U07, K2MBM_U08	C2, C3	Lab1 - Lab5	N3, N4, N5
PEK_K01	K2MBM_K06, K2MBM_K09	C1, C2	Lec1 - Lec5	N1-N5
PEK_K02 - PEK_K03	K2MBM_K01, K2MBM_K03, K2MBM_K04, K2MBM_K05	C3	Lec1 - Lec5, Lab1 - Lab5	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metoda elementów skończonych**
Name in English: **Finite Element Method**
Level and form of studies: **III level, doktoranckie**
Kind of subject: **optional**
Subject code: **MMMD00003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	180				
Form of crediting	Examination				
Group of courses					
Number of ECTS points	6				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Calculus and matrix algebra
2. Fundamentals of material science and technical mechanics
3. Ability of solving algebraic equations

SUBJECT OBJECTIVES

C1. Learn the basics of the finite element method theory
C2. Learn how to prepare proper model for FEM calculations
C3. Learn to model and perform simulations of the effort of the load carrying structures with use of numerical methods
C4. Learn to interpret results of performed simulations. Assessment of the stress and displacement of the load carrying structures

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Have knowledge in the fundamentals of finite element method
PEK_W02 - Have the ability to build proper model for calculations of different load carrying structures
PEK_W03 - Is able to use FEM in practical application of calculation of engineering structures. Can formulate and solve problems concerning strength of load carrying structures.

II. Relating to skills:
PEK_U01 - Is able to formulate technical problem in the field of strength of load carrying structures with use of Finite Element Method.
PEK_U02 - Have the knowledge to prepare proper geometrical and discrete model to solve the task in the range of elastic deformation.
PEK_U03 - Is able to perform FEA in the field of liner and nonlinear statics, dynamics, vibrations and linear buckling.

III. Relating to social competences:
PEK_K01 - Learn the responsibility for his work.
PEK_K02 - Creative thinking and acting
PEK_K03 - Learn team work due to the necessity of information flow during project realisation

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Development of the numerical methods in the theory of constitutive equations.	2
Lec2	Approximation functions, classifications of finite elements, convergence conditions	3
Lec3	Rod and beam finite element. Presentation of the basic characteristics.	3
Lec4	Truss and frame structures. Introduction to the stiffness matrix. Application of the finite elements to the engineering structures.	4
Lec5	Shell-beam model building for the FEA in the complex engineering structures	3
Lec6	Definition of the material model used in simulations of static, dynamic problems with use of FEM.	2
Lec7	Methodics of the interpretation of real structural and thermal loads of load carrying structures in terms of application to the numerical model	3
Lec8	Application of special elements (mass, damper, spring..) as a development of the numerical model	2
Lec9	Numerical simulations with use of FEM in statics, dynamics and thermal problems. Results interpretation	3
Lec10	Verification and validation of numerical simulations in purpose of the correlation with the experimental measurements	3
Lec11	Examples of FEM application for solution of technical problems	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	test
P = P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusinski E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE

Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wyd. PWr Wrocław 2002

Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005

Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979

Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984

Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990

Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Finite Element Method
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	D3_W03, D3_W04	C1		N1
PEK_W02	D3_W03	C2		N1
PEK_W03	D3_U05, D3_U09	C3, C4		N1

SUBJECT SUPERVISOR

Prof. dr hab. inż. Eugeniusz Rusiński tel.: 71 320-42-85 email: Eugeniusz.Rusinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium interdyscyplinarne**
Name in English: **Interdisciplinary Seminar for PhD Students**
Level and form of studies: **III level, doktoranckie**
Kind of subject: **university-wide**
Subject code: **MMMD00008S**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					15
Number of hours of total student workload (CNPS)					30
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the 2nd degree studies at Faculty of Mechanical Engineering or Faculty of Fundamental Problems of Technology or at similar faculties.

SUBJECT OBJECTIVES

C1. Improvement in the knowledge of physicochemical and mechanical properties of construction materials.
C2. Improvement in the skills of measurements of physical properties of materials for mechanical constructions.
C3. Improvement in the skills of preparing an interdisciplinary dissertation.
C4. Acquisition and strengthening of the social competence including: ability to discuss results of consecutive stages of PhD dissertation and methodology of presenting the theses during seminars and conferences.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the properties of selected construction materials.
PEK_W02 - Student knows how to determine the properties of construction materials.
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods that are essential to determine the properties of construction materials.

II. Relating to skills:
PEK_U01 - Student can select a material on the basis of knowledge of its properties and application in mechanical constructions
PEK_U02 - Student can use constitutive model of a body to describe material's properties
PEK_U03 - Student can apply experimental verification methods to construction materials

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the topic of his/her dissertation
PEK_K03 - Student adheres to the customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	1. Each PhD student will present: State of the art in the topic of his/her dissertation, principles of the work, purpose, thesis and key tasks, schedule, results covering the consecutive stage of the works on dissertation, publication plans, a plan of actions for the next phase of dissertation, 2. Discussion will concern methodology of determining physicochemical and mechanical properties, a manner of presenting results as well as state of the art.	15
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. tutorials
N3. traditional lecture with the use of transparencies and slides
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03, PEK_U01-PEK_U03, PEK_K01-PEK_K03	Presentation of the topic and written report.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Interdisciplinary Seminar for PhD Students
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	D3_W01, D3_W02, D3_W03	C1,C2, C3,C4		N1,N2, N3,N4
PEK_U01-PEK_U03	D3_U02, D3_U08, D3_U09	C1,C2, C3,C4		N1,N2, N3,N4
PEK_K01-PEK_K03	D3_K02, D3_K06	C1,C2, C3,C4		N1,N2, N3,N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elektrotechnika**
Name in English: **Electrical engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMR031001 (MMR031301)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and understands basic principles of physics, especially electrostatics and electromagnetism.
2. Student is able to compute differential and integral calculus.
3. Student defines and solves correctly problems connected with the profession.

SUBJECT OBJECTIVES

C1. Basic knowledge about electrical circuits and electromagnetic fields.
C2. Knowledge about construction and work of the electrical machines and devices.
C3. Ability for team work and measurements of electrical machines and devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows basic principles of electrical circuits and electromagnetism and their utilization in electrical machines and devices.
PEK_W02 - Student knows principles, construction and destination of transformers and chokes.
PEK_W03 - Student knows construction and characteristics of electrical machines.

II. Relating to skills:
PEK_U01 - Student is able to build measurement circuit and make measurements of basic electrical quantities.
PEK_U02 - Student is able to make simple laboratory measurements of electrical devices.
PEK_U03 - Student is able to determine of characteristics of basic electrical motors.

III. Relating to social competences:
PEK_K01 - Student is aware of their own responsibility for their work and a willingness to comply with the principles of teamwork.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Literature. Basic principles of electrical engineering	2
Lec2	Principles of circuit theory. AC and DC current. Power and work.	2
Lec3	Electromagnetism- basic quantities, magnetic properties, magnetic circuits. Electromagnetic induction phenomenon. Self and mutual inductance.	2
Lec4	Electrical and mechanical energy transformation- basic principles and relations, applications.	2
Lec5	R, L, C elements in AC circuits.	2
Lec6	Resonance circuits, real power, reactive power, power factor correction, filters.	2
Lec7	AC circuits. Three-phase voltage generation. Four-cable system. Wye and delta connections.	2
Lec8	Transformers and chokes- construction, principles and work analysis.	2
Lec9	Types of transformers and their applications, autotransformers and current transformers.	2
Lec10	Induction motor- construction, principles of work.	2
Lec11	Types of induction motor works, load characteristics.	2
Lec12	Starting, braking, speed control. Application of induction motors.	2
Lec13	Synchronous machines- construction, principles of work, applications.	2
Lec14	DC machines- construction, principles of work.	2
Lec15	Types of DC motors, load characteristics, starting, braking and speed control, applications.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction, safety instructions.	1

Lab2	Real power in AC three-phase systems.	2
Lab3	Three-phase transformer measurement.	2
Lab4	Squirrel-cage induction motor measurement.	2
Lab5	Squirrel-cage induction motor supplied with frequency converter.	2
Lab6	DC shunt motor measurement.	2
Lab7	DC series motor measurement.	2
Lab8	Grades.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	writing test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U01 PEK_U01 PEK_K01	laboratory reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990).
Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000).

SECONDARY LITERATURE
Elektrotechnika i elektronika dla nieelektryków. Podręczniki akademickie, Praca zbio-rowa, WNT 2004
E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W05	C1		N1, N2
PEK_W02	K1MBM_W05	C2		N1, N2
PEK_W03	K1MBM_W05	C2		N1, N2
PEK_U01	K1MBM_U13, K1MBM_U35	C2, C3		N3
PEK_U02	K1MBM_U13	C2, C3		N3
PEK_U03	K1MBM_U13	C2, C3		N3
PEK_K01	K1MBM_K04	C3		N3

SUBJECT SUPERVISOR

dr hab. inż. Ludwik Antal tel.: 71 320 32 63 email: ludwik.antal@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elektrotechnika**
Name in English: **Electrical engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **MMR032001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and understands basic principles of physics, especially electrostatics and electromagnetism.
2. Student is able to compute differential and integral calculus.
3. Student defines and solves correctly problems connected with the profession.

SUBJECT OBJECTIVES

C1. Basic knowledge about electrical circuits and electromagnetic fields.
C2. Knowledge about construction and work of the electrical machines and devices.
C3. Ability for team work and measurements of electrical machines and devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows basic principles of electrical circuits and electromagnetism and their utilization in electrical machines and devices.
PEK_W02 - Student knows principles, construction and destination of transformers and chokes.
PEK_W03 - Student knows construction and characteristics of electrical machines.

II. Relating to skills:
PEK_U01 - Student is able to build measurement circuit and make measurements of basic electrical quantities.
PEK_U02 - Student is able to make simple laboratory measurements of electrical devices.
PEK_U03 - Student is able to determine of characteristics of basic electrical motors.

III. Relating to social competences:
PEK_K01 - Student is aware of their own responsibility for their work and a willingness to comply with the principles of teamwork.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Literature. Basic principles of electrical engineering. Principles of circuit theory. AC and DC current. Power and work.	2
Lec2	Electromagnetism- basic quantities, magnetic properties, magnetic circuits. Electromagnetic induction phenomenon. Self and mutual inductance.	2
Lec3	R, L, C elements in AC circuits. Resonance circuits, real power, reactive power, power factor correction, filters.	2
Lec4	AC circuits. Three-phase voltage generation. Four-cable system. Wye and delta connections.	2
Lec5	Transformers and chokes- construction, principles and work analysis. Types of transformers and their applications, autotransformers and current transformers.	2
Lec6	Induction motor- construction, principles of work.	2
Lec7	Types of induction motor works, load characteristics.	2
Lec8	Starting, braking, speed control. Application of induction motors.	2
Lec9	Synchronous machines- construction, principles of work, applications.	2
Lec10	DC machines- construction, principles of work, load characteristic, starting, braking and speed control, applications.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Introduction, safety instructions.	1
Lab2	Real power in AC three-phase systems.	2
Lab3	Three-phase transformer measurement.	2
Lab4	Squirrel-cage induction motor supplied with frequency converter.	2
Lab5	DC shunt motor measurement.	2
Lab6	Grades.	1

	Total hours: 10

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. multimedia presentation N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	writing test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U01 PEK_U01 PEK_K01	laboratory reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990)
Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000)

SECONDARY LITERATURE

Elektrotechnika i elektronika dla nieelektryków. Podręczniki akademickie, Praca zbiorowa, WNT 2004
E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W05	C1		N1,N2
PEK_W02	K1MBM_W05	C2		N1,N2
PEK_W03	K1MBM_W05	C2		N1,N2
PEK_U01	K1MBM_U13, K1MBM_U35	C2, C3		N3
PEK_U02	K1MBM_U13	C2, C3		N3
PEK_U03	K1MBM_U13	C2, C3		N3
PEK_K01	K1MBM_K04	C3		N3

SUBJECT SUPERVISOR

dr hab. inż. Ludwik Antal tel.: 71 320 32 63 email: ludwik.antal@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Alternatywne układy napędowe**
Name in English: **Alternative Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMR041401L**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of informatics and solving differential equations.
2. Having a knowledge of mechanics.
3. Ability to analyze and design systems in particular hydraulic drive systems.

SUBJECT OBJECTIVES

C1. Gaining skills in modeling and simulation of the systems.
C2. Knowledge of design methodology using a computer simulation system.
C3. Performance analysis of the results of computer simulation in the form of a report and / or a multimedia presentation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is able to build a simulation model of a selected real object.
PEK_U02 - Understand the purpose and can simplify the actual model and describe it in the form of mathematical equations.
PEK_U03 - Is Able to plan a program of simulation, analyze the results, draw conclusions and present them in an appropriate form.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to Simulink	2
Lab2	Creation of a model and simulation of a harmonic oscillator.	2
Lab3	Creation of a model and simulation of hydraulic bumper..	2
Lab4	Creation of a model and simulation of vehicle entry to the curb (car suspension).	4
Lab5	Creation of a model and simulation of start up of hydrostatic transmission.	4
Lab6	The choice of project for realizing in the second half of the semester. Subject should be related to modeling and simulation of the alternative drive system used in motor vehicles.	2
Lab7	The operation analysis of the structure or process. Real model.	2
Lab8	Simplifying assumptions- physical model.	2
Lab9	Creation of a mathematical model of the object. Implementation of the simulation model.	2
Lab10	Running the simulation model. The simulation research.	4
Lab11	Analysis and study results.	2
Lab12	Presentation of the results	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. problem discussion
N3. The report from the laboratory

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Laboratory report
F2	PEK_U02	Report
F3	PEK_U03	Participation in discussions
P = 0,4F1+0,4F2+0,2F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Matlab Simulink – Handbook, 2010.
2.Cannon R.H. jr: Dynamic of phisical systems. WNT. 1973.
3.BP Zeigler, H Praehofer, TG Kim: Theory of modeling and simulation: Integrating discrete event and continuous complex dynamic systems. 2000.
4.Lennart Ljung: System Identification. 1999.
5. Raymond J. Madachy: The Modeling Process with System Dynamics, 2007.
6. Kulisiewicz M., Piesiak S.: Metodologia modelowania i identyfikacji mechanicznych układów dynamicznych. Oficyna Wydawnicza Politechniki Wrocławskiej, 1995.
6.Nizioł J.: Podstawy drgań w maszynach. Skrypt Politechniki Krakowskiej, Kraków 1996.
7.Szczepaniak C.: Podstawy modelowania systemu: człowiek – pojazd – otoczenie. wyd. Nauk. PWN 1999.

SECONDARY LITERATURE

1.Bekey G.A., Karplus W.I.: Obliczenia hybrydowe. WNT 1976.
2.Kącki E.: Równania różniczkowe cząstkowe w zagadnieniach fizyki i techniki. PWN 1992.
3.Osiński Z.: Zbiór zadań z teorii drgań. PWN. 1988.
4.Budak M., Samerski A., Tichonov V.: Badania i problemy fizyki matematycznej. PWN 1965.
5.Arczyński S.: Mechanika ruchu samochodu. WNT, Warszawa 1997.
6.MitschkeM.: Dynamika samochodu. Tom 1. Napęd i hamowanie. WKiŁ 1987. Tom 2. Drgania. WKiŁ 1988.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Alternative Drive Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_UO1	K2MBM_AE_U14	c1	Lab1; Lab2; Lab3; Lab4; Lab5	N1, N2, N3
PEK_UO2	K2MBM_AE_U03, K2MBM_AE_U14	c2	Lab6 to Lab10	N1, N2, N3
PEK_U03	K2MBM_AE_U03	c3	Lab11; Lab12	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Krzysztof Kędzia tel.: 71 320-26-67 email: krzysztof.kedzia@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Alternatywne układy napędowe**
Name in English: **Alternative Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMR041401W**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The base knowlege about electricity, definition of DC and AC voltage and electrical current, resistancy, reactancy, impedancy, electrical capacity and inductancy, frequency,active,reactive and apperancy elecrtical power, rules of Ohm and Kirchoff, calculation of simply electrical circuits, unstabil status of circuits,, electrical sources, batteries.
2. The base knowlege about electronics, diodes, transistors,amplifiers,integrated circuits,regulators and supplyers. The base knowlege about theory of regulations.
3. The base knowlage about electrical machines and electrical drives DC and AC.

SUBJECT OBJECTIVES

C1. The knowlege of base sources of electrical energy and their power supply in motor vehickles of convetional, electrical and hybrid types.
C2. The knowlege of basic power electronical circuits applied in motor vehickles of electrical and hybrid types.
C3. The knowlege of basic electrical drives with brushless electrical machines as a main drives of hybrid motor vehickles.
C4. The knowlege of hybrid vehickles with series and paralell drives.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to define the condition for power supply circuits of electrical and hybrid vehickles and calculate the main parameters of batteries and ultracapacitors.
PEK_W02 - The student is able to apply of power electronics systems of control of drives for electrical and hybrid vehickles, describe the main relations of voltage and current,rotation speed,process of dynamical starts,constans drive and braking ststus.
PEK_W03 - The student is able to describe condition of work status of series and paralell hybrid drives.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The repertory of fundamentals of electritechnics	2
Lec2	The description of basic electrical sources supply of hybrid and electrical drives and present applied solutions of vehickles	2
Lec3	The description of different types of batteries and ultracapacitors	2
Lec4	The description base power electronics elements	2
Lec5	The description and analysis status of one and two puls rectifiers	2
Lec6	The description and analysis status of three and six puls rectifiers	2
Lec7	The analysis of status of DC choppers	4
Lec8	The analysis of status of different type of converters	6
Lec9	The analysis of status of different type of electrical machines DC and AC supply	4
Lec10	The analysis of status of brushless machines type BLDC	2
Lec11	The control systems of converters with brushless machines type BLDC	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	oral answer
F2	PEK_W02	test
F3	PEK_W03	problematic talk
P = F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Maciej Pawłowski:Alternative drive systems, Wydawnictwo Polit.Wrocł.Wrocław 2011
2.Ali Emadi: Handbook of Automotive Power Electronics and Motor Drives.T&F Group, Boca Ratan' Illinois 2005

SECONDARY LITERATURE

1.K.Jankowski.Elektrotechnika samochodowa-Ćwiczenia Laboratoryjne.Wyd.Politechn.Radomskiej 2010
2.Czerwiński A.:Akumulatory-baterie-ogniwa.WKiŁ,Warszawa 2005
3.Herner A.,Riehl H-J.:Elektrotechnika i elektronika w pojazdach Samochodowych.WKiŁ,Warszawa 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Alternative Drive Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_AE_W10	C1-C4	Lec1 to Lec11	N1, N2

SUBJECT SUPERVISOR

dr inż. Maciej Pawłowski email: maciej.pawlowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Prawo gospodarcze**
Name in English: **Business Law**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **PRZ001157**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				15
Number of hours of total student workload (CNPS)	60				60
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	2				2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of the country and the making of law

SUBJECT OBJECTIVES

C1. Informing students about basic organizational and legal forms of enterprises
C2. Informing students about the requirements to start a business
C3. Informing students about basic consumer rights

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He recognizes and understands basic terms, economic rules and phenomena as well as their effects in market economy, he knows conditions and principles of making optimal decisions by market entities (producers and consumers), he has knowledge about markets and production factors.
PEK_W02 - He has basic knowledge about economy law and running business, he knows legal regulations concerning establishing enterprises in Poland and their functioning, he knows issues of trade relations, he knows and understands basic terms of industrial property protection and author’s law.

II. Relating to skills:
PEK_U01 - He can explain regulations of economy law and running business,he can explain issues of legal protection of intellectual and industrial property in Polish and European legislation.
PEK_U02 - He can find information in literature, he can integrate and interpret humanistic texts.
PEK_U03 - He can use law codes and apply law provisions in typical situations in professional practice.

III. Relating to social competences:
PEK_K01 - He understands the need of permanent learning and knows such possibilities (2nd and 3rd grade studies, post-graduate studies, courses). He understands necessity of developing professional , personal and social competences.
PEK_K02 - He understands legal aspects and results of engineer activity.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course. Conditions of the course. The concept of law and the rule of law. Construction of a legal norm. The system of law. Business Law with other branches of the law. Solving practical examples. Sources of law.	2
Lec2	Presentation of the most important legal concepts related to the business activity (entrepreneur, natural or legal, economic activity). Sources of law related to the economic activity.	2
Lec3	Starting a business in Poland by individuals. Starting a business in the form of companies (place of business start). Starting a business in selected countries of the European Union. Doing business on the Internet.	2
Lec4	Insolvency and Restructuring - procedure	2
Lec5	Product liability - complaints of goods and services	2
Lec6	Product liability - safety and health of consumer	2
Lec7	Product liability - Internet sales	2
Lec8	Final test	1
		Total hours: 15
Form of classes – Seminar		Number of hours
Sem1	Introductory classes	1
Sem2	Presentation of the main bodies involved in the creation and exaction of economic law	2

Sem3	The most common contracts related to the business activity (sales, leasing, insurance)	2
Sem4	The most common contracts related to the business activity (leasing, transportation, errand)	2
Sem5	Najczęstsze umowy związane z prowadzoną działalnością gospodarczą (agencja, komis, franchising, faktoring)	2
Sem6	Basic organizational and legal forms of business (partnerships and equity)	4
Sem7	Completion of the course - Final test	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	final test
P = F1+F2+F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	the participation in discussions of problem, the defense of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Nowińska E., Cybula P. (red), European consumer law and the polish law, Wydawnictwo Zakamycze, Kraków 2005.
2. Bogaczyk I., Krupski B., Lubińska H., Starting a business. Setting up and running a business, Wydawnictwo Forum, 2011.
3. Jeleńska A., Corporations, Wszechnica podatkowa, Kraków 2012.
4. Cieśliński A. (red), Community Economic Law -Volume II, C.H.Beck, Warszawa 2007.
5. Jacyszyn J. (red), Commercial companies in questions and answers, LexisNexis, 2012

SECONDARY LITERATURE
1.Koch A., Napierała J.,Agreement in trade, Wolters Kluwer Polska – LEX, 2011.
2.Gospodarek J., Agreement in trade, Szkoła Główna Handlowa, Warszawa 2010.
3.Zymonik K., Guarantee of producer, Problemy jakości nr 2/2008, s.30-34

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Business Law
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ZIP_W13, K1ZIP_W26	C3	Lec1, Lec5, Lec6, Lec7	N1, N2, N3
PEK_W02	K1ZIP_W22, K1ZIP_W26	C1, C2	Lec1, Lec2, Lec3, Lec4	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U22, K1ZIP_U24, K1ZIP_U26	C1,C2	Cl2- Cl7	N1, N2, N3
PEK_K01, PEK_K02	K1ZIP_K01, K1ZIP_K09	C1,C2	Cl2 - Cl7	N1, N2, N3

SUBJECT SUPERVISOR

dr Krzysztof Zymonik tel.: 713202864 email: krzysztof.zymonik@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Prawo gospodarcze**
Name in English: **Business Law**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **PRZ001157**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				10
Number of hours of total student workload (CNPS)	60				60
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	2				2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of the country and the making of law

SUBJECT OBJECTIVES

C1. Informing students about basic organizational and legal forms of enterprises
C2. Informing students about the requirements to start a business
C3. Informing students about basic consumer rights

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He recognizes and understands basic terms, economic rules and phenomena as well as their effects in market economy, he knows conditions and principles of making optimal decisions by market entities (producers and consumers), he has knowledge about markets and production factors.
PEK_W02 - He has basic knowledge about economy law and running business, he knows legal regulations concerning establishing enterprises in Poland and their functioning, he knows issues of trade relations, he knows and understands basic terms of industrial property protection and author's law.

II. Relating to skills:
PEK_U01 - He can explain regulations of economy law and running business,he can explain issues of legal protection of intellectual and industrial property in Polish and European legislation.
PEK_U02 - He can find information in literature, he can integrate and interpret humanistic texts.
PEK_U03 - He can use law codes and apply law provisions in typical situations in professional practice.

III. Relating to social competences:
PEK_K01 - He understands the need of permanent learning and knows such possibilities (2nd and 3rd grade studies, post-graduate studies, courses). He understands necessity of developing professional , personal and social competences.
PEK_K02 - He understands legal aspects and results of engineer activity.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course. Conditions of the course. The concept of law and the rule of law. Construction of a legal norm. The system of law. Business Law with other branches of the law. Solving practical examples. Sources of law.	2
Lec2	Starting a business in Poland by individuals. Starting a business in the form of companies (place of business start). Starting a business in selected countries of the European Union. Doing business on the Internet.	2
Lec3	Product liability - complaints of goods and services	2
Lec4	Product liability - safety and health of consumer	2
Lec5	Legal aspects of mergers and divisions of companies. Final test.	2
		Total hours: 10

Form of classes – Seminar		Number of hours
Sem1	Basic organizational and legal forms of business (partnerships and equity)	4
Sem2	The most common contracts related to the business activity (sales, leasing, insurance)	2
Sem3	The most common contracts related to the business activity (leasing, transportation, errand)	2
Sem4	The most common contracts related to the business activity (agency, commission, franchising, factoring)	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Final test
P = F1+F2+F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	The participation in discussions of problem, the defense of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Nowińska E., Cybula P. (red), European consumer law and the polish law, Wydawnictwo Zakamycze, Kraków 2005.
2. Bogaczyk I., Krupski B., Lubińska H., Starting a business. Setting up and running a business, Wydawnictwo Forum, 2011.
3. Jeleńska A., Corporations, Wszechnica podatkowa, Kraków 2012.
4. Cieśliński A. (red), Community Economic Law -Volume II, C.H.Beck, Warszawa 2007.
5. Jacyszyn J. (red), Commercial companies in questions and answers, LexisNexis, 2012.

SECONDARY LITERATURE

1.Koch A., Napierała J.,Agreement in trade, Wolters Kluwer Polska – LEX, 2011.
2.Gospodarek J., Agreement in trade, Szkoła Główna Handlowa, Warszawa 2010.
3.Zymonik K., Guarantee of producer, Problemy jakości nr 2/2008, s.30-34

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Business Law
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ZIP_W13, K1ZIP_W26	C3	Lec 1, Lec3, Lec4	N1, N2, N3
PEK_W02	K1ZIP_W22, K1ZIP_W26	C1, C2	Lec1 - Lec5	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U22, K1ZIP_U24, K1ZIP_U26	C1, C2	Cl2 - Cl5	N1, N2, N3
PEK_K01, PEK_K02	K1ZIP_K01, K1ZIP_K09	C1,C2	Cl2 - Cl5	N1, N2, N3

SUBJECT SUPERVISOR

dr Krzysztof Zymonik tel.: 713202864 email: krzysztof.zymonik@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Infrastruktura transportu**
Name in English: **Transport Infrastructure**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRB031001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				30
Number of hours of total student workload (CNPS)	90				60
Form of crediting	Examination				Crediting with grade
Group of courses					
Number of ECTS points	3				2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to use computer equipment as well as using the program for multimedia presentations

SUBJECT OBJECTIVES

C1. Understanding the elements forming the transport systems, the relationship between them and the general principles for their design.
C2. Learning how to analyze and formulate assumptions about transport infrastructure.
C3. Strengthening the team collaboration skills and an awareness of the need to search for new theoretical and practical solutions in the field of transport infrastructure.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the existing types of transport systems and the structure of the relationship between them, called and identifies infrastructure, classifies and describes their structures.
PEK_W02 - has a basic knowledge of the principles of design of road motor transport, airports, lines and junctions, waterways and ports as well as the principles of selection of their functional parameters.
PEK_W03 - Understands social, economic and non-technical conditions of operation of transport systems.

II. Relating to skills:
PEK_U01 - Gains and interprets by himself literature informations, databases and other sources in aspect of transport systems
PEK_U02 - Analyzes and makes assumptions about transport infrastructure.
PEK_U03 - Selects the necessary information, the links between them, explains actions of construction as well as transport systems and shall discuss their application.

III. Relating to social competences:
PEK_K01 - is creative and is aware of the continuing vocational training
PEK_K02 - works well both individually and in a team.
PEK_K03 - is aware of the consequences of the decisions in the field of engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Transport infrastructure in spatial planning. Infrastructure development of individual modes of transport in Poland and Europe.	2
Lec2	The classification and categorization of roads and streets. General conditions for design of roads and streets	2
Lec3	Characteristics and classification of road pavements. Research and technology of road pavements. Road pavement structure design. Drainage of roads and streets.	2
Lec4	Intersections of the roads. Highways and motorway junctions.	2
Lec5	Aviation. Air transport infrastructure.	2
Lec6	Railway infrastructure. Classification and categorization of railway lines. Elements of railway roads.	2
Lec7	Types and components of the rail surface structure. Principles of geometry of the railways.	2
Lec8	The railway network. Classification of operating points. Traffic stations and trading posts - the types and equipment.	2
Lec9	Traffic control devices. Internal and external infrastructure of traffic control devices.	2
Lec10	Network of waterways, their division and classification.	2
Lec11	Methods of regulation of navigable rivers, regulation and canalization systems rivers.	2
Lec12	Navigable channels, division, design and construction. Water management channels. Hydrotechnical structures of maritime activities.	2
Lec13	Floating fleet. Inland ports and seaports. Ferry Terminals.	2

Lec14	Infrastructure of freight, intermodal terminals.	2
Lec15	Directions of infrastructure development - global trends	2
		Total hours: 30
Form of classes – Seminar		Number of hours
Sem1	Classes organizational principles of assessment and credit. The choice of topics and terms of presentation.	2
Sem2	The history of the development of road construction. Basic terms related to the road construction. Classification of means of transport . Pedestrian traffic. Cycling. Visibility conditions in the design of roads. Traffic safety.	2
Sem3	Research carried out on the materials used in road construction. Classification of road pavements. Earthworks in road construction. Maintenance of road pavements.	2
Sem4	Types of intersections and road junctions. Service area. Toll stations. The impact of road traffic on the environment. Means of public transport.	2
Sem5	The history of aviation. Airfield construction. Elements of the airline. Advantages and disadvantages of air transport.	2
Sem6	The history of railway construction.	2
Sem7	Modern railways in the world and in Poland.	2
Sem8	Unconventional railways.	2
Sem9	Trams and subway.	2
Sem10	Rivers and sailing channels in Poland and abroad.	2
Sem11	Hydrotechnical nodes and shipping lock	2
Sem12	Construction and use of the lift and ramps.	2
Sem13	Inland ports, wharves structures, handling facilities.	2
Sem14	Sea ports, terminals, handling facilities.	2
Sem15	Infrastructure of freight, intermodal terminals. Global trends of development of transport infrastructure.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01, PEK_W02, PEK_W03	Final exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W03, PEK_U01, PEK_U02	on the basis of the discussion on the issues presented
F2	PEK_U03	developed on the basis of the paper and its thesis defense
P = 0.3F1+0.7F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Transport Infrastructure
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_K06, K1TR_K07, K1TR_K08, K1TR_W06	C1		N1
PEK_W02	K1TR_K02, K1TR_K05, K1TR_K07	C1,C2		N1
PEK_W03	K1TR_K02	C1		N1
PEK_U01	K1TR_U01, K1TR_U04	C1		N2,N3
PEK_U02	K1TR_U01, K1TR_U04	C2		N2,N3
PEK_U03	K1TR_U01, K1TR_U04	C2, C3		N2,N3
PEK_K01	K1TR_K01	C2, C3		N2,N3
PEK_K02	K1TR_K03, K1TR_K11, K1TR_U06	C2, C3		N2,N3
PEK_K03	K1TR_K07	C2, C3		N2,N3

SUBJECT SUPERVISOR

dr inż. Lech Pawlik tel.: 71 320-37-36 email: lech.pawlik@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska - geometria wykreślna**
Name in English: **Engineering graphics - descriptive geometry**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	30			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry
2. Student has ability to use of the drawing utensils.
3. Student has ability to draw basic geometric structures, such as division of a line's segment into n equal parts, plotting a regular hexagon.

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane as the basis for design recording (engineering drawing).
C2. Knowledge in the field of the geometric structures restitution based on Monge's projections.
C3. Preparation for the design recording (engineering drawing) application.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge on geometric structure mapping onto drawing's plane using Monge's projection method and elementary knowledge in the field of axonometry.
PEK_W02 - Student knows an appropriate solution algorithm of mapping of the position and the relationship of the geometric formations in the space, as well as identifying the measures relationship.
PEK_W03 - Student knows the rules for drawing, using Monge's method, showing localization of the element or geometric structure in the space.

II. Relating to skills:
PEK_U01 - Student can practically apply the principles of the Monge's projection method to map the elements and geometric structures (including solids) on the drawing plane.
PEK_U02 - Student can set the size of the dimensions characterized measuring tasks of geometry.
PEK_U03 - Student can provide restitution of the geometric structure on the basis of Monge's projection and submit the result by axonometric projection.

III. Relating to social competences:
PEK_K01 - Student is able to work independently and solve problems involving Monge projection method.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions and principles of the parallel, rectangular projection by Monge's projection, the mapping of basic geometric elements (points, line, plane).	2
Lec2	Common elements - edges and breakdown points; parallel and perpendicular elements.	2
Lec3	Transformation of the position (rotation, revolved section, increasing of the revolved section) and the reference system transformation (additional projection plane).	2
Lec4	Solids - definitions; solid section as a set of common elements of the solid cutting plane, solid's breakdown points by a straight line.	2
Lec5	Cutting of the solids with projecting planes set - a modification of the initial solid's view, developed views.	2
Lec6	Penetration of the solids - transmission lines definition, the use of auxiliary cutting planes and reference system transformation.	2
Lec7	Projection in the three orthogonal planes; axonometry basis; completion of the missing solid projection - use of the axonometric projection.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Information on the drawing utensils and principles of the geometric structures drawing. Projection of a point and straight line, the mapping of a plane using her traces, identification of the basic elements localization in space using two orthogonal projection planes.	2

Cl2	Belonging of the basic geometric elements, completion of the missing projection; particular localization of the geometric elements.	2
Cl3	Edge as common element of two planes. Breakdown point as common element of straight line and plane. Particular cases of a common elements.	2
Cl4	Edge between flat figures (auxiliary projection planes application); breakdown point of the flat figure by straight line. Identification and construction of the parallel and orthogonal relationship between basic geometrical elements.	2
Cl5	Rotation and revolved section of the basic geometrical elements (rotation of a line's segment and plane); application of the localization transformation for measuring tasks (determination of the real size of a line's segment, angle, flat figure).	2
Cl6	Determination of the projections of plane geometrical structures with selected parameters and the desired position in space (increasing of revolved section of a plane figure). Application of the reference system transformation in measuring tasks and identification of the position (angle relative to the projecting plane, distance of the point from the plane, setting the points projections at a set distance from the plane).	2
Cl7	Test K1 (includes classes's 1 - 6 material)	2
Cl8	The mapping of the elementary solids using Monge's projection, points and lin's segments belonging to the solid's walls identification; determination of the cross sections of polyhedra with projection planes.	2
Cl9	Determination of the polyhedra cross sections cutted by arbitrary planes. Determination of the cross section of the solids with surfaces. Solid's breakdown points by lines (use of auxiliary cutting planes containing penetrating straight line) determination.	2
Cl10	Developed view of a polyhedron and solid containing ruled surface. Cutting of the solid with projection planes as a modification of the initial form of solid - cutting of the polyhedron.	2
Cl11	Cutting of a solid of revolution. Polyhedra transmission lines determination.	2
Cl12	Solids (containing surfaces) transmission lines determination.	2
Cl13	Solid mapping onto three orthogonal projectionl planes. Solid modification using projection plane.	2
Cl14	Solid mapping using axonometric projection. Determination of the missing solid projection modified by cutting planes. Relationship between Monge's projection and axonometric projection.	2
Cl15	Test K2 (includes classes's 8 - 14 material)	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. problem exercises
N3. tutorials
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W02, PEK_U01, PEK_U02	test no. 1, good rating is nedeed (min. 3.0)
F2	PEK_W02, PEK_U01, PEK_U02, PEK_U03	test no. 1, good rating is nedeed (min. 3.0)
F3	PEK_K01	evaluation of n projects (sheets), n = min. 4 - max. 8, good rating of each project is nedeed, F3 = (P1 +...+ Pn)/n
P = [(F1+F2)/2]*4/5+F3*1/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania),
[2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998,
[3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001,
[4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005

SECONDARY LITERATURE
[1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania),
[2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997,
[3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997,
[4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering graphics - descriptive geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1TR_W07	C1, C2, C3	Lec1-Lec7	N1, N3
PEK_UO1, PEK_UO2, PEK_UO3	K1TR_U03	C1-C3	Cl1-Cl6, Cl8-Cl14	N2. N3. N4
PEK_K01	K1TR_K05	C1-C3	Lec1-Lec7, Cl1-Cl6, Cl8-Cl14	N4

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy transportowe**
Name in English: **Transportation systems**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of mathematics, the laws of physics and chemistry at the secondary level.
2. Ability to use and retrieve information from the literature and the Internet.
3. Understands the need for education and is aware of the social role of an engineer.

SUBJECT OBJECTIVES

C1. Basic information about transport systems, the importance of transport in the economy, transportation and environmental protection.
C2. Transport systems, the components, the operating modes of transport means.
C3. The structure of transport in Poland and the EU, development strategies, new technologies in transport.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Formulates, defines the elements of the transport infrastructure, explains the principles of operation of the systems.
PEK_W02 - Identifies, explains the principles of operation modes on transport means, explains the relationship between the state of transport infrastructure and rules of operation on means of transport.
PEK_W03 - Defines the historical conditions of infrastructure development, explains the latest trends and development in transport, explains the strategies for the development of transport.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Understands the need and knows the possibility of constant learning.
PEK_K02 - Understands and is aware of the non-technical aspects and impacts of engineering activities in transport.
PEK_K03 - Is aware of the importance and understanding of the human aspects of technical activities.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Transport systems - basic definitions and classification, the base of the systems assesment.	2
Lec2	Geographical conditions and Polish system of transport, links between the system and systems of European countries.	2
Lec3	Description of the transport system, its characteristics, the principles of assessment.	2
Lec4	The main trends in transport policy for the EU.	2
Lec5	Transport policy in Poland, the directions of transport development.	2
Lec6	The role of transport in the country's economy, the demand for transport services, the role of the state budget for transport activities.	2
Lec7	Road transport, classification of means of transport, infrastructure.	2
Lec8	Rail transport, rolling stock, railway road.	2
Lec9	Water transport: inland, maritime, transport means and infrastructure.	2
Lec10	Pipeline transportation (hydrotransport).	2
Lec11	Air transport, airports, safety.	2
Lec12	Transhipment hubs, tasks of nodes, location.	2
Lec13	Problems of integration of transport, intermodal transport, logistics centers.	2
Lec14	Ecology in transport, external costs, environmental pollution.	1
Lec15	Information technology in the management of transportation systems.	2
Lec16	Final test	1
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rydzykowski Wł.; Wojewódzka – Król K.; Transport, Wydawnictwo Naukowe PWN, Warszawa 1997.
Grzywacz W,; Rydzykowski Wł.; Wojewódzka – Król K.; Polityka transportowa, Wydawnictwa Uniwersytetu Gdańskiego, Gdańsk 2000.

SECONDARY LITERATURE

Wright P.H.; Ashford N.J.; Tranportation Engineering, John Wiley &Sons, New Yrok, 1998

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Transportation systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_W01, K1TR_W03	C1,C2,C3	Lec1, Lec3, Lec6, Lec15	N1
PEK_W02	K1TR_W06, K1TR_W09, K1TR_W14	C1,C2,C2	Lec7, Lec8, Lec9, Lec10, Lec11, Lec14	N1, N2
PEK_W03	K1TR_W13, K1TR_W18	C1,C2,C3	Lec2, Lec4, Lec5, Lec12l, Lec13	N1, N2

PEK_K01	K1TR_K01, K1TR_K07	C1	Lec2, Lec14	N1, N2
PEK_K02	K1TR_K02	C1, C2	Lec1, Lec14	N1, N2
PEK_K03	K1TR_K07, K1TR_K09	C3	Lec4, Lec5, Lec6	N1,N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jan Kulczyk tel.: 71 320-25-70 email: Jan.Kulczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level.
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C4. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C5. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.

PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.

PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:

PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances.

PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring.

PEK_U03 - Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:

PEK_K01 - Search for information and its critical analysis

PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.

PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Sprawy organizacyjne. Podstawowe pojęcia metrologii. Wielkości i jednostki miar. Układy jednostek miar. Układ SI, wzorce jednostek miar, układ hierarchiczny wzorców jednostek miar.	2
Lec2	Measurement, measurement types, method and measurement principle.	2
Lec3	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec4	Dimensions, tolerance of linear dimensions nad fits.	3
Lec5	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	3
Lec6	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec7	Tolerance and machine parts measurement.	6
Lec8	Tolerating and measurements of machines parts manufactured in the process of: casting, plastic forming, welding, plastics processing.	2
Lec9	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec10	Mehods and means of mechanization and automation of measurements.	2
Lec11	Analysis of dimension. Fundamentals of statistical control of dimensions.	2

Lec12	Fundamentals of coordinate measurement techniques.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03; PEK_K01; PEK_K02; PEK_K03;	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.

SECONDARY LITERATURE
[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1TR_W12	C1; C2; C3; C4; C5	Wy1-Wy12	N1; N2; N3
PEK_U01; PEK_U02; PEK_U03;	K1TR_U01	C1; C2; C3; C4; C5	Wy1-Wy12	N1; N2; N3
PEK_K01; PEK_K02; PEK_K03;	K1TR_K09	C1; C2; C3; C4; C5	Wy1-Wy12	N1; N2; N3

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika I**
Name in English: **Mechanics I**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge, skills and competences on the level after Mathematics I and Linear algebra

SUBJECT OBJECTIVES

C1. Solving technical problems on the basis of mechanics rules
C2. Making statical strength analysis of machines elements.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define basic quantities in Mechanics (Force and momentum). He knows conditions of static equilibrium of forces system.
PEK_W02 - He knows the solving methods of beams and frames
PEK_W03 - He knows the Centroid of Area, the center of Gravity of a Mass, Moments of inertia

II. Relating to skills:
PEK_U01 - He is able to calculate the inner forces in the beams and frames with their diagrams
PEK_U02 - He can calculate the joints constructures (strusses)
PEK_U03 - He can determine the centroidal and principal Moments of inertia,

III. Relating to social competences:
PEK_K01 - He can search information and is able to review it critically.
PEK_K02 - He can objectively evaluate the arguments as well as rationally explain and justify the own point of view on the base of knowledge from Mechanics
PEK_K03 - He can observe customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Curriculum. Requirements. Literature.Theory of vectors algebra, statics, degrees of freedom, supports of the rigid body	2
Lec2	Force and momentum. Principal vector and principal momentum of forces system. Statics. Conditions of static equilibrium of forces system. The change of momentum point.	2
Lec3	The resultant of any set of forces.	2
Lec4	Plane forces system. Reactions in the statically determinate systems (Beams, Trusses, Frames).	2
Lec5	Concurrent forces system.Trusses. Method of Joints.	2
Lec6	Conditions of static equilibrium of forces system. Plane forces system reduction.	2
Lec7	Trusses. Method of Joints.	2
Lec8	Internal forces in Beams (analytical methods, diagrams).	2
Lec9	Centroid of Area. The center of Gravity of a Mass.	2
Lec10	Moments of inertia. Product of inertia. Parallel–axis theorem. Rotation transformation of Moments of inertia	2
Lec11	Iinertia tensor, inertia ellipsoid. Principal axes.	2
Lec12	Kinematics, motion of particle, trajectory, one–dimensional model. Velocity, acceleration.	2
Lec13	Velocity and acceleration in natural coordinates. Classification of motions	2
Lec14	Velocity and acceleration in the plane motion.	2
Lec15	Test	2
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	The examples for Conditions of static equilibrium of forces system. Plane forces system. Determination of reactions in the supports.	2
Cl2	Analytical methods of trusses solving. Ritter's methods.	2
Cl3	Internal forces in beams (analytical methods, diagrams).	2
Cl4	Internal forces in beams (analytical methods, diagrams). Beams with Joints.	1
Cl5	Internal forces in Frames (analytical methods, diagrams).	1
Cl6	Centroid of Area. The center of Gravity of a discrete Multi-mass structures.	1
Cl7	Determination of Moments of inertia & inertia products. Parallel–axis theorem.	2
Cl8	Kinematics of particle in orthogonal coordinates.	2
Cl9	Test.	2
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides
N2. Calculation exercises
N3. Self study - preparation for project class
N4. tutorials
N5. Self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02, PEK_K03.	test
F2	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02, PEK_K03.	oral-writing exam
P = F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03.	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 1, Statics, John Wiley & Sons, Inc., New York, 1998
2. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 2, Dynamics, John Wiley & Sons, Inc., New York, 1998

SECONDARY LITERATURE
1. Mary Lunn, A First Course in Mechanics, Oxford Science Publications, Oxford 1991
2. Philip Dyke, Roger Whiteworth, Guide to Mechanics, MacMillan Press, London 1992
3. Herbert Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03,	K1TR_W03	C1	Lec1 - Lec15	N1, N4, N5
PEK_U01, PEK_U02, PEK_U03,	K1TR_U01	C2	Cl1 - Cl9	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03.	K1TR_K07	C3	Lec1 - Lec15, Cl1 - Cl9	N4, N5

SUBJECT SUPERVISOR

dr inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania środków transportu I**
Name in English: **Basics of engineering design in transport I**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of mathematics, physics and mechanics
2. ability to solve basic problems of mathematical analysis and the ability to describe the basic physical phenomena

SUBJECT OBJECTIVES

C1. Understanding the basic principles of construction and methods of analysis, modeling and design mechanisms used in transport
C2. Understanding the properties of selected groups of planar and spatial mechanisms use in transport (linkages, gears, cams and manipulators)

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has a theoretical knowledge of analysis of mechanisms used in transport
PEK_W02 - has a theoretical knowledge of design of mechanisms used in transport

II. Relating to skills:
PEK_U01 - The ability to define the basic elements of mechanism
PEK_U02 - The ability to build a computer model of the mechanism and ability to perform simulation researches
PEK_U03 - Ability to analyze of kinematics and kinetostatics of mechanisms using vector, analytical and computer methods

III. Relating to social competences:
PEK_K01 - a sense of responsibility for their own work and the willingness to comply with the rules work in a team and to take responsibility for collaborative tasks
PEK_K02 - Understands the impact of engineering

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview of functional machines and mechanisms for transport, basics of structural analysis	2
Lec2	Structural analysis of mechanisms - mobility, local mobility, constraints	2
Lec3	Methods for the type synthesis of mechanisms	2
Lec4	Kinematic analysis of mechanisms - methods for determining the new positions, centers of rotation	2
Lec5	Kinematic analysis of mechanisms - methods for determining the velocity and acceleration	2
Lec6	Elements of dynamic analysis - forces in kinematic systems (inertial forces, the active forces, the forces in joints)	2
Lec7	Elements of dynamic analysis - Kinetostatics (vector method)	2
Lec8	Linkage mechanisms in transport - property characterization, analysis and application	2
Lec9	Manipulators (serial, parallel) - construction, characteristics, applications	2
Lec10	Manipulators (serial, parallel) - kinematics manipulators	2
Lec11	Gears, planetary gears mechanisms - construction, characteristics, applications	2
Lec12	Planetary gear mechanisms - analysis. Cam mechanisms in vehicles - characteristics, applictions	2
Lec13	Cam mechanisms in vehicles - analysis and design	2
Lec14	The geometric synthesis of linkage mechanisms	2
Lec15	Test	2
		Total hours: 30
Form of classes – Project		Number of hours

Proj1	Structural analysis of mechanisms (class of joints, rules of schematization, mobility of mechanisms (project and short test)	3
Proj2	Basics of computer modeling of mechanisms in program SAM (Simulation and Analysis of Mechanism)	2
Proj3	Advanced modeling of mechanisms in the program SAM (dimensions, drives)	2
Proj4	Linkages mechanisms - kinematic analysis (vector method), (project and short test)	2
Proj5	Modeling and computer simulations of linkage mechanisms (project)	2
Proj6	Linkages mechanisms - kinetostatic analysis (vector method), (project and short test)	2
Proj7	Modeling and computer simulations of planetary gear mechanisms (project)	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. tutorials
N3. self study - preparation for project class
N4. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	Evaluation of the project, Evaluation of the short test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of engineering design in transport I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1TR_W07	C1-C2	Le1-Le14	N1-N4
PEK_U01-PEK_U03	K1TR_U08, K1TR_U09	C1-C2	Pr1-Pr7	N1-N3
PEK_K01, PEK_K02	K1TR_K03, K1TR_K09	C1-C2	Le1-Le14	N1-N4

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Bałchanowski tel.: 71 320-27-10 email: jacek.balchanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika II**
Name in English: **Mechanics II**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031016**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	90			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	3			
including number of ECTS points for practical (P) classes		3			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	2.1			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge, skills and competences on the level after Mechanics I.

SUBJECT OBJECTIVES

C1. Resolving some technical problems using Mechanics rules.
C2. Making kinematical and dynamical analysis of machines elements.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with
a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows kinematics & dynamics mass particle & rigid body.
PEK_W02 - He knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance).
PEK_W03 - He knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert's principle).

II. Relating to skills:
PEK_U01 - He is familiar with energy conservation law. He can use it to the dynamics equations of motion of rigid body.
PEK_U02 - He can use linear momentum & angular momentum rules to description dynamics of motion.
PEK_U03 - He is familiar with static & dynamic balance under rotation over fixed axis.

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review it.
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify own point of view on the base of knowledge from Mechanics.
PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Kinematics of rigid body. Translation & rotation about a fixed axis.	2
Lec2	Plane motion, velocity, temporary center of rotation.	2
Lec3	Centroids, accelerations in plane motion.	2
Lec4	Kinematics of rigid body rotation about a fixed point, Euler's angles, velocity, aksoids.	2
Lec5	Angular acceleration, acceleration in rotation about a fixed point, regular precession.	2
Lec6	Relative motion, general motion of rigid body.	2
Lec7	Dynamics, force, d'Alembert rule.	2
Lec8	Examples of the tasks of the dynamics, the vibrations of the one-mass single degree of freedom system.	2
Lec9	The definition of work. Elementary work. Gravity forces, stiffness forces. The kinetic and potential energy. Power.	2
Lec10	Potential energy. The principle of work and kinetic energy equivalence.	2
Lec11	Dynamics of systems of particles, principle of motion of the mass center, linear & angular momentum.	2
Lec12	Dynamics of rigid body in rotary motion.	2
Lec13	Linear & angular momentum of rigid body in general motion.	2
Lec14	Determination of the dynamic responses in rotation. The method of linear & angular momentum rules.	2
Lec15	Test.	2

		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Calculation of velocity & acceleration vectors in particle motion.	2
Cl2	Plane motion, velocity, temporary center of rotation.	2
Cl3	Accelerations in plane motion.	2
Cl4	Kinematics of relative motion.	2
Cl5	Examples of the tasks of the dynamics of particle.	2
Cl6	Test 1.	2
Cl7	Examples of tasks from vibrations of simple mechanical systems with one degree of freedom.	2
Cl8	Relative motion of rigid body examples.	2
Cl9	The definition of work. Elementary work. Gravity forces, stiffness forces. The kinetic and potential energy. Power.	2
Cl10	Potential energy. The principle of work and kinetic energy equivalence.	2
Cl11	The principle of the center of mass motion.	2
Cl12	Dynamics of rigid body,	2
Cl13	Linear & angular momentum of rigid body in rotary motion.	2
Cl14	Determination of the dynamic responses in rotation. The method of linear & angular momentum rules.	2
Cl15	Test 2.	2
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides.
N2. Calculation exercises.
N3. Self study - preparation for project class.
N4. Tutorials.
N5. Self study - self studies and preparation for examination.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_K01 - PEK_K03.	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03.	Oral answers, test 1, test 2.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 1, Statics, John Wiley & Sons, Inc., New York, 1998
2. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 2, Dynamics, John Wiley & Sons, Inc., New York, 1998

SECONDARY LITERATURE
1. Mary Lunn, A First Course in Mechanics, Oxford Science Publications, Oxford 1991
2. Philip Dyke, Roger Whiteworth, Guide to Mechanics, MacMillan Press, London 1992
3. Herbert Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1TR_W03	C1	Lec1 - Lec15	N1, N4, N5
PEK_U01, PEK_U02, PEK_U03	K1TR_U01	C2	Cl1 - Cl15	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K1TR_K07	C3	Lec1 - Lec15, Cl1 - Cl15	N4, N5

SUBJECT SUPERVISOR
dr inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031017**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.
PEK_W03 - Able to define the elements of the measurement process and their impact on the result of the measurement.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - Umie dokonać doboru odpowiedniego sprzętu pomiarowego oraz dokonać jego konfiguracji w zależności od postawionego zadania pomiarowego. Potrafi korzystać z sprzętu pomiarowego stosowanego w przemyśle maszynowym do pomiaru wielkości geometrycznych.
PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Measurements of linear dimensions.	2
Lab3	Measurements of angular dimensions, direct and indirect measurements of cones.	2
Lab4	Identification and measurement of threads.	2
Lab5	Assessment of the geometrical structure of the surface.	2
Lab6	Identification and measurement of cylindrical gears.	2
Lab7	Measurements of selected shape deviations and displacements.	3
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. report preparation
N3. self study - preparation for laboratory class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE
[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1TR_W12	C1; C2; C3; C4; C5; C6	La1 - La7	N1; N2; N3; N4;

PEK_U01; PEK_U02; PEK_U03;	K1TR_U01	C1; C2; C3; C4; C5; C6	La1 - La7	N1; N2; N3; N4;
PEK_K01; PEK_K02; PEK_K03;	K1TR_K03, K1TR_K09	C1; C2; C3; C4; C5; C6	La1 - La7	N1; N2; N3; N4;

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**
Name in English: **Strength of materials**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031018**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2	2	1		
Number of hours of total student workload (CNPS)	90	60	60		
Form of crediting	Examination	Crediting with grade	Crediting with grade		
Group of courses					
Number of ECTS points	3	2	2		
including number of ECTS points for practical (P) classes		2	2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4	1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of higher mathematics
2. Knowledge of the elements of material engineering
3. Knowledge of rigid body mechanics

SUBJECT OBJECTIVES

C1. Learning the elements and scope of application of the mechanics of uniform and non-uniform deformable bodies
C2. Acquiring the skills of calculating tension
C3. Acquiring the skills of experimental determination of the mechanical properties of materials and their application to determine permissible stresses

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The students are able to recognise the type of loading and calculate the tensions for simple instances of loads and/or a determined length of fracture
PEK_W02 - The students are able to propose the basic criteria for evaluating material resistance to damage manifested in excessive strain and/or fracture caused by overloading or subcritical fracture development
PEK_W03 - The students are able to specify the basic options for preventing and/or controlling the fracture of material both during the production and processing, and its exploitation relating to skills

II. Relating to skills:
PEK_U01 - The students know how to calculate strain, stress, and the critical fracture length for simple method of loading

III. Relating to social competences:
PEK_K01 - The students know how to experimentally determine the values of basic mechanical properties and use them to determine the admissible load level

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts of strength of materials. Types of defects and the criteria of their classification. The subject matter of the studies. External and internal forces. Definition of stress. The Saint-Venant's principle. The system of units applied in strength-related calculations. Simple cases of loading: tension and compression. Basic concepts of strength of materials. Types of defects and the criteria of their classification. The subject matter of the studies. External and internal forces. Definition of stress. The Saint-Venant's principle. The system of units applied in strength-related calculations. Simple cases of loading: tension and compression.	2
Lec2	Simple cases of loading. Stress and strain analysis	2
Lec3	Simple cases of loading: shearing. Torsion of rods of circular section	2
Lec4	Simple cases of loading. Free torsion of rods of any cross-section shape. Moments of inertia of plain figures	2
Lec5	Bending	2
Lec6	Complex strength. Strength hypothesis	2
Lec7	Complex strength. Basic examples of complex strength	2
Lec8	Bending line of beams	2
Lec9	Statically indeterminate and complex instances of bending beams	2
Lec10	Buckling. Fatigue	2
Lec11	Fracture of materials. Introduction to fracture mechanics. Testing resistance to unstable crack development in the plane strain condition. The advantages of the knowledge of KIC	2
Lec12	The criteria and principles of applying fracture mechanics to design safe high-pressure devices	2

Lec13	Creep fracture. Testing resistance to creep fracture. The principles of evaluating and predicting the life (durability) of materials working in the creep condi	2
Lec14	Testing resistance to ductile/shear fracture. Introduction to shear fracture mesomechanics. The criteria for preventing and/or controlling shear fracture development.	2
Lec15	The principles of material selection depending on their function, the imposed requirements (restrictions) and the aim. The material indices. The diagrams of properties and their application during the selection of materials	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Statistically determinate rod systems, thermally loaded and loaded with axial forces	2
Cl2	Statistically indeterminate systems during tension and compression	2
Cl3	Torsion of rods of circular section. Calculating helical springs	2
Cl4	Pure and technological shearing. Calculating rivet, welded, clevis and key fasteners	2
Cl5	Bending, determining normal stre	2
Cl6	Calculating obliquely bent beams	2
Cl7	Determining tangent stress in the beams bent by cross-section forces.	2
Cl8	Test	2
Cl9	Determining normal stress during the axial bending of rods with typical cross-section	2
Cl10	Determining the deflection of rods with typical cross-section	2
Cl11	Application of effort hypotheses	2
Cl12	Calculating the columns subjected to compressive loads (buckling)	2
Cl13	Calculating the critical fracture length. Determining the time of inspection of the structures exposed to catastrophic fracture development	2
Cl14	Calculating the admissible pressure according to the yield and the leak-before-break criterion	2
Cl15	Test	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction	2
Lab2	Metals and plastics tension test	2
Lab3	Measurement of strains using the electric resistance wire strain gauge	2
Lab4	Testing fatigue strength	2
Lab5	Testing fatigue strength	2
Lab6	Buckling – experimental determination of the critical force of columns. Compression test	2
Lab7	Simple and oblique bending. Summary and crediting the laboratory classes	3
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Oral answers, (written) test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01	entrance test, report on laboratory classes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa`1998. Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996.Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997. Neimitz A.: Mechanika pękania. PWN, Warszawa 1998.Dzidowski E. S.: Mechanizm pękania poślizgowego w aspekcie dekohezji sterowanej metali. Wyd.PWr., Wrocław 1990.Dzidowski E. S.: Physical concept of shear fracture mesomechanism and its applications. Central European Journal of Engineering, 2011, nr 1(3), s. 217-233.Dzidowski E. S.: Jak projektować, wytwarzać i eksploatować rury do bezpiecznej pracy pod ciśnieniem. Rudy i Metale, 2008, nr 11, s. 714-721.

SECONDARY LITERATURE

Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Strength of materials

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1TR_W03	C1	lec1-lec15	N1
PEK_U01	K1TR_U13	C2	Cl1-Cl14	N2
PEK_K01	K1TR_K01, K1TR_U13	C3	Cl1-Cl14	N3

SUBJECT SUPERVISOR

dr hab. inż. Edward Dzidowski email: edward.dzidowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika płynów**
Name in English: **Fluid Mechanics**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031020**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses	X				
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a structured knowledge of mathematics, including algebra and analysis.
2. Student has a structured knowledge of physics, mechanics.
3. Student has a structured knowledge of basis of machine design and production of means of transport.

SUBJECT OBJECTIVES

C1. Understanding the basic laws of mechanics in relation to flows of liquids and gases.
C2. Gaining ability to use basic laws of fluid mechanics in the construction and design of means of transport
C3. Gaining ability to use basic laws of fluid mechanics in the means of transport operation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define basic laws of fluid mechanics.
PEK_W02 - Student is able to explain the principles of means of transport operation and the phenomena utilized in their construction.
PEK_W03 - Student is able to Indicate the relationship between the fundamental laws of fluid mechanics and principles of operation of means of transport equipment.

II. Relating to skills:
PEK_U01 - Student is able to analyse the process of the phenomena associated with the flows in the means of transport operation.
PEK_U02 - Structured knowledge of the theory of motion and operation of means of transport.
PEK_U03 - Student is able to combine law of fluid mechanics with the problems of means of transport design and operation.

III. Relating to social competences:
PEK_K01 - Student understands the legal aspects and effects of engineering activities.
PEK_K02 - Student understands and is aware of the non-technical aspects and impacts of engineering activities in transport.
PEK_K03 - Student is aware of the necessity of individual and group activities that go beyond the engineering operation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of liquids and gases, forces and stresses in fluids,basic concepts of field theory.	2
Lec2	Newtonian and non-Newtonian fluids, fluid motion analysis method, streamlines , potential and rotational flow.	2
Lec3	The basic equations of fluid mechanics, the continuity equation, the conservation of momentum equation for the ideal and real fluids (Euler equation and Navier-Stokes equations).	2
Lec4	Hydrostatic equations, communicating vessels, the pressure forces of the liquid on the walls.	1
Lec5	Buoyancy and stability of floating bodies. Impact on the operational safety of waterway transport.	2
Lec6	Euler equation integrals - Bernoulli's equation, examples of applications: measurements of velocity, the flow of liquid through the holes.	2
Lec7	The equations of momentum and moment of momentum equation, hydrodynamic reaction, principles of turbo-machinery and propellers.	2
Lec8	Real fluids, laminar and turbulent flow, the Bernoulli's equation for real fluids.	1
Lec9	Flow in open channels, the critical speed.	1
Lec10	The flow similitude, the dimensionless numbers in fluid dynamics, examples of applications.	2
Lec11	Examples of solutions of N-S equations , flows in the axially-symmetric pipes , major losses and their calculation, the effect of roughness.	2

Lec12	Flow in pipes, pipelines characteristics, the unsteady phenomena - water hammer.	2
Lec13	The theory of the boundary layer, laminar and turbulent layer, the phenomenon of flow separation, flows around means of transport.	1
Lec14	Flow around bodies, drag forces. Classification of resistance of body motion between the two fluids. The methods of determining the motion resistance.	2
Lec15	Aerofoil, hydrodynamic characteristic of aerofoil and hydrofoil. Methods of calculation of forces on aerofoil.	2
Lec16	Numerical methods in fluid mechanics, examples of use in the analysis of external flows.	2
		Total hours: 28
Form of classes – Classes		Number of hours
Cl1	Exercises illustrating the application of the Euler equation and Pascal's law.	2
Cl2	Calculation of pressure forces on the walls.	2
Cl3	Application of the Bernoulli's equation and the continuity equation for calculating ideal fluid flow.	2
Cl4	Calculation of the buoyancy and stability of floating bodies.	2
Cl5	Application of the conservation of momentum equation and moment of momentum equation to calculate the hydrodynamic forces.	2
Cl6	Calculation of the pressure loss in closed in pipelines. Determination of pipeline characteristics.	2
Cl7	Calculation of the motion resistance and hydrodynamic forces on aerofoils and hydrofoils.	2
Cl8	Final Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02,PEK_W03, PEK_U01, PEK_U02, PEK_U03	test
P = 0.5*F1+0.5*FC		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	test
P = F1=FC		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Bukowski J., Kijkowski P.; Kurs mechaniki płynów, PWN, 1980.
Orzechowski Z., Prywer J., Zarzycki R.: Mechanika płynów w inżynierii środowiska. PWN, Warszawa 1998.
Jeżowiecka-Kabsch K., Szewczyk H.: Mechanika płynów. Oficyna Wydawnicza PWr, Wrocław 2001.

SECONDARY LITERATURE

Burka S.E., Nałęcz T.J.: Mechanika płynów w przykładach. PWN, Warszawa 1994.
Zieliński A.: Wybrane zagadnienia z mechaniki płynów. Oficyna Wydawnicza PWr, Wrocław 2011.
Dudziak J. Teoria okrętu, Gdańsk, 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fluid Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_W03	C1	Lec1-Lec16	N1, N2
PEK_W02	K1TR_W07, K1TR_W10, K1TR_W12	C2, C3	Lec7, Lec9, Lec12, Lec14, Lec15	N1, N2
PEK_W03	K1TR_W07, K1TR_W10, K1TR_W12	C2, C3	Lec7, Lec9, Lec12, Lec14, Lec15, Lec16	N1, N2
PEK_U01	K1TR_U01, K1TR_U06, K1TR_U18	C1, C2, C3	Cl1-Cl7	N3
PEK_U02	K1TR_U10, K1TR_U14	C1, C2, C3	Cl1-Cl7	N3
PEK_U03	K1TR_U03, K1TR_U06, K1TR_U07	C1, C2, C3	Cl1-Cl7	N3

PEK_K01, PEK_K02, PEK_K03	K1TR_K01, K1TR_K03, K1TR_K05, K1TR_K07	C1, C2, C3	Cl1-Cl7	N3

SUBJECT SUPERVISOR
Prof. dr hab. inż. Jan Kulczyk tel.: 71 320-25-70 email: Jan.Kulczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy logistyki**
Name in English: **Fundamentals of logistics**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031021**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	90	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the organization and operation of the production enterprise

SUBJECT OBJECTIVES

C1. To familiarize students with the basic tasks of logistics business processes.
C2. Some specific models and methods used in the design and evaluation of logistics systems.
C3. Characterization of core technology and material flow logistics information systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the structure of the logistics system, its components and the relationships between them.
PEK_W02 - He knows the methods and strategies of managing logistics processes in the enterprise

II. Relating to skills:
PEK_U01 - It can be used for selected models and methods for the design, management and evaluation of logistics system.
PEK_U02 - He can choose the material flow technology and information flow

III. Relating to social competences:
PEK_K01 - Able to present opinions on the social and environmental impact of the operation of the supply chain

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	History of the development of logistics. Basic concepts and definitions.	2
Lec2	System and logistics process, structure. classification criteria	2
Lec3	Strategies for managing logistics processes; Just In Time.	2
Lec4	Logistics supply. Inventory management.	2
Lec5	Logistics of production. Range of computer support: MRP I, MRP II, ERP.	2
Lec6	Logistics distribution. Demand forecasting	2
Lec7	Reverse logistics. Ecologistics	2
Lec8	Information technology, automatic identification method.	2
Lec9	Information Technology, Electronic Data Interchange.	2
Lec10	Packaging. Basic functions. Logistic label.	2
Lec11	Technologies of storage.	2
Lec12	Handling technology	2
Lec13	Transport technologies. Linear infrastructure .	2
Lec14	Logistics centers. Point infrastructure .	2
Lec15	Logistics optional; examples: peacekeeping, health, public events.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Introduction to exercise. Overview of the exemplary embodiment of the supply chain	2
Cl2	Zarządzanie zapasami. Klasyfikacja ABC / XYZ.	2
Cl3	Prognozowanie popytu	2
Cl4	Selection of inventory control system	2
Cl5	Simulation of a Kanban production system	2
Cl6	Transport management in the context of supply chain	2

Cl7	Storage. Summary of activities.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem exercises
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01	Written exam - test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Ballou R.H. Business :ogistics / Supply Chain Management. Pearson Education Inc. 2004.
Logistyka. Red. D. Kisperska_Moroń, S. Krzyżaniak. ILiM, Poznań 2009.
Logistyka. Teoria i praktyka.Tom I i II. Red. S. Krawczyk. Difin, Warszawa 2011.

SECONDARY LITERATURE

Zając P.: CRM - Zarządzanie relacjami z klientem w logistyce dystrybucji. Navigator 17. Oficyna Wydaw. Politechniki Wrocławskiej, Wrocław 2007.
Kwaśniowski S., Nowakowski T., Zając M.: Trasnport intermodalny w sieciach logistycznych. Navigator 18. Oficyna Wydaw. Politechniki Wrocławskiej, Wrocław 2008.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of logistics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_W02	C1, C2	Lec1, Lec2, Lec8 - Lec15	N1
PEK_W02	K1TR_W21	C2	Lec2 - Lec7	N1
PEK_U01	K1TR_U09	C2	Cl1 - Cl7	N2, N3
PEK_U02	K1TR_U10	C3	Cl1 - Cl7	N2, N3
PEK_K01	K1TR_K02	C1	Cl1 - Cl7	N1

SUBJECT SUPERVISOR

Prof. dr hab. inż. Tomasz Nowakowski tel.: 71 320-35-11 email: Tomasz.Nowakowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania środków transportu II**
Name in English: **Fundamentals of Means of Transport Design II**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031022**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	90			60	
Form of crediting	Examination			Crediting with grade	
Group of courses	X				
Number of ECTS points	3			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to mechanics, strength of materials and theory of machines and mechanisms.
2. Knowledge of rules in engineering graphics.

SUBJECT OBJECTIVES

C1. Acquiring knowledge of the basics of the designing and operation of transportation means.
C2. Acquiring ability to select computational models for basic machinery elements in the fields of supporting structures and connections, bearing components and elastic elements in general engineering applications.
C3. Acquiring basic skills in the field of designing of simple machinery components basing on knowledge of the structure and the ability to analyze selected solutions and designing, as well as the operation of these objects.
C4. Acquiring of an ability to organize work in a team and to fulfil own specified tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a detailed knowledge on principles of designing of elements, subassemblies and assemblies in means of transportation.
PEK_W02 - Has a detailed knowledge on built of machinery elements (e.g. connectors, transmissions and supporting structures) used in transportation means.
PEK_W03 - Has a detailed knowledge on operation and reliability of transportation means.

II. Relating to skills:
PEK_U01 - Can compile reports from performed engineering works.
PEK_U02 - Can search information available in the literature in the field of designing of elements of the transportation means.
PEK_U03 - Can formulate guidelines for the process of operation of selected transporation equipment.

III. Relating to social competences:
PEK_K01 - Can think creatively.
PEK_K02 - Can organize work for others in a project group, as well as fulfil the assigned tasks in the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, rules ofssessment and literature. Basic issues of designing methods in elements of transportation means. Methods, methodologies, processes, technical projects.	2
Lec2	Elements of transportation means - evaluation criteria.	2
Lec3	Manufacturability of mechanical structures in transportation means.	2
Lec4	Standardization in designing. Accuracy of technologies used for production of machinery elements.	2
Lec5	Selected tribological issues - operation as a source of information about construction of transportation means' elements.	2
Lec6	Steel constructions, permanent and non-permanent joints.	2
Lec7	Basic mechanical and energy phenomena in parts of transportation means.	2
Lec8	Machinery shaft, axles, joints. Analysis of shaft's vibrations.	2
Lec9	Sliding and rolling bearings. Determination of characteristics of sliding bearing. Seals.	2
Lec10	Elastic elements. Importance of deformations in designing of machinery parts. Spring suspension in transportation means.	2
Lec11	Clutches and brakes. Thermal processes in machinery parts.	2
Lec12	Mechanical transmissions in transportation means. Gears (law of gearing, characteristics of cycloid and involute gearing, correction of meshing, tooth model in strength analysis, helical and bevel gears).	2
Lec13	Epicyclic gearing and harmonic drive in transportation means.	2
Lec14	Worm and screw drives. Construction and operation of chain and friction drives.	2
Lec15	Summary of the lectures, review of exam problems, additional explanations.	2

		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Scope of the project, rules of assessment and literature. Assignment of individual designing topics.	2
Proj2	Reonstruction of a simple transportation mean, such as bicycle, car jack. Mechanical model and physical principle of operation.	2
Proj3	Simplified drawings and dimensioned drawings of selected simple transportation mean.	2
Proj4	Construction of models of transportation mean's parts.	2
Proj5	Methods for detailing the goal of designing of transportation mean's parts.	2
Proj6	A practical usage of heuristic and algorithmic methods (morphological table, tree of solutions for own project).	2
Proj7	Synthesis - example and practice of designing of transportation mean's parts.	2
Proj8	Classifying significance of criteria of evaluation. Generating and clasifying initial solutions.	2
Proj9	Technical documentation of the project. Assembly drawing - more detailed presentation of selected solution of power transmission.	2
Proj10	Technical documentation of the project. Assembly drawing - more detailed presentation of selected nodes.	2
Proj11	Technical documentation of the project. Dimensioned drawing of selected part of transmissions.	2
Proj12	Technical documentation of the project. Dimensioned drawing of selected part of brake unit.	2
Proj13	Technical documentation of the project. Dimensioned drawing of selected part of power transmission unit.	2
Proj14	Remodelling of an own algorithm of designing. Synthesis of project popularising (optional).	2
Proj15	Presentation and project acceptance.	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. traditional lecture with the use of transparencies and slides
N3. problem discussion
N4. project presentation
N5. Computer stands with AutoCAD (for project classes)

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Participation in problem discussions. Oral-written exam.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of computational part of the project. Evaluation of project preparation. Presentation of the project.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Dietrich M. (red), Fundamentals of Machinery Design, PWN, Warszawa, after 2000 (in Polish).
[2] Kurmaz L. et al. Fundamentals of Machinery Design, PWN, Warszawa, after2000 (in Polish).
[3] Miller S.: Kinematic structures. WNT Warszawa 1988 (in Polish).
[4] Rydzanicz I.: Engineering drawing. Wroclaw University of Technology Publishing House, Wrocław, 2005 (in Polish).
[5] Fundamentals of Machinery Design (different authors) over 20 volumes (in Polish).

SECONDARY LITERATURE
[1] Avallone E. A., Baumeister III T., Sadegh A. M. Marks, Standard Handbook for Mechanical Engineers. The McGraw-Hill Companies, 2007.
[2] Dziama A. i inni (red), Fundamentals of Machinery Design, PWN, Warszawa, 2002 (in Polish).
[3] Kurmaz L. i inni. Fundamentals of Machinery Design. Designing, PWN, Warszawa, after 2000 (in Polish).
[4] Pahl G., Beitz W.: Engineering Design, WNT, Warszawa 1984.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Means of Transport Design II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K1TR_W07	C1	Lec1 - Lec4, Lec15	N1, N2, N3
PEK_W02	K1TR_W07	C1	Lec6 - Lec15	N1, N2, N3
PEK_W03	K1TR_W14	C1	Lec3 - Lec5, Lec7, Lec15	N1, N2, N3
PEK_U01	K1TR_U03	C2, C3	Proj3, Proj4, Proj14, Proj15	N4, N5
PEK_U02	K1TR_U01, K1TR_U06	C2, C3	Proj9 - Proj13	N3
PEK_U03	K1TR_U13	C3	Proj1 - Proj6	N3, N4
PEK_K01	K1TR_K05	C2, C3	Proj6 - Proj8	N3, N4
PEK_K02	K1TR_K03	C4	Proj5 - Proj8	N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Franciszek Przystupa tel.: 71 320-21-55 email: franciszek.przystupa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031025**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of mathematical analysis

SUBJECT OBJECTIVES

C1. Knowledge of the basic problems of automation.
C2. Knowledge of the construction, operation and application principles of automation equipment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic concepts of the theory of automatic control systems and control.
PEK_W02 - The student knows the principles of mathematical modeling of linear dynamical systems, methods of analysis and synthesis of control systems in different domains: time, operators and frequency.
PEK_W03 - The student has the knowledge to evaluate the quality of linear control systems as well as the design of digital control systems.

II. Relating to skills:
PEK_U01 - The student is able to analyze and design basic circuits automatic adjustment.
PEK_U02 - The student is able to analyze digital programmable automation systems.

III. Relating to social competences:
PEK_K01 - Students can interact and work in a group.
PEK_K02 - The student is able to think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic concepts, the structure of control systems and their classification.	2
Lec2	Description of linear automation systems: differential equations, transfer function characteristics time.	2
Lec3	Description of linear automation systems: spectral transmittance, the frequency characteristics.	2
Lec4	Dynamic element: proportional, inertial differentiat	2
Lec5	Dynamic element: Integral, oscillating delay	2
Lec6	Stability. Theorem stability properties of stable and unstable systems.	2
Lec7	Description of discrete systems. The difference equation, transmittance, spectral transmittance characteristics time.	2
Lec8	Automatic adjustment. Requirements. Static control. Floating control.	2
Lec9	Regulators: PI, PD, PID.	2
Lec10	Nonlinear Systems. Methods of description and analysis.	2
Lec11	Discrete automatic control.	2
Lec12	oolean algebra	2
Lec13	Logic combination	2
Lec14	Sequential logic	2
Lec15	Test	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Training of health and safety, organizational matters. Static and dynamic characteristics of automation components.	3

Lab2	Simulation testing of components and automation systems in Matlab-Simulink	2
Lab3	Components and systems jointed relay	2
Lab4	Combinatorial synthesis of control systems	2
Lab5	Modeling and programming sequential processes	2
Lab6	PLC programming languages	2
Lab7	Two-sided control	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	grade point average of all laboratories
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J. Awrejcewicz, W. Wodzicki, Fundamentals of Automatic Control. Theory and Examples. Publishing Politechnika Łódzka, 2012.
2. Marek Żelazny, Fundamentals of Automatic Control, Publishing, PWN, 1963
3. T. Mikulczyński. Laboratory fundamentals of automatic and automation. Publishing PWr. 2005

SECONDARY LITERATURE

1. M. Werszko, R. Werszko, Fundamentals of Automatic Control. Selected topics. Publishing DWSP iT, 2011

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Automatic Control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1TR_W09	C1, C2	Lec1-Lec15	N1
PEK_U01, PEK_U02	K1TR_U09	C1,C2	Lab1-Lab7	N2
PEK_K01, PEK_K02	K1TR_K03	C1,C2	Lab1-Lab7, Lec1-Lec15	N1, N2

SUBJECT SUPERVISOR

dr inż. Daniel Nowak tel.: 44-42 email: daniel.nowak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Środki transportu II**
Name in English: **Means of transport II**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031026**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				15
Number of hours of total student workload (CNPS)	60				60
Form of crediting	Crediting with grade				Crediting with grade
Group of courses	X				
Number of ECTS points	2				2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ordered knowledge of core subjects: physics, mathematics
2. Ordered knowledge of specialized subjects: solid mechanics, fluid mechanics, transportation systems
3. Able to prepare and make a presentation on a chosen topic and lead the discussion.

SUBJECT OBJECTIVES

C1. Learning the bases for the construction of means of transport: water, hydro, air transport
C2. Learning the basics of operating modes of transportation: water, hydro, air transport
C3. Learning the safety rules and regulations in force in transport: water and air transport

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to characterize and describe in detail the construction, design and calculation rules for means of transport: pipeline, water and air transport.
PEK_W02 - Able to characterize and describe in details operating on transport means: pipeline, water and air transport.
PEK_W03 - Student can discuss the safety rules of means of transport: pipeline, water and air transport.

II. Relating to skills:
PEK_U01 - Able to analize the construction, design and calculation rules for means of transport: pipeline, water and air transport.
PEK_U02 - Able to perform basic construction-exploitation calculations of transport means: pipeline, water and air transport.
PEK_U03 - Able to make a presentation, conduct public speech and establish a discussion on means of transport: pipeline, water and air transport.

III. Relating to social competences:
PEK_K01 - Understands the need and knows the possibility of constant learning
PEK_K02 - Knows the regulations and safety rules of transport means: pipeline, water and air transport
PEK_K03 - Is aware of the importance and understanding of the environmental aspects of the technical activities

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The division and classification of the goods fleet, rules of dimensioning, the role of classification societies in the construction and operation	2
Lec2	Basics of ship construction, spatial distribution, systems of hull structure, classification of loads	2
Lec3	Rules of hydrostatic calculations	2
Lec4	Propulsion systems, marine propellers, principles of selection	2
Lec5	Steering systems, the maneuverability	2
Lec6	The propulsion characteristics of ship, motion resistance	2
Lec7	The division and classification of means of inland waterway transport	2
Lec8	Effect of navigational and meteorological conditions for the operation of means of water transport.	2
Lec9	Means of maritime transport	2
Lec10	Stability issues of vessels while operating	2
Lec11	Components of water transport costs, energy consumption, ecology in water transport	2
Lec12	Elements of hydro infrastructure, pipelines, pumps, fittings	2
Lec13	Energy losses, the cost of transportation	1
Lec14	Air transport, infrastructure, means of transportat, basic operating parameters, safety	2
Lec15	Operating rules for air transport, transport costs	2

Lec16	Final test	1
		Total hours: 30

Form of classes – Seminar		Number of hours
Sem1	Basic physical and chemical characteristics of crude oil, natural gas, the rules for determining losses in hydrotransport, pumps and compressors in hydrotransport.	2
Sem2	Classification of airports and passengers aircrafts, safety systems in air transport	2
Sem3	Construction of aircraft hulls, types of engines used in aerospace, alternative energy sources	2
Sem4	The division and classification of sea and river ports, standard equipment	2
Sem5	Propulsion systems in shipbuilding (engines, propellers), the rules for determining the parameters of propulsion systems (model tests, approximate methods)	2
Sem6	Classification societies on the construction and operation of water transportation means: classification, stability, registered capacity.	2
Sem7	Detailed characterization, construction, operation, method of transport on water and air.	2
Sem8	The greatest maritime disasters, aviation, their causes and effects	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_W02,PEK_W03, PEK_U01, PEK_U02PEK_U03	Final test
P = 0.6*F1+0.4*FS		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_W02,PEK_W03, PEK_U01, PEK_U02PEK_U03	presentation, speech, draft, participation in discussions of problem
P = F1=FS		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Żylicz A.; Statki śródlądowe, Wydawnictwo Morskie, Gdańsk, 1979.
2. Buczkowski L. Podstawy budownictwa okrętowego, Politechnika Gdańska, Gdańsk 1970.
3. Wright P.H.; Ashford N.J.; Tranportation Engineering, John Wiley &Sons, New Yrok, 1998

SECONDARY LITERATURE
1. Rydzykowski Wł.; Wojewódzka – Król K.; Transport, Wydawnictwa Naukowe PWN, Warszawa 1997

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Means of transport II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01,PEK_W02, PEK_W03, PEK_U01, PEK_U02,PEK_U03, PEK_K01,PEK_K02, PEK_K03	K1TR_K02, K1TR_K04, K1TR_K06, K1TR_K07, K1TR_K08, K1TR_K09, K1TR_U01, K1TR_U04, K1TR_U06, K1TR_U10, K1TR_U16, K1TR_W06, K1TR_W07	C1,C2,C3	Lec1-Lec16	N1,N3
PEK_W01,PEK_W02, PEK_W03, PEK_U01, PEK_U02,PEK_U03, PEK_K01,PEK_K02, PEK_K03	K1TR_K02, K1TR_K04, K1TR_K06, K1TR_K07, K1TR_K08, K1TR_K09, K1TR_U01, K1TR_U04, K1TR_U06, K1TR_U10, K1TR_U16, K1TR_W06, K1TR_W07	C1,C2,C3	Se1-Se15	N2,N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jan Kulczyk tel.: 71 320-25-70 email: Jan.Kulczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania środków transportu I**
Name in English: **Manufacturing techniques of means of transport I**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031028**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	90		90		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	3		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of the basic mechanical properties of engineering materials, and has ordered knowledge about the types of metallic materials engineering - their construction, properties, applications and selection rules. He has adequate knowledge of the structure of steel and cast iron, the principles of classification and labeling and has a basic knowledge of heat and thermo-chemical treatment, has a knowledge of alloy steels and non-ferrous metals and alloys.
2. Is able to analyze macroscopic breakthroughs, microstructure of materials, the origin of technological defects , is able to determine the characteristics of the microstructure of metallic materials; is able to identify phases on the basis of equilibrium diagrams, can distinguish between the microstructure in terms of carbon content in steel, the influence of heat treatment, is able to characterize the transport systems and have a basic knowledge about the designing of transport means.
3. Is able to read and interpret drawings and diagrams used in the technical documentation, is able to do the technical documentation. Is able to characterize the transport systems and have a basic knowledge about the designing of transport means.

SUBJECT OBJECTIVES

C1. Familiarization of students with the processes and techniques of production from the liquid metal, the plastic molding and welding techniques used in the production of of transport means.
C2. Acquisition of knowledge about the basic techniques and skills chipless machining for selection of these processes.
C3. The acquisition and consolidation of social skills including ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in the procedure observance existing in academia and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic technologies of casting
PEK_W02 - Knows the basics of plastic forming technologies of elements and their relevance and application in the production of means of transport
PEK_W03 - Knows the basic methods of welding and process parameters, and has knowledge of the applications of welding processes, resistance welding and soldering in the manufacture of products

II. Relating to skills:
PEK_U01 - Is able to choose a suitable casting technology and define the basic parameters of the process
PEK_U02 - Is able to choose the technology of plastic forming and defining the basic parameters of the process
PEK_U03 - Is able to choose the appropriate method of joining the elements of the product and to determine the basic parameters of the process

III. Relating to social competences:
PEK_K01 - Searches of information and its critical analysis
PEK_K02 - Objective evaluation of arguments and rational explanations and justifications own point of view using the knowledge of casting, plastic forming and welding
PEK_K03 - Respects the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Overview the specific manufacturing techniques, basic concepts and algorithms for the manufacture of cast	2
Lec2	The materials used for the production of molding and core as well as methods for producing and testing the properties of these masses	2
Lec3	Methods for manual and automatic production of foundry molds and cores. Production of molds and cores with masses of chemo-and thermohardenable	2
Lec4	Production of castings in durable molds	2
Lec5	Smelting of alloys and heat treatment of castings. Test of knowledge	2
Lec6	Influence of deformation on the structure and properties of the material.	2
Lec7	Cold and hot plastic processing	2
Lec8	Forming of sheets	2

Lec9	Volumetric processing	2
Lec10	Devices for plastic treatment. Test of knowledge	2
Lec11	The types of joints and welds, welding positions, oxy fuel welding	2
Lec12	Arc welding with coated electrodes, in protective gases (TIG, MIG, MAG) and under fluxing agent	2
Lec13	Soldering and brazing	2
Lec14	Resistance welding and friction welding	2
Lec15	Thermal Cutting and welding stress. Test of knowledge	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Cold deformation and annealing of materials	2
Lab2	Tests sheets Drawability	2
Lab3	Rolling of sheets and profiles	2
Lab4	Extrusion machine components	2
Lab5	Production of metal products by drawing	2
Lab6	Cutting, bending and sheet metal stamping	2
Lab7	Forging machine components	2
Lab8	Organizational matters. Welding safety. Gas welding of steel.	2
Lab9	Soldering and brazing of steel, copper and aluminum	2
Lab10	Electric resistance welding. Friction welding.	2
Lab11	Manual welding with coated electrodes	2
Lab12	Gas-shielded welding TIG, MIG, MAG	2
Lab13	The stress and strain of welding. Submerged arc welding.	2
Lab14	Thermal cutting - oxygen and plasma	2
Lab15	Robotic welding	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_K01, PEK_K02	partial final test
F2	PEK_W02, PEK_K01, PEK_K02	partial final test
F3	PEK_W03, PEK_K01, PEK_K02	partial final test
P = średnia z F1+F2+F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_K01 - PEK_K03	short test
F2	PEK_W03, PEK_U02, PEK_K01 - PEK_K03	short test
F3	PEK_W03, PEK_U03, PEK_K01 - PEK_K03	short test
P = średnia z F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Perzyk M. et al; Foundry. WNT Warszawa 2000. Granat K. Laboratory of casting. Script WUT., Wroclaw, 2007. Gronostajski J., Plastic forming of metals. Wroclaw 1974, http://www.metalplast.pwr.wroc.pl/instrukcje.html. Ambroziak A. (ed.): manufacturing techniques. Welding. Laboratory. Pwr, Pretoria 2011, http://www.Dbc.Wroc.Pl

SECONDARY LITERATURE

Handbook Engineer - Foundry. WNT Warszawa 1986. Romanowski P., Handbook of cold working, Publishing House of Science and Technology, Warsaw, 1976. Pilarczyk, J. (eds.Handbook Engineer. Welding. Vol I and II, WNT Warszawa, 2003, 2005. Klimpel A: Welding, Resistance Welding and Cutting Metals., WNT, Warsaw, 1999. Klimpel A: Surfacing and thermal spraying. WNT Warszawa 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing techniques of means of transport I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1TR_W07	C1, C2	Le1 - Le15	N1, N5
PEK_U01 - PEK_U03	K1TR_U01, K1TR_U06	C1, C2	Lab1 - Lab15	N2, N3, N4
PEK_K01 - PEK_K03	K1TR_K03, K1TR_K07	C3	Le1-Le15, Lab1-Lab15	N1 - N5

SUBJECT SUPERVISOR

dr inż. Piotr Białucki tel.: 42-71 email: piotr.bialucki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Eksploatacja techniczna**
Name in English: **Operation of technical systems**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031029**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	15
Number of hours of total student workload (CNPS)	60			30	30
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	Crediting with grade
Group of courses					
Number of ECTS points	2			1	1
including number of ECTS points for practical (P) classes				1	1
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of problems dealing with materials, strength and design.
2. Acquaint students with the role of human in technical objects operation.

SUBJECT OBJECTIVES

C1. Introduction of problems dealing with randomness of processes observed in technical systems operation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student should be able to identify and point out the most important factors disturbing right operation and should can assess operation effectivness

II. Relating to skills:
PEK_U01 - Student should get ability of assessing and influencing on operation effectiveness as well as reacting on disturbances.

III. Relating to social competences:
PEK_K01 - Student should know how to organize operational process in relation to other operational actors.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Concepts of machine operation, life cycle, operational costs.	2
Lec2	Description of men and technical object in operational system.	2
Lec3	Definition and assessment of operational process. Operation organization.	2
Lec4	Definition of operational environment and its influence on object operation.	2
Lec5	Description of object technical state. Disturbances in operation.	2
Lec6	Concept and definition of failure and fault. Ageing.	2
Lec7	Failures classification, modes, causes and consequences in the system Man-Machine-Environment	2
Lec8	Object classification due to maintenance. Organization and maintenance methods.	2
Lec9	Randomness in operation, aging and degradation.	2
Lec10	Introduction to operational reliability, measures, assessment.	2
Lec11	Maintenance and spare parts problems.	2
Lec12	Introduction to technical diagnostics.	2
Lec13	Corrective and preventive maintenances.	2
Lec14	Preventive maintenance models. Basics of RCM.	2
Lec15	Object testing in operation. Weak elements.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction to truck database analysis	2
Proj2	Statistical analysis of database and calculation of availability measures.	2
Proj3	Statistical analysis of database and calculation of effectiveness measures.	2
Proj4	Study on random variables describing failure process (mileage, time). Statistical analysis of given random variables.	2
Proj5	Study on random variables describing maintenance (time, workload). Statistical analysis of given random variables.	2

Proj6		2
Proj7	Operational costs analysis.	1
Proj8	Weak elements analysis.	2
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Introduction and subjects distribution. Description of way of preparation and presentation of subject on chosen subject. Taking into consideration energy consumption, initial and operation cost, failures and maintenance. Each student presents one object.	1
Sem2	Technical and operational characteristics of road vehicles.	2
Sem3	Technical and operational characteristics of rail vehicles.	2
Sem4	Technical and operational characteristics of water-born ships.	2
Sem5	Technical and operational characteristics of airplanes.	2
Sem6	Technical and operational characteristics of fuels.	2
Sem7	Technical and operational characteristics of oils and greases.	2
Sem8	Technical and operational characteristics of supporting materials (fluids, filters, batteries, etc.).	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of slides
N2. self study - preparation for project class
N3. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_K01	writing test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	report
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	study on report and presentation of chosen subject
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Hebda M., Janicki D., Trwałość i niezawodność samochodów w eksploatacji. WKŁ. Warszawa 1977.
Hebda M., Mazur T., Pelc H., Teoria eksploatacji pojazdów. WKŁ. Warszawa 1978.
Konieczny J., Wstęp do teorii eksploatacji urządzeń. WNT. Warszawa 1971.
Olearczuk E., Zarys teorii użytkowania urządzeń technicznych. WNT. Warszawa 1972.
Polska Norma PN-93/N-050191. Słownik terminologiczny elektryki. Niezawodność, jakość usługi.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation of technical systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_U01, K1TR_U04, K1TR_U13, K1TR_U14, K1TR_U15, K1TR_W14	C1	Wy1-Wy15	N1
PEK_U01	K1TR_U10, K1TR_U11	C2	Pr1-Pr8	N2
PEK_01	K1TR_U12, K1TR_U13	C3	Se1-Se8	N1,N2,N3

SUBJECT SUPERVISOR

dr hab. inż. Marek Młyńczak tel.: 71 320 38 17 email: marek.mlynczak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka I**
Name in English: **Computer science I**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031032**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the course "Mathematical Analysis I".
2. Knowledge of the course "Algebra and Analytic Geometry".
3. Basic skills of computer hardware.

SUBJECT OBJECTIVES

C1. Presentation of the applicability of programs Excel and Matlab for solving the engineering and scientific problems.
C2. Ability to use the IT tools for solving the engineering and scientific problems.
C3. Ability to build algorithms and the creation of procedures for solving the engineering and scientific problems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Is understood the essence of the use of IT tools for solving the engineering and scientific problems.
PEK_W02 - Know rules for creating algorithms and procedures for solving the engineering and scientific problems.

II. Relating to skills:
PEK_U01 - Is able use IT tools for solving the engineering and scientific problems.
PEK_U02 - Is able create algorithms and procedures for solving the engineering and scientific problems.

III. Relating to social competences:
PEK_K01 - Is able formulate the problem, make a plan and develop a procedure to solve it using IT tools.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	A spreadsheet - calculation form , the function wizard , nesting functions.	4
Proj2	A spreadsheet - the use of logical function.	2
Proj3	A spreadsheet - Graphs.	4
Proj4	A spreadsheet - finding the optimal solution - Solver tool.	2
Proj5	A spreadsheet - array procedures, calculations using matrix algebra.	2
Proj6	Test I	2
Proj7	Matlab - the basic operations	4
Proj8	Matlab - functions and scripts	4
Proj9	Matlab - library functions, graphs	4
Proj10	Test II	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises
N2. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK-W01, PEK-U01 PEK-W02, PEK-U02, PEK-K01	test I test II
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Krzysztof Masłowski, Excel 2007/2010 PL. Ćwiczenia zaawansowane.
Bogumiła Mrozek, Zbigniew Mrozek, MATLAB i Simulink. Poradnik użytkownika.

SECONDARY LITERATURE
Maciej Gonet, Excel w obliczeniach naukowych i inżynierskich.
Elżbieta Szymczyk, Matlab dla mechaników

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer science I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W02	K1TR_W05	C1	Pr 1-5, Pr 7-9	N1, N2
PEK_U01 - PEK_U02	K1TR_U07	C1, C2, C3	Pr 1-5, Pr 7-9	N1, N2
PEK_K01	K1TR_K05	C2, C3	Pr 1-5, Pr 7-9	N1, N2

SUBJECT SUPERVISOR

dr inż. Wiktor Słomski tel.: 71 320-24-65 email: Wiktor.Slomski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka II CAD**
Name in English: **Computer science II CAD**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM031033**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				90	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in range of technical drawing based on 3D models

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students should be know the rules of the modeling 3D of the machines parts and assemblies with using CAD systems
PEK_W02 - Students should be know the methods of analysis and testing the parameters of machines and equipment carried on 3D virtual models (virtual prototypes).
PEK_W03 - Students should be know the using of CAD systems for creative and innovative design.

II. Relating to skills:
PEK_U01 - Students should be able to build 3D models of machine parts
PEK_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEK_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:
PEK_K01 - Student gains the skills to take responsibility for their work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Basic solid modeling - rules for creating a 2D sketch, operations on 2D sketches, fittings in the sketch (geometric and dimensional fittings), solid modeling with extrude methods.	4
Proj2	Basic solid modeling - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations.	4
Proj3	The project of assembly: the concept, solid modeling with rotation, one and multibody modeling.	6
Proj4	The project of assembly: solid operations - sweep, loft, split.	4
Proj5	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts.	4
Proj6	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults.	2
Proj7	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings and assembly drawings.	4
Proj8	Completion of the course: work during classes.	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE
http://autodesk-inventor-pl.typepad.com/
http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer science II CAD
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1TR_W07	C3	Pr1 - Pr7	N1, N2
PEK_U01 - PEK_U03	K1TR_U09	C1, C2	Pr1 - Pr7	N1, N2
PEK_K01	K1TR_K03	C3	Pr1 - Pr7	N1, N2

SUBJECT SUPERVISOR

dr inż. Wiktor Słomski tel.: 71 320-24-65 email: Wiktor.Slomski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo bierne pojazdów pasażerskich**
Name in English: **Passive safety of passenger vehicles**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031100**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in the field of strength of materials.
2. Knowledge of transport infrastructure.
3. Design basics of transport means.

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the filed of passenger vehicles.
C2. Acquisition of knowledge of the design elements providing the passive safety in passenger vehicles.
C3. The acquisition of knowledge in the field of research and design of road infrastructure elements of ensuring passive safety.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The correct definition of test procedures for passenger vehicles.
PEK_W02 - Rules for calculating biomechanical criteria for determining the level of injury.
PEK_W03 - Ability to propose design changes to improve passive safety.

II. Relating to skills:
PEK_U01 - Ability to carry out simulation studies in the field of passive safety.
PEK_U02 - Ability to interpret the results of studies in the field of passive safety for passenger vehicles.
PEK_U03 - The ability to analyze the results obtained during the tests.

III. Relating to social competences:
PEK_K01 - Acquires teamwork skills.
PEK_K02 - Thinks and works in a creative way.
PEK_K03 - Student deliberately takes some actions and knows their consequences

PROGRAMME CONTENT

	Form of classes – Lecture	Number of hours
Lec1	Introduction to road safety.	2
Lec2	Road safety with regard to statistical data.	2
Lec3	Studies of passive safety in buses.	2
Lec4	Studies of passive safety in cars.	2
Lec5	compatibility of vehicles.	2
Lec6	Vehicle collisions with pedestrians	2
Lec7	Dummies used for testing of passive safety. Biomechanical criteria in the assessment of passive safety.	2
Lec8	Construction and types of energy consuming components.	1
		Total hours: 15

	Form of classes – Project	Number of hours
Proj1	Discussion of design project. Introduction to the FE software	2
Proj2	Principles of construction of computational models of energy-absorbing elements	2
Proj3	Evaluation of the impact of the adopted model on the accuracy of the results.	2
Proj4	Principles of construction of shell models.	2
Proj5	Methods of dynamic analysis taking into account the physical and geometric nonlinearity.	2
Proj6	Analysis of the dynamic process of crushing energy-absorbing components. Example.	2
Proj7	Definition of the analysis results. Determination of basic elements necessary to assess the energy absorption during compression.	2
Proj8	Methodology static analysis taking into account the physical and geometric nonlinearity.	2

Proj9	Analysis of the process of quasi-static bending energy consuming components. Example.	2
Proj10	Working out the analysis results. Definition of basic parameters needed to assess the energy absorption.	2
Proj11	Develop own geometric model construction for energy absorption.	2
Proj12	Design a model for FEM calculations.	2
Proj13	Definition of load and carrying out computer simulation	2
Proj14	Analysis of the results obtained and to determine the basic features of energy-absorbing element.	2
Proj15	Working out the final report.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem exercises
N3. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	writing or oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	evaluation of the computational part of the project, oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Zieliński A., Konstrukcja nadwozi samochodów osobowych i pochodnych, WKiŁ, Warszawa 2008 Wicher J., Bezpieczeństwo samochodów i ruchu drogowego, WKiŁ, Warszawa 2004Rusiński E., Metoda elementów skończonych. System COSMOS/M, WKiŁ Warszawa 1994Rusinski E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE

Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wyd. PWr Wrocław 2002Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Passive safety of passenger vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_W07	C1, C2	Wy1, Wy2, Wy3, Wy4, Wy6, Wy7	N1
PEK_W02	K1TR_W07	C1, C2	Wy3, Wy4, Wy6, Wy7	N1
PEK_W03	K1TR_TP_W03	C1, C3	Wy1, Wy5, Wy8	N1
PEK_U01	K1TR_U01	C1, C2	Pr1, Pr2, Pr3, Pr4, Pr5, Pr8, Pr11, Pr12, Pr13	N2
PEK_U02	K1TR_U10	C1, C2		N2
PEK_U03	K1TR_U04, K1TR_U09	C1, C2	Pr7, Pr10, Pr 14, Pr15	N3
PEK_K01	K1TR_K03	C1, C3	Pr1, Pr2, Pr3, Pr4, Pr5, Pr6,	N2
PEK_K02	K1TR_K05, K1TR_K09	C1, C3	Pr6, Pr7, Pr9, Pr10,	N2
PEK_K03	K1TR_K09	C1, C3	Pr7, Pr8, Pr13, Pr14, Pr15	N3

SUBJECT SUPERVISOR

dr inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Transport pionowy pasażerski**
Name in English: **Vertical passenger transport**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				15
Number of hours of total student workload (CNPS)	30				60
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	1				2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics, in terms of kinematics, statics and dynamics at high school level
2. Ability to read drawings and produce sketches of devices for vertical transport of passengers, together with structural diagrams of simple systems containing these devices
3. Ability to use tools for creating multimedia presentations

SUBJECT OBJECTIVES

C1. C1 Knowledge of the types of structures, parameters and fundamental elements for the vertical system of passenger transport (VSPT), knowledge of the principles of their operation and control, knowledge of the selection of the elements of these systems, ie., special, short-distance transport equipment (SDT) such as lifts, escalators, cable, and ski lifts
C2. Acquisition of basic skills to identify structural types, carry out analytical description and calculation of basic technical and operating characteristics of VSPT systems and their SDT components to meet specified passenger flow
C3. Awareness of the interrelationship between size and type of structures of VSPT systems together with technical parameters of its SDT components and operating characteristics (capabilities) as well technical characteristics (due to energy efficiency considerations) of the VSPT systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic structures, parameters, principles of operation and control of VSPT systems and their basic STD elements
PEK_W02 - Has knowledge of the principles of selection of STD elements with cyclic movement (lifts) and those of continuous operation (escalators, cable cars and ski lifts) that operate in specified passenger flow systems, as implemented by VSPT

II. Relating to skills:
PEK_U01 - Able to identify the structure and basic parameters of VSPT systems, and create general schemes for these structures
PEK_U02 - Can determine computationally the basic technical parameters of VSPT systems and their STD components ensuring the implementation of a given passenger flow

III. Relating to social competences:
PEK_K01 - Is aware of the relationship between size and and types of structural systems of VSPT, together with technical characteristics of its STD components and operating (capabilities) and technical (due to energy efficiency considerations) parameters of these systems.
PEK_K02 - Recognizes the relationship between adequate knowledge of mathematics and selected branches of mechanics used in the identification and analysis of VSPT systems

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts, review and classification of VSPT systems; types of structures. Factors influencing the efficiency of VSPT systems working cyclically and continuously	2
Lec2	The basic elements of VSPT systems for cyclic operation (passenger lifts), classification according to the design features, application, intensity of use; general selection criteria	2
Lec3	Basic technical and operating parameters and factors determining productivity of cyclic work STD systems (lifts	2
Lec4	General principles of control, selected topics and standardized requirements for lift safety; typical safety devices for passenger lifts	2
Lec5	The basic elements of VSPT systems for continuous operation (escalators, cable cars and ski lifts), classification according to design features and intended use; general criteria of selection	2
Lec6	Basic technical and operational parameters and factors determining the performance of continuous work STD systems (escalators, lifts and cable cars)	2
Lec7	General principles of control, selected topics and standardized safety requirements for continuous work SDT systems; typical safety equipment for these systems	2
Lec8	Selected aspects of automation of VSPT systems	1
		Total hours: 15
Form of classes – Seminar		Number of hours

Sem1	Examples of solutions for VSPT systems differing in: size, location, logistical structure, degree of automation, type of operation (cyclic or continuous), productivity, and installed capacity	2
Sem2	Examples of solutions for cyclic work VSTP systems of a given structure, degree of automation, productivity, types of STD equipment (cranes, lifts, rail cars, etc.)	2
Sem3	Examples of STD elements (cranes, lifts, rail cars, etc.), cyclic work VSPT systems; basic design, technical and operational characteristics, degree of automation of STD	2
Sem4	Examples of solutions for safety and control devices in cyclic work VSPT systems of a given structure, degree of automation, productivity, type of STD equipment (cranes, lifts, rail cars, etc.).	2
Sem5	Examples of solutions for continuous work VSPT systems of a given structure, degree of automation, capacity, type of STD equipment (escalators, lifts and cable cars).	2
Sem6	Examples of STD elements (escalators, cable cars and ski lifts) for continuous work VSTP systems, basic design, technical and operational characteristics degree of automation of STD equipment	2
Sem7	Examples of solutions for safety and control devices in continuous work VSPT systems of a specified structure, degree of automation, productivity, and types of STD equipment (escalators, lifts and cable cars).	2
Sem8	Examples of algorithms and procedures for the control of selected VSTP systems	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Mark of paper and its presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Kwaśniewski J. -Passenger lifts and elevators, structure and eksploitation. Publ. AGH Cracow 2004
[2] Goździecki M., Świątkiewicz H. – Conveyors. WNT Warsow 1978
[3] Mindur I. - Contemporary technologies of transport. Publ. T.U. Radom 2002

SECONDARY LITERATURE

[1] Piątkiewicz A., Urbanowicz H. - Electrical lifts. WNT Warsow 1972
[2] Kudzielka H. - Cable cars and ski lifts. Publ. KaBe Krosno 2010
[3] Catalogues of lifts and conveyors offered by firms: FAMAK, KONE, SCHINDLER, OTIS, AUIMUND

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Vertical passenger transport
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_W10	C1	Lec1	N1, N2, N3
PEK_W02	K1TR_W10	C1	Lec2 to Lec8	N1, N2, N3
PEK_U01	K1TR_U18	C2	Sem1, Sem2, Sem4, Sem6	N2, N3, N4
PEK_U02	K1TR_U18	C2	Sem3, Sem5, Sem7	N2, N3, N4
PEK_K01, PEK_K02	K1TR_K04	C3	Lec1 to Lec8, Sem1 to Sem8	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Eugeniusz Grabowski tel.: 71 320-28-89 email: Eugeniusz.Grabowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Proseminarium dyplomowe**
Name in English: **Diploma Thesis Seminar**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031110**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					15
Number of hours of total student workload (CNPS)					30
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes					0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of problems dealing with subject of final project.

SUBJECT OBJECTIVES

C1. Attain of ability of problem recognition and formulation of the task to solve.
C2. Attain of ability of sources and bibliography collecting to prepare compact text of problem solving using methods learned during study.
C3. Attain of ability of public presentation of achievements.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student can formulate and present in writing form (text, tables, graphs) the way of problem solving an final solution.

II. Relating to skills:
PEK_U01 - Student should know how to edit writing work with steps of solving given problem.

III. Relating to social competences:
PEK_K01 - Easiness of interpersonal communication.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Description of the way of final project preparation. Origin of the subject, contents: state of art, problem, solution, summery, literature.	1
Sem2	Final project presentation: assumptions, aim and scope with justifying and sources of knowledge and data. Subjects of students according to list 1-4.	2
Sem3	Final project presentation: assumptions, aim and scope with justifying and sources of knowledge and data. Subjects of students according to list 5-10.	2
Sem4	Final project presentation: assumptions, aim and scope with justifying and sources of knowledge and data. Subjects of students according to list 11-15.	2
Sem5	Final project presentation: assumptions, aim and scope with justifying and sources of knowledge and data. Subjects of students according to list 16-20.	2
Sem6	Final project presentation: assumptions, aim and scope with justifying and sources of knowledge and data. Subjects of students according to list 21-25.	2
Sem7	Final project presentation: assumptions, aim and scope with justifying and sources of knowledge and data. Subjects of students according to list 26-30.	2
Sem8	Final project presentation: assumptions, aim and scope with justifying and sources of knowledge and data. Subjects of students according to list 16-30.	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01	assessment of final project progress
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Poradnik inżyniera mechanika.

SECONDARY LITERATURE
http://www.wm.pwr.wroc.pl/88428.dhtml

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma Thesis Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_U01, PEK_K01	K1TR_U01, K1TR_U04, K1TR_U07	C1, C2, C3	Se2-Se8	N1

SUBJECT SUPERVISOR

dr hab. inż. Marek Młyńczak tel.: 71 320 38 17 email: marek.mlynczak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo transportu pasażerskiego**
Name in English: **Safety of passenger transport**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031115**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the construction of means of transport.
2. Knowledge of transport infrastructure.
3. Skills of individual and group laboratory working.

SUBJECT OBJECTIVES

C1. To acquaint the participants with factors affecting passenger safety.
C2. To gain basic knowledge of the methods of accident reconstruction.
C3. To acquire the skills to evaluate and interpret test results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has knowledge of the factors affecting the safety of passengers.
PEK_W02 - It has knowledge about the safety of passenger transport in the various transport sectors.
PEK_W03 - It has a basic knowledge of safety engineering of transport systems;especially road safety.

II. Relating to skills:
PEK_U01 - Is able to obtain and use information from literature, databases and other sources to the activities of vehicle construction engineering.
PEK_U02 - It has the ability to self-learning in order to improve the professional competence.
PEK_U03 - Able to estimate the safety of passenger transport.

III. Relating to social competences:
PEK_K01 - Is aware of the importance, responsibility and impact of activities of the transport engineer.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic terms, legal regulations safety issues. The criteria for evaluation.	2
Lec2	Integrated brake assist system.	2
Lec3	Active safety elements of chassis systems.	2
Lec4	Traction control systems.	2
Lec5	Numerical computer aided systems for road accidents reconstruction.	2
Lec6	Road transport safety.	2
Lec7	Safety of water transport.	2
Lec8	Safety of rail transport.	2
Lec9	Photographic documentation, measurement and description of the accident.	2
Lec10	Mechanics of car movement in emergency situations.	2
Lec11	Mechanics of vehicle collisions.	3
Lec12	The collision with a pedestrian.	2
Lec13	Reconstruction of road traffic accidents.	3
Lec14	An integrated system of transport safety.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Research on the influence of chassis parameters on drivability.	2
Lab2	The test of the ABS model.	2
Lab3	The test of steering system.	2
Lab4	Tests of the brake system. Traction control systems.	2
Lab5	The test of energy consumption of structure on the drop-hammer.	2
Lab6	The test of loads affecting the dummy in simple crash tests.	2
Lab7	The test of materials and stitches used for the construction of airbags.	2

Lab8	Testing and assessment of the safety belts	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. multimedia presentation
N4. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	Wy1-Wy5	final test
F2	Wy6-Wy14	final test
P = (F1 +F2) / 2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	La1-La4	test, report
F2	La5-La8	test, report
P = (F1 +F2) / 2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Prochowski L. et al.: Podstawy rekonstrukcji wypadków drogowych. WKŁ Warszawa 2008
Krystek R. red pracy zbiorowej Zintegrowany system bezpieczeństwa transportu Tom I Diagnoza bezpieczeństwa transportu w PolsceWKŁ Warszawa 2009.
Unarski J., Zębala J.: Zbiór podstawowych wzorów i równań stosowanych w analizie wypadków drogowych. Wydanie 2, Wydawnictwo – Instytut Ekspertyz Sądowych, Kraków 2012
Wicher J.:Bezpieczeństwo samochodów i ruchu drogowego, Wydawnictwo Komunikacji i Łącznośći, Warszawa 2001
Zieliński A.: Konstrukcja nadwozi samochodów osobowych i pochodnych, WKŁ Warszawa 1998
Informator techniczny BOSCH: Układy bezpieczeństwa i komfortu jazdy. WKŁ, Warszawa 2000
Informator techniczny BOSCH: Układ stabilizacji toru jazdy ESP. WKŁ, Warszawa 2000
Tomasz Szczuraszek, Bezpieczeństwo ruchu miejskiego, WKŁ.

SECONDARY LITERATURE

Wierciński J., Reza A.: Wypadki drogowe. Vademecum biegłego sądowego Wydanie 2 uaktualnione, Wydawnictwo – Instytut Ekspertyz Sądowych Krakw 2008
Wach W.: Symulacja wypadków drogowych w programie PC-Crash. Instytut Ekspertyz Sądowych Kraków 2010
Uwe Rokosch, Poduszki gazowe i napinacze pasów, WKŁ.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Safety of passenger transport
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1TR_W13	C1, C2, C3	Lec1-Lec14	N1, N3
PEK_U01, PEK_U02, PEK_U03	K1TR_U06, K1TR_U18	C1, C2, C3	Lab1-Lab18	N2, N4

SUBJECT SUPERVISOR

dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo bierne pojazdów towarowych**
Name in English: **Passive safety of commercial vehicles**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031200**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in the field of strength of materials.
2. Knowledge of transport infrastructure.
3. Design basics of transport means.

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the filed of freight vehicles.
C2. Acquisition of knowledge of the design elements providing the passive safety in freight vehicles.
C3. The acquisition of knowledge in the design of freight vehicles.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The correct definition of test procedures for goods vehicles.
PEK_W02 - Design principles of freight vehicles with regard to passive safety.
PEK_W03 - Ability to propose design changes to improve passive safety.

II. Relating to skills:
PEK_U01 - Ability to carry out simulation studies in the field of passive safety.
PEK_U02 - Ability to interpret the results of studies in the field of passive safety of freight vehicles
PEK_U03 - The ability to analyze the results obtained during the tests.

III. Relating to social competences:
PEK_K01 - Acquires teamwork skills.
PEK_K02 - Thinks and works in a creative way.
PEK_K03 - Student deliberately takes some actions and knows their consequences

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to vehicle safety in freight.	2
Lec2	Studies of passive safety in trucks.	2
Lec3	Studies of passive safety in construction and mining machines.	2
Lec4	Structural elements ensure the safety of machine operators and rules for their design.	2
Lec5	Numerical methods in the evaluation of passive safety.	2
Lec6	Methodology for conducting simulation studies in the field of passive safety of freight vehicles.	2
Lec7	Methods for solving nonlinear problems physically and geometrically in the assessment of passive safety of freight vehicles	2
Lec8	The directions of development.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Discussion of design project. Introduction to the FE software	2
Proj2	Principles of construction of computational models of elements that protect the operators.	2
Proj3	Evaluation of the impact of the adopted model on the accuracy of the results.	2
Proj4	Principles of construction of shell models.	2
Proj5	Methods of dynamic analysis taking into account the physical and geometric nonlinearity.	2
Proj6	Analysis of the structure protecting opertator while being hit by falling objects. The example.	2
Proj7	Development of the analysis results. Determination of basic necessary to assess the protective structure.	2

Proj8	Methodology static analysis taking into account the physical and geometric nonlinearity.	2
Proj9	Analysis of the structure in terms of protecting the loaded static lateral force resulting from the rollover. The example.	2
Proj10	Development of the analysis results. Determination of basic necessary to assess the protective structure during the rollover.	2
Proj11	Develop own geometric model construction to protect against falling objects and protects the operator during rollover.	2
Proj12	design a model for FEM calculations.	2
Proj13	Definition of load and carrying out computer simulation	2
Proj14	Analysis of the results obtained and to determine the basic size for the assessment of protective structures.	2
Proj15	Working out the final report.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem exercises
N3. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	writing or oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	evaluation of the computational part of the project, oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Dyrektywa Maszynowa 2006/42/WE
Prochowski L., Żuchowski A., Samochody ciężarowe i autobusy, WKiŁ, Warszawa 2006
Zieliński A., Konstrukcja nadwozi samochodów osobowych i pochodnych, WKiŁ, Warszawa 2008
Wicher J., Bezpieczeństwo samochodów i ruchu drogowego, WKiŁ, Warszawa 2004
Rusiński E., Metoda elementów skończonych. System COSMOS/M, WKiŁ Warszawa 1994
Rusinski E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE
Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wyd. PWr Wrocław 2002
Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005
Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Passive safety of commercial vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_TT_W01, K1TR_W07	C1, C2	Wy1, Wy2, Wy3, Wy5, Wy6, Wy 7	N1
PEK_W02	K1TR_W07	C2, C3	Wy2, Wy3	N1
PEK_W03	K1TR_TT_W01, K1TR_TT_W03	C2, C3	Wy4, Wy6, Wy8	N1
PEK_U01	K1TR_U01	C1, C2	Pr1, Pr2, Pr3, Pr4, Pr5, Pr8, Pr11, Pr12, Pr13	N2
PEK_U02	K1TR_U09, K1TR_U10	C1, C2	Pr3, Pr6, Pr 9	N2
PEK_U03	K1TR_U04, K1TR_U09	C2	Pr7, Pr10, Pr 14, Pr15	N3
PEK_K01	K1TR_K03	C1, C2	Pr1, Pr2, Pr3, Pr4, Pr5, Pr6,	N2

PEK_K02	K1TR_K05, K1TR_K09	C1, C2	Pr6, Pr7, Pr9, Pr10,	N2
PEK_K03	K1TR_K09	C1, C2	Pr7, Pr8, Pr13, Pr14, Pr15	N3

SUBJECT SUPERVISOR

dr inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Centra logistyczne**
Name in English: **Logistics Center**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				15
Number of hours of total student workload (CNPS)	30				60
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	1				2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of logistics.
2. Basic knowledge of mechanical engineering
3. The ability of logical thinking, reasoning.

SUBJECT OBJECTIVES

C1. Understanding the concept of "logistics center", along with the whole issue of modern technology on securing the flow of industrial transport and storage of materials supply systems, production and distribution.
C2. Skills in controlling flows of goods and electronic exchange of information about them.
C3. Life skills in logistics centers.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the term "logistics center", replace part of the structural and operational, naming and describing its various components.
PEK_W02 - Able to identify logistics center appropriate for specific tasks handling and transport equipment (technology), and they are implemented (suitable magazines and front hubs).
PEK_W03 - Able to calculate the possibilities for picking processes and choose the right one

II. Relating to skills:
PEK_U01 - Able to characterize the process of attempting to operate the technical resources of the logistics center in the right: technically and economically feasible way.
PEK_U02 - Collaborates with other magazines (logistics centers) in the supply chain coordinating action if necessary.
PEK_U03 - Selects the appropriate packaging for goods and means of long-distance transport using their permissible parameters (eg., A load or weight limit).

III. Relating to social competences:
PEK_K01 - Works independently and interact as a team.
PEK_K02 - Respects the findings doing the job.
PEK_K03 - Discussed, maintaining openness to other sentence.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Providing basic and supplementary literature. Overview of the course based on object tab. Term examination of the course. Introduction to the subject by recalling already learned knowledge base. Logistic centers in the earlier courses and to discuss the concept of a logistics center.	1
Lec2	Definition of storage. Division and discussion of the basic ways of storage. Providing storage systems evaluation indicators.	1
Lec3	Discussion of the high-bay warehouse construction to build indoor and "self-supporting". Illustrating the film showing high storage operating units pallet and boxes Stacking KLT single-column, two-column - these content.	1
Lec4	Discussion of the examples of the use of high technology, automated storage example: - Logistics center in Dresden and Hamburg car magazine, - Library of Silesia in Katowice (KLT box) - easyPack	1
Lec5	Discussion of the storage technology of dynamic and static storage (definitions). A definition: Piecing homogeneous unit load. Discussion rack storage drive-in: - Cruising version, not cruising, - Provide the advantages and disadvantages of storage drive-in, the determination of queuing methods, utilization rates of storage space, - The problem of manual rack using forklift trucks, - Characteristics of the truck to handle drive-in rack.	1

Lec6	Discussion rack storage pater-noster and carousel and ..... - The technical requirements, - Operational problems, - The area of applications, advantages, disadvantages, utilization rates of storage space, queuing. Case Study,, discussion.	1
Lec7	Discussion rack storage pater-noster and carousel and ..... - The technical requirements, - Operational problems, - The area of applications, advantages, disadvantages, utilization rates of storage space, queuing. Case Study,, discussion.	1
Lec8	Discussion storage racks on wheels: - The technical requirements, - Operational problems, - The area of applications, advantages, disadvantages, utilization rates of storage space, queuing. Case Study,, discussion.	1
Lec9	Providing effective methods: - Use space on EURO pallet, - The use of typical cargo space vehicle bodies. Example calculations.	1
Lec10	The issue of media economy logistics centers: - Discussion of the pallet pooling of activities including an analysis of optional example: EPAL or CHEP. - Waste containers - Alternative media logistics applications. Example optional palette Styrofoam or cardboard.	1
Lec11	Providing methods of selecting a forklift truck for storage tasks. Discussion on the example of the calculation takes into account the characteristics of the method for selecting the drive truck, vehicle service time windows loading docks.	1
Lec12	Discussion of the division of forklifts. Characterization of basic movements working forklift. Ratings and operating the forklift (determination of the center of gravity, energy intensity).	1
Lec13	Construction of a forklift truck with electric drive. - Areas of application, - Advantages and disadvantages. Discussion of exemplary embodiments.	1
Lec14	Construction forklift gas-powered. - Areas of application, - Advantages and disadvantages. Discussion of exemplary embodiments.	1
Lec15	Overview of the stacker crane warehouse construction, including: - Operational height, - Construction (single-column, two-column) - Operating mechanisms - Ways of positioning.	1
Lec16	Discussion of basic cycles stacker crane warehouse. Presentation on the example of the essence of scheduling computational cycles stacker crane warehouse.	1
Lec17	Final test 1Z2, binding material from lecture 1 to lecture 14.	1

Lec18	Discussion of techniques in handling logistics centers using conveyors: - Variety of conveyors, - Basic structural elements, - Building components.	1
Lec19	Scheduling conveyors and calculate their performance with regard to cooperation with other devices. Example of calculation associated with the queuing strings of load units on the transport conveyer.	1
Lec20	AGV technologies used in devices handling logistics centers: - Principles of operation of AGV technology, - Principles of operation of vehicles equipped with AGV technology.	1
Lec21	AGV technologies used in devices handling logistics centers: - Principles of operation of AGV technology, - Principles of operation of vehicles equipped with AGV technology.	1
Lec22	The use of cranes to operate intermodal terminals in logistics centers: - Types of cranes are used, - Scheduling. Analysis example of the use of a crane at the logistics center.	1
Lec23	Discussion of the organization spread scenery. Principles for the preparation card charge flow in logistics centers.	1
Lec24	Subsystem flow of information at the logistics center: - A traditional paper-based, - EDI (using automatic identification) electronic workflow.	1
Lec25	The flow of information at the logistics center using bar codes: - Discussion of the code GS1-8; 13, with the modulo 39 - Analysis of examples marking codes piece goods.	1
Lec26	The flow of information at the logistics center using bar codes: - Discussion of the GS1-128 bar codes and modulo 103, - Discussion of labeling rules SSCC piece units, - Standard identifiers applications. - Analysis of examples marking codes piece goods. - The marking of containers GS1-128 bar codes.	1
Lec27	Barcodes for logistics applications: - Discussion of logistic label according to the standard GS-1 through the use of the codes GS1-13 and 128, SSCC, MA, - Analysis of the examples of the determination of logistic label loading units.	1
Lec28	Posts reloading piece of transport logistics center: - Types of loading docks, - Foliarki, - Weight.	1
Lec29	Analysis of logistics centers, in terms of: - Infrastructure, - Organizational structure, - Logistics functions. Optional: Logistics Center Dresden, Italy, something else.	1
Lec30	Final test 2Z2, which is under the lecture material from 15 to 29.	1
		Total hours: 30
Form of classes – Seminar		Number of hours

Sem1	Topic 1 .: "warehouse logistics centers with a maximum storage height above 12 m equipped with stacker cranes" Topic 2 .: "warehouse logistics centers with a maximum storage height of less than 12 m" Theme 3. "warehouse logistics specialist centers - Optional: cold or silos".	2
Sem2	Topic 5 .: "Place components in logistic centers, their infrastructure and logistics processes implemented" Theme 6 .: "Manoeuvring in logistics centers - implemented logistics processes, and the problem of managing" Topic 7 .: "Is gantry can work efficiently handling terminals for logistics?". Topic 8 .: "Crane in logistics centers and give their construction and performance parameters.	2
Sem3	About 9 .: "truck container logistics centers (new or used) - or cranes ?, About 10 .: "Whither internal transport technology using forklifts and computer-assisted lifting?". About 11 .: "Forklift universal (optional specialized) in the logistic center - Map applications" About 12 .: "Applications conveyors (optional: Band / roller / chain) in logistic centers"	2
Sem4	About 13 .: "conveyor suspended - at the logistics center or production hall?". About 14 .: "Manipulators and robots - their functions in logistic centers" About 15 .: "Touring handling logistics centers (optional temperature regime)" About 16 .: "Using containers in logistics centers.") In logistic centers "	2
Sem5	About 17 .: "Operation pallet logistics centers" About 18 .: "Using transport and storage containers for logistics" About 19 .: "laminating machines pallets (optional: weight) in logistic centers. About 20 .: "Food and drink, hotels, petrol stations, workshops for logistics"	2
Sem6	About 21 .: "Computer systems used in logistics centers" About 22 .: "Automatic identification of goods in logistics centers" About 23 .: "Radio systems used for the exchange of information logistics center." Topic 24. Electronic Data Interchange (ang. EDI), e-signature, e-documents in logistic centers.	2
Sem7	About 25 .: "Bonded warehouses in logistic centers" About 26 .: "Highways (formal requirements, eg. Speed, width and number of lanes) in the area of access to logistics centers" Subject 27: "railway sidings (formal requirements, eg. Speed, the amount / length of track, traction) in the area of access to logistics centers" About 28 .: "airport serving the logistics center, the principle of the organization of work, etc.".	2
Sem8	About 29 .: "Inland ports / marine logistics centers" About 30 .: "International logistics center in Hamburg - how does it work?" ..	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. case study
N4. problem discussion
N5. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
F2	PEK_U01, PEK_U02, PEK_U03PEK_K01, PEK_K02, PEK_K03	participate in discussions problem, written tests
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03PEK_U01, PEK_U02, PEK_U03	verbal response test, the evaluation of the preparation and presentation of the paper,
F2	PEK_K01, PEK_K02, PEK_K03PEK_W01, PEK_W02, PEK_W03PEK_U01, PEK_U02, PEK_U03	test
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Korzeń Z.: „Logistyczne systemy transportu bliskiego i magazynowania” T. I; Instutut Logistyki i Magazynowania; Poznań 1998;
[2] Korzeń Z.: „Logistyczne systemy transportu bliskiego i magazynowania” T. II; Instutut Logistyki i Magazynowania; Poznań 1999;
[3] Fijałkowski J.: „Transport wewnętrzny w systemach logistycznych”; Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001.
[4] Krawczyk S. (red.): "Logistyka. Teoria i praktyka"; Wydawnictwo DIFIN; Warszawa; 2011;
[5]dla potrzeb seminarium materiały z czasopism specjalistycznych polsko- i angielskojęzycznych (np. w wersji elektronicznej).

SECONDARY LITERATURE

[1]. Gudehus T.: „Logistik” T. I; Grundlagen, Verfahren und Strategien; Springer, Hamburg; 1999;
[2]. Gudehus T.: „Logistik” T. I; Netzwerke, Systeme und Lieferketteen; Springer, Hamburg; 1999;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logistics Center
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1TR_K01, K1TR_U07, K1TR_U11, K1TR_U21, K1TR_W06, K1TR_W09, K1TR_W10	C1, C2, C3	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7, Wy8, Wy9, Wy10, Wy11, Wy12, Wy13, Wy14, Wy15	N1, N2, N3, N4, N5
PEK_U01, PEK_U02, PEK_U02, PEK_K01, PEK_K02, PEK_K03	K1TR_U19, K1TR_U20, K1TR_U21, K1TR_W06, K1TR_W09, K1TR_W10	C1, C2, C3	Se1, Se2, Se3, Se4, Se5, Se6, Se7	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Paweł Zając tel.: 71 320-27-19 email: pawel.zajac@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy przeładunku**
Name in English: **Transshipment systems**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031205**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				15
Number of hours of total student workload (CNPS)	30				60
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	1				2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics, in terms of kinematics, statics and dynamics at high school level
2. Ability to read drawings and diagrams used in the representation of short-distance (handling) transport systems devices, and schematics of simple structures systems containing these devices
3. Ability to use tools for creating multimedia presentations

SUBJECT OBJECTIVES

C1. Knowledge of the types of structures, parameters and fundamental elements of bulk material handling and compact cargo systems; knowledge of the principles of their operation and control, knowledge of the selection of elements (handling devices) for these systems
C2. Acquisition of basic skills of identification of structures, analytical description plus calculation of basic technical and operational characteristics of transshipment systems and their components (material handling devices - MHD) to ensure implementation of specified flow of materials and loads
C3. Awareness of the interrelationship between sizes and types of transshipment structures together with the technical characteristics of their components (MHD) plus operating (capabilities) and technical (energy efficiency considerations) characteristics of these systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know the basic structure, parameters, principles of operation and control, as well as the basic elements of bulk materials and compact cargo transshipment systems
PEK_W02 - Has knowledge of the selection principles for the elements of cyclic work (cranes), continuous operation (conveyors), and mixed mode (mobile working machines), operating in specified material flows and cargo handling systems

II. Relating to skills:
PEK_U01 - Able to identify the structure and basic parameters of bulk materials and compact cargo shipment systems; can create schematics of these structures.
PEK_U02 - Can computationally determine the basic technical parameters of transshipment systems and their components (cranes and conveyors) to ensure realisation of specified flow of materials and loads

III. Relating to social competences:
PEK_K01 - Is aware of the relationship between sizes and types of the transshipment systems structures, and technical characteristics of their components (MHD), and operating (capabilities) and technical (energy efficiency considerations) characteristics of these systems
PEK_K02 - Recognizes the relationships between adequate knowledge of mathematics and mechanics used in the relevant areas, to identify and analyze the transshipment systems

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts, review and classification of transshipment systems; types of structures. Factors influencing efficiency of continuous, cyclic, and mixed mode operation transshipment systems	2
Lec2	The basic elements of the transshipment system for cyclic operation (cranes); classification according to the design features, intended use, and intensity of operation; general selection criteria	2
Lec3	Basic technical parameters and factors determining the transshipment efficiency of cranes. General rules for the control of cranes, and selected topics on their automation	2
Lec4	Basic elements of continuous work handling systems (conveyors), classification according to design features and intended use, general selection criteria	2
Lec5	Basic technical parameters and factors determining the transhipment efficiency of conveyors. General principles of control and selected topics on conveyor automation	2
Lec6	Basic elements of the handling systems for mixed operation (mobile working machines); classification according to design features and intended use	2
Lec7	Basic technical parameters and factors determining the transshipment efficiency of mobile working machines. General rules for the control, and selected topics concerning automation of these machines	2
Lec8	Selected topics in automation handling systems	1
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Examples of solutions for handling systems differing in: size, location, logistical structure, degree of automation, type of loads and materials, capacity, and installed power	2
Sem2	Examples of solutions for cyclic work handling structures, degree of automation, capacities, types of handling equipment appropriate to types of loads and materials	2
Sem3	Examples of parts of handling systems operating in a cyclic mode (cranes); basic design features, technical and operational parameters; degree of automation	2
Sem4	Examples of solutions for a continuous work handling system of a given structure, degree of automation, capacities, types of handling equipment appropriate to the type of loads and materials	2
Sem5	Examples of parts of handling systems operating continuously (conveyors); basic design features, technical and operational parameters; degree of automation	2
Sem6	Examples of solutions to the mixed handling systems of a given structure, degree of automation, capacities, and types of handling equipment appropriate to the type of loads and materials	2
Sem7	Examples of parts of handling systems operating in a mixed mode (mobile working machines); basic design features, technical and operational characteristics; degree of automation	2
Sem8	Examples of fully automated handling systems	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Mark of paper and its presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Korzeń Z. - Logistic systems of handling and storage. Vol.1. ILM Poznań 1998
[2] Mindur L.Contemporary technologies of transport. Publ. Radom TU 2002

SECONDARY LITERATURE
[1] Piątkiewicz A., Sobolski R. – Cranes. WNT Warsow 1977
[2] Goździecki M., Świątkiewicz H. – Conveyors. WNT Warsow 1978
[5] Catalogues of unified components of cranes and conveyors offered by firms: FAMAK, DEMAG, ABUS, KONE CRANES, AUMUND

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Transshipment systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_W10	C1	Lec1	N1, N2, N3
PEK_W02	K1TR_W10	C1	Lec2 to Lec8	N1, N2, N3
PEK_U01	K1TR_U18	C2	Sem1, Sem2, Sem4, Sem6	N2, N3, N4
PEK_U02	K1TR_U18	C2	Sem3, Sem5, Sem7	N2, N3, N4

PEK_K01, PEK_K02	K1TR_K04	C3	Lec1 to Lec8, Sem1 to Sem8	N1, N2, N3, N4

SUBJECT SUPERVISOR
dr inż. Eugeniusz Grabowski tel.: 71 320-28-89 email: Eugeniusz.Grabowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **CAL**
Name in English: **Computer aided logistics**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031206**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of management, design and analysis of transport and logistics processes/systems.
2. Basic knowledge of spreadsheet (eg. Excel).

SUBJECT OBJECTIVES

C1. The course aims to introduce students to the subject of integrated systems supporting enterprise management, in case of logistics and transport support. Presentation of basic terms related to computer systems, their classification and rules for the selection, implementation and operation.
C2. Presentation of the principles of electronic data interchange (EDI) in the logistics chain, its use in the cargo transport.
C3. Presentation and provide knowledge on the use of computer simulation to solve problems in the area of logistics interests.
C4. The introduction to the subject of information systems and other tools used to managing a warehouse, a shipping and transport company
C5. Teaching work in a group in the implementation of selected projects

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has an extended knowledge of the latest IT solutions supporting management of transport enterprise and fleet.
PEK_W02 - The student has a basic knowledge of the use of computer simulation methods to solve problems in the area of transport and logistics.
PEK_W03 - The student has the ability to use computer tools for modeling transport systems.

II. Relating to skills:
PEK_U01 - The student is able to use computer tools for analysis, rating and improvement existing technologies in the area of the enterprises in the TSL.
PEK_U02 - The student is able to perform the model of logistics process using the tools to develop a computer simulation (Flexsim Software).

III. Relating to social competences:
PEK_K01 - The student is able to work in a group, organize and plan the way to perform work, can take different roles and functions.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction and presentation of methods for solving common logistics and transportation tasks using spreadsheet and other computer tools 1/3 Issue 1: ABC/XYZ Analysis	2
Proj2	Introduction and presentation of methods for solving common logistics and transportation tasks using spreadsheet and other computer tools 2/3 Issue 1: Demand forecasting methods Issue 2: Solving problems in the area of maintaining inventories and planning the distribution process.	2
Proj3	Introduction and presentation of methods for solving common logistics and transportation tasks using spreadsheet and other computer tools. Presentation of the principles of electronic data interchange (EDI) in the logistics chain and its use in the transport of cargo. 3/3 Issue 1: Mapping of selected logistics and transport processes using BPMN, practical exercises Issue 2: Electronic Data Interchange (EDI) in the logistics chain, its use in the transport of cargo.	2
Proj4	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 1/11 Issue 1: An introduction to the Flexsim Software, object-oriented modeling.	2
Proj5	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 2/11 Issue 1: Programming the basic logic functions, global tables and labels.	2
Proj6	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 3/11 Issue 1: Programming the kinematics of objects.	2

Proj7	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 4/11 Issue 1: Development of the simulation model of the logistics process (eg. warehouse inventory management process, container terminal).	2
Proj8	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 5/11 Issue 1: Development of the simulation model of the logistics process (eg. warehouse inventory management process, container terminal).	2
Proj9	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 6/11 Issue 1: Development of the simulation model of the logistics process (eg. warehouse inventory management process, container terminal).	2
Proj10	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 7/11 Issue 1: Development of the simulation model of the logistics process (eg. warehouse inventory management process, container terminal).	2
Proj11	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 8/11 Issue 1: Sensitivity analysis of the model.	2
Proj12	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 9/11 Issue 1: Sensitivity analysis of the model.	2
Proj13	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 10/11 Issue 1: Interpretation of the results, decision, solution to the problem.	2
Proj14	Logistics and transportation problems solving, using tools for computer simulations (Flexsim Software) 11/11 Issue 1: Interpretation of the results, decision, solution to the problem.	2
Proj15	Examination of the subject	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. problem exercises
N3. self study - preparation for project class
N4. project presentation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Examination of the subject

F2	PEK_U01	Rating of exercises carried out during the course
F3	PEK_U02	Rating of the project
F4	PEK_K01	Rating of involvement in the implementation of group tasks
P = 0,3*F1+0,2*F2+0,4*F3+0,1*F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer aided logistics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1TR_TT_W02, K1TR_W05	C1 - C4		N1 - N5
PEK_U01- PEK_U02	K1TR_U07	C1, C2, C4		N1 - N5
PEK_K01	K1TR_K03	C5		N1 - N5

SUBJECT SUPERVISOR

dr inż. Marcin Plewa tel.: 71 320-23-91 email: marcin.plewa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Niekonwencjonalne systemy transportu towarów**
Name in English: **Unconvencial goods transport systems**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031213**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					30
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the issues presented in the course "History of Transportation", "transport systems" and "Transportation in the cities."
2. Ability to prepare presentation and editing in writing papers on transport systems.
3. no prerequisites for competence

SUBJECT OBJECTIVES

C1. Get to know the unconventional freight systems - advantages, disadvantages and scope of each solution.
C2. Familiar with the problem of social responsibility for the implementation of specific transportation solutions. Acquiring the ability to present the proposed solutions in a manner understandable to the public.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course the student is able to characterize the various unconventional freight systems in terms of their origins and applicability.

II. Relating to skills:
PEK_U01 - As a result of the course the student is able to analyze the impact of the operation of transport systems on social behavior and evaluate the usefulness of a particular system to be implemented in concrete terms.

III. Relating to social competences:
PEK_K01 - As part of the course the student acquires skills in presenting to the public the advantages and disadvantages and the effects of the implementation of specific solutions in the field of transport.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introductory classes, discussion of the issues, the division of topics	2
Sem2	Freight ropeway (cable cars, funicular rail)	2
Sem3	Rail mounted and rack (rail mounted symmetrically and asymmetrically, railways gear)	2
Sem4	Monorails (railways unit, gyro)	2
Sem5	Railways air (atmospheric railway, railway tubular pneumatic post)	2
Sem6	Railways cushion	2
Sem7	Unconventional systems on inland waterways - ramps and other	2
Sem8	Unconventional ways of transporting goods by air - (balloons, airships)	2
Sem9	Unconventional systems freight airport - (highloader, container and pallet transporters air)	2
Sem10	Airport transport systems - (double drum belt conveyors, circular - Rotary, etc.)	2
Sem11	Storage systems change in the direction of the airport shuttle - (Vertisorter, Vertibelt, Diverter, Reverse sorter)	2
Sem12	Purpose and conditions of use of non-conventional systems - network	2
Sem13	Purpose and conditions of use of non-conventional systems - point	2
Sem14	Purpose and conditions of use of non-conventional systems - linear	2
Sem15	The directions of the future development of non-conventional systems - final discussion	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. report preparation
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_K01	preparation of oral and multimedia presentation on a selected topic
F2	PEK_W01, PEK_U01, PEK_K01	prepare to discuss the problem in the form of a written report
F3	PEK_U01, PEK_K01	assessment of active participation in discussions on the analyzed topics
P = 0,33*F1+0,33*F2+0,34*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Schneigert Z.: Koleje niekonwencjonalne. WKŁ Warszawa 1971[2] Bahke E.: Systemy transportowe dziś i jutro. WKŁ Warszawa 1977

SECONDARY LITERATURE
[3] miesięcznik Świat Kolei[4] miesięcznik Technika Transportu Szynowego[5] miesięcznik Autobusy - Technika, Eksploatacja, Systemy Transportowe

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Unconvencial goods transport systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_TT_W03, K1TR_W13	C1	Se1-Se15	N1,N2,N3
PEK_K01	K1TR_K06, K1TR_K08	C2	Se1-Se15	N1,N2,N3
PEK_U01	K1TR_U01, K1TR_U16, K1TR_U20	C2	Se1-Se15	N1,N2,N3

SUBJECT SUPERVISOR

dr inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Procesy transportu towarowego**
Name in English: **Freight transport processes**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031214**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Znajomość zagadnień przedstawianych w ramach kursów "Środki transportu", "Infrastruktura transportu", "Teoria ruchu pojazdów", "Podstawy inżynierii ruchu", "Ekonomika transportu towarowego"
2. The ability to use optimization methods presented in the course "Operations Research".
3. no requirements for the competence

SUBJECT OBJECTIVES

C1. Purchase of goods for process design skills using appropriate methods and algorithms.
C2. Knowledge of methods of assessment and analysis of freight transport processes.
C3. Familiar with the principles of minimizing the impact of noise on the implementation of the freight transport processes.
C4. Achieving an ability to select the vehicle to transport task.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Following the course, the student should be able to describe the issues related to the design and implementation of transport processes in relation to the carriage of goods.
PEK_W02 - As a result of the course the student has knowledge and is able to propose suitable metrics to define the basic quantities characterizing the transport processes in the transport of goods.

II. Relating to skills:
PEK_U01 - Following the course, the student should be able to choose the characteristics of the vehicle to the needs of the constructed transport offer (goods).
PEK_U02 - As a result of the course the student will be able to design the transportation process.

III. Relating to social competences:
PEK_K01 - As part of the course the student acquires knowledge of legal implications of the creation of engineering studies at the tender specification.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Determining the travel time (choice of traction to the transport task, the method for determining the driving time: measurements, calculations, projections, sales and technical stops in different transport systems, technical intervals).	3
Lec2	Construction schedules (tabular timetable and traffic chart; construction traffic graph; auxiliary graphs busy infrastructure services schedule, reducing working time circuit diagram RS). Order an ad-hoc basis.	3
Lec3	Organization of cargo handling (call direct - and indirect p2p - Hub & Spoke, expected confidence interchange; types of transfers; efficiency hubs).	3
Lec4	The implementation of the transport of goods. Cyclic schedules (lots) of vehicles (airplanes) stores. The cyclic schedule and ad hoc connection. Adapting to the needs of the transport infrastructure.	3
Lec5	Disruption to traffic (traffic congestion, disruption to rail and air, noise propagation analysis, methods to prevent interference, dispatching; compensation for principal).	3
Lec6	Parametric analysis of the processes of freight (cargo characteristics, measurement and quality analysis, analysis of business dyspozytury, short- and long-term forecasting of demand).	3
Lec7	Reminder messages graphs (graph and its elements, directed and undirected graphs, cost and bandwidth nodes and branches, basic graph algorithms: shortest path, minimum spanning tree, maximum throughput).	3
Lec8	Graph algorithms for practical applications (search for connections in freight transport, traveling salesman problem, the use of classical algorithms and their adaptation to the actual limit).	3
Lec9	Transport process model (model grafowy elements of the process, modeling critical paths, Petri nets, simulation models).	3
Lec10	Final test	3
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction to classes. Inventory Organizer transport requirements and the needs of shipping companies.	3
Proj2	Designing routes for using graph-algorithms.	3
Proj3	Designing traffic chart (technical assumptions, assumptions commercial, conflict of access to infrastructure).	3
Proj4	Chart analysis of traffic due to the additional conditions (constraints at work, transport circuits, the organization handling).	3
Proj5	Class Settlement (show measurement results, discussion of results).	3
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. case study
N3. problem discussion
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01	Average ratings of the various stages of the project
F2	PEK_U01, PEK_U02, PEK_K01	activity in the discussion during the project
P = 0,8*F1+0,2*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Marcinkowski J.: Systemy transportowe. Środki transportu. Politechnika Wrocławska, Wrocław 1988.
[2] Tarski I.: Czynnik czasu w procesie transportowym. WKŁ, Warszawa 1976.
[3] Neider J.: Transport międzynarodowy. PWE Polskie Wydawnictwo Ekonomiczne, 2011.
[4] Kacperczyk R.: Transport i spedycja. Transport. Część 1. Difin Centrum Doradztwa i Informacji, 2009.

SECONDARY LITERATURE
[5] Korzan B.: Elementy teorii grafów i sieci. Metody i zastosowania. WNT, Warszawa 1978.
[6] Malarski M.: Inżynieria ruchu lotniczego. Oficyna Wydawnicza Politechniki Warszawskiej, 2006.
[7] Komar Z., Wolek Cz.: Inżynieria ruchu drogowego. Wybrane zagadnienia. Politechnika Wrocławska, Wrocław 1994.
[8] Cormen T. H., Leiserson Ch. E., Rivest R. L.: Wprowadzenie do algorytmów. WNT, Warszawa 1997 i in.
[9] Sysło M. M., Deo N., Kowalik J. S.: Algorytmy optymalizacji dyskretnej. PWN, Warszawa 1995.
[10] Wyrzykowski W.: Ruch kolejowy (tom I - ruch pociągów). WKŁ, Warszawa 1966.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Freight transport processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1TR_W10	C1, C3	Wy1-Wy9	N1
PEK_W02	K1TR_W12	C2	Wy4, Wy5, Wy8, Wy9	N1
PEK_U01	K1TR_TT_U01, K1TR_U12	C1, C4	Pr1-Pr5	N2-N5
PEK_K01	K1TR_K02, K1TR_K09	C4	Pr1-Pr5	N3, N4
PEK_U02	K1TR_TT_U02, K1TR_TT_U03, K1TR_U08	C1, C2, C3	Pr1-Pr5	N2-N5

SUBJECT SUPERVISOR

dr inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo transportu towarowego**
Name in English: **Freight Transport Security**
Main field of study (if applicable): **Transport**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **TRM031215**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the traffic engineering of automotive vehicles
2. Knowledge of transport infrastructure
3. Basics of designing of means of transport

SUBJECT OBJECTIVES

C1. To acquaint the participants with factors affecting safety goods transport and materials handling safety
C2. Understanding the basic knowledge of the transport of goods and materials handling
C3. To acquaint the participants with the basic concepts of rescue system in land transport

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge about the factors affecting on safety freight transport
PEK_W02 - Has knowledge of traffic engineering, control and management of transport systems
PEK_W03 - He has knowledge of developments in freight transport systems

II. Relating to skills:
PEK_U01 - Can obtain information from literature, databases, engineering standards and other sources, can integrate the information, make their interpretation, and draw conclusions
PEK_U02 - Can make a critical analysis of means and transportation systems due to the criteria

III. Relating to social competences:
PEK_K01 - Student is aware of the legal action taken as an engineer
PEK_K02 - Is aware of the importance, responsibility and impact of activities in the transport engineerin

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification of freight by different institutions. Hazard analysis on the transported freight. The forces acting on freight in different situations. Protection of freight and the methods of protection used in the road and rail transport	2
Lec2	The forces acting on the vessel under the influence of waves, the principle of loading because of the stability, the rules ballast of ships, protection of containers and other cargo and vehicles on vessels	2
Lec3	The dangerous cargo, hazard, designation, rules for transporting of hazardous materials by road (ADR) and rail (RID, SMGS Appendix No. 2)	2
Lec4	Rules of safe transport of inland waterway transport (ADN), The conventions and international regulations (IMDG, etc.). Rules for safe transport of by air (ICAO)	2
Lec5	Engineering solutions and equipment of road vehicles influencing an increase of safety during the transport of goods and people, the statistics of road accidents and their causes. Actions to increase the safety of transport on the road.	2
Lec6	Passive safety of materials handling. The basic requirements of European standards (EN) and international (ISO) and Office of Technical Inspection (UDT) in the design, manufacture and operation materials handling (UTB) Examples of safe design solutions UTB	2
Lec7	The organization and system evaluation of emergency in road transport in Poland	2
Lec8	Active safety handling. The basic requirements of standards and regulations UDT in the operation and construction safety equipment UTB. Basic safety equipment UTB - general construction diagrams. Examples of design solutions UTB	2
Lec9	The calculation of the forces acting on the vehicle and the freights in different situations: acceleration, braking, ride the curve of the road, wheel slip.	2

Lec10	The forces acting on rail vehicle and the freights in different situations: braking, collision. Protection, road safety on the curved track, critical velocity of traffic	2
Lec11	Rules of rational selection of protective measures in road transport freight. Friction as a factor that contributes to the safety of cargo protection	2
Lec12	Cargo carrying capacity, stability (center of gravity, the curve of righting lever, stability criterion by the PRS or IMO)	2
Lec13	Rules for selection of isothermally and refrigerating means of transport. The safety of perishable freight	2
Lec14	Analysis of transport possibilities containers for the specified part of the inland waterway (the number of containers, weight, number of layers)	2
Lec15	Description of the procedure in the event of a dangerous situation in land transport and analysis of hazards during transportation of hazardous materials	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	The test of the brake system. Effect of weight distribution on the braking process	2
Lab2	The test of chassis frame and the geometry of the vehicles. Criteria for assessment the geometry of the chassis vehicles	2
Lab3	Test and identification of road wheels vehicle. Determination of vehicle traction performance	2
Lab4	Evaluation of electromechanical and strain gauge type capacity limiter of the overhead traveling crane	2
Lab5	Evaluation of laser protection system lever against railway collision	2
Lab6	Evaluation of electronic protection system of handling machine against loss of stability	2
Lab7	Analysis of vehicle load and method of loading the goods	2
Lab8	Stability test of vehicle for the transport of goods during the curvilinear motion	2
		Total hours: 16

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_W02, PEK_W03	final test

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02	short test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Przepisy instytucji klasyfikacyjnych PRS, IMO, Przepisy Reńskie.
[2] Jóźwiak Z., Kierzkowski A., Kulczyk J., Kwaśniowski S.: Transport ładunków nie-bezpiecznych. Seria Navigator nr 23. Ofic. Wyd. Pol. Wroc. Wrocław 2012 (w przy-gotowaniu).
[3]Jerzy Wicher, „Bezpieczeństwo samochodów i ruchu drogowego”, Wydawnictw Ko-munikacji i Łącznośći, Warszawa 2001
[4] Grabowski E. – Artykuły nt. metod i technik ograniczania zukosowania dźwignic to-rowych w kwartalniku „Transport Przemysłowy” w latach 2001-2002
[5] Norma EN 13001-1:2007 – Bezpieczeństwo dźwignic. Ogólne zasady projektowania. Część 1 – Postanowienia ogólne i wymagania
[6] P.A. Wrzecioniarz, W. Ambroszko, A. Górniak - Energy Efficient design of powertrain and body, PWr, 2011

SECONDARY LITERATURE
[1] Grzegorczyk K, Buchcar R.; Towary niebezpieczne Transport w praktyce. Wyd.ADeR Błonie 2009
[2] Różycki M., Kędzior J.: Zabezpieczenie ładunków. Mikołów. 2007
[3] ATP – Umowa o międzynarodowych przewozach szybko psujących się artykułów żywnościowych o specjalnych środkach transportu do tych przewozów. Dz. U. nr 49, poz. 254 z 26 października 1984 r wraz z późn. zm.
[4] RID Regulamin dla międzynarodowego przewozu kolejami towarów niebezpiecz-nych. Aneks I do Załącznika B Umowy CIM wchodzącej w skład Konwencji COTIF. Wersja obowiązująca od 1 styczeń 2004 . Wyd. PKP Cargo S.A. Warszawa 2007
[5] ADN – Umowa europejska dotycząca międzynarodowego przewozu śródlądowymi drogami wodnymi towarów niebezpiecznych (ADN) Dz. U. nr. 235 , poz. 1537, z dnia 13 grudnia 2010 r.
[6] ADR Umowa europejska o przewozach drogowych materiałów niebezpiecznych. Dz. U. nr 30, poz. 287 z dn.6 czerwca 1975 z późn. zm. Wersja z 1 stycznia 2009 r.
[7] Ciećkiewicz J., Benin-Goren O., Guła P., Krzowski K., Nakonieczny S., NiteckiJ., Ratownictwo medyczne w wypadkach masowych. Górnicki Wydawnictwo Medyczne 2005.
[8] Vershoof J. - Cranes. Design, Practice and Maintenance. Professional Engineering Publishing Limited, London &Bury St. Edmonds 2000
[9] Antoniak J. – Urządzenia i systemy transportu podziemnego w kopalniach. Wyd. „Śląsk” Katowice 1990
[10] Przepisy UDT – Warunki techniczne dozoru technicznego. Dźwignice i przenośniki. Wymagania ogólne. DT-DE/WO
[11] Materiały firmy WABCO, KNORR

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Freight Transport Security
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1TR_TT_W01, K1TR_TT_W02, K1TR_TT_W03	C1, C2, C3	Lec1-Lec15	N1
PEK_U01, PEK_U02	K1TR_U01, K1TR_U10	C1, C2, C3	Lab1-Lab8	N2, N3
PEK_K01, PEK_K02	K1TR_K02, K1TR_K09	C1, C2, C3	Lec1-Lec15, Lab1-Lab8	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Karol Jaśkiewicz tel.: 21-72 email: karol.jaskiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja transportu**
Name in English: **Transport Automation**
Main field of study (if applicable): **Transport**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of automation confirmed by completion of relevant course at university level
2. Has basic knowledge of means of transport confirmed by completion of relevant course
3. Has basic knowledge of theory of vehicle motion confirmed by completion of relevant course

SUBJECT OBJECTIVES

C1. To gain knowledge of automation of transport means and transport systems
C2. To gain skills in analysis and skills of correct interpretation of the results of experimental studies of automation layouts of transport means and transport systems
C3. To consolidate competence in the following areas: thinking and acting creatively and the ability to determine appropriate priorities for to achieve specific purpose

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has basic knowledge of the components of control systems used in transport means and transport systems
PEK_W02 - has knowledge of construction and principles of operation of typical automation systems used in far transport means and systems
PEK_W03 - has knowledge of construction and principles of operation of typical automation systems used in material handling equipment and systems

II. Relating to skills:
PEK_U01 - is able to elaborate the results of experimental tests of automation systems used in a transport
PEK_U02 - is able to correctly interpret the results: experimental tests and diagnostic of automation systems used in transport

III. Relating to social competences:
PEK_K01 - has well established competence to think and act creatively
PEK_K02 - has well established competence in determining the appropriate priorities in order to accomplish a specific task

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introduction to automation systems for transport	2
Lec2	Sensors in automation systems for transport means. Temperature sensors. Proximity transducers	2
Lec3	Sensors in automation systems for transport means. Sensors of linear and angular displacement. Speed and acceleration sensors.	2
Lec4	Sensors in automation systems for transport means. Sensors for measurement of forces, moments, pressures and flows.	2
Lec5	Controllers and operator panels in automation systems of transport means and their programming	2
Lec6	Microcontrollers in automation systems of transport means and their programming	2
Lec7	Typical communication standards used in transport vehicles and handling systems	2
Lec8	Navigation systems used in transport means	2
Lec9	Automation in vehicles used for loading and unloading of materials	2
Lec10	Automation of warehouse transport	2
Lec11	Handling automation	2
Lec12	Automation in road transport	2
Lec13	Automation in means and rail transport systems	2
Lec14	The selected automation systems for air transport and marine	2
Lec15	Automatic traffic control systems	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Health and Safety Training. Selection of elements and programming of the control system of working machine manipulator.	3
Lab2	Programming of an example of operator panel of transport vehicle	2
Lab3	Experimental studies of control system of robot used for ropeway's rope diagnostics	2
Lab4	The investigation of the new generation's mechatronic steering system for articulated vehicle	2
Lab5	Experimental studies of an automatic scooping system of industrial vehicle	2
Lab6	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab7	Examination of jib crane monitoring system	2
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4. report preparation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03, PEK_K01÷PEK_K02	written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U02, PEK_K01÷PEK_K02	laboratory reports, short tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] A. Adamski: Inteligentne systemy transportowe: sterowanie, nadzór i zarządzanie. UWND AGH, 2003r. [2] J. Dyduch, M. Pawlik: Systemy automatycznej kontroli jazdy pociągu. Oficyna Wydawnicza Politechniki Radomskiej, 2002r. [3] A. Herner: Elektronika w samochodzie. WKiŁ, 2001r. [4] Z. Korzeń: Logistyczne systemy transportu i magazynowania. Tom I i II. Instytut Logistyki i Magazynowania, 1998r. [5] M. Lesko, J. Guzik: Sterowanie ruchem drogowym. Wydawnictwo Politechniki Ślaskiej, 2000r. [6] J. Narkiewicz: GPS - Globalny system pozycyjny. WKiŁ, 2003r.

SECONDARY LITERATURE
[1] J. Sołdek: Automatyzacja statków. Wydawnictwo Morskie, 1985r. [2] S. Bociek, J. Gruszecki: Układy sterowania automatycznego samolotem. Oficyna Wydawnicza Politechniki Rzeszowskiej, 1999r. [3] R. Pełka: Mikrokontrolery - architektura, programowanie, zastosowania. WKiŁ, 2000r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Transport Automation
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_W05	C1	Lec1÷Lec8	N2, N5
PEK_W02	K2TR_W05	C1	Lec9÷Lec11	N2, N5
PEK_W03	K2TR_W05	C1	Lec12÷Lec15	N2, N5
PEK_U01	K2TR_U03	C2	La1÷La7	N1, N2, N3, N4
PEK_U02	K2TR_U03	C2	La1÷La7	N1, N2, N3, N4
PEK_K01	K2TR_K01	C3	Lec1÷Lec7, La1÷La7	N1, N2, N3, N4, N5
PEK_K02	K2TR_K03	C3	Lec1÷Lec7, La1÷La7	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Andrzej Kosiara tel.: 71 320-23-46 email: Andrzej.Kosiara@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania MES**
Name in English: **Basics of FEM.**
Main field of study (if applicable): **Transport**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Physics, Mechanics, Fundamentals of the strength of materials.
2. Knowledge of engineering materials
3. Conducting basic strength analysis in elastic strain range.

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the basics of the theory of finite element method.
C2. Acquiring the ability to design a suitable model for FEM calculations.
C3. Acquisition of the ability to undertake the strength calculations using FEM.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Theoretical basis of the finite element method.
PEK_W02 - Principles of the construction of numerical models (geometry and discrete) for FEM calculations.
PEK_W03 - One has the knowledge about the possibilities of the use of FEM.

II. Relating to skills:
PEK_U01 - One can independently use the FEM software
PEK_U02 - One can design an adequate object and discrete geometric model and properly define the boundary conditions.
PEK_U03 - One can perform the calculation in terms of statics analysis and interpret the obtained results

III. Relating to social competences:
PEK_K01 - Student acquires teamwork skills.
PEK_K02 - One thinks and works in a creative way
PEK_K03 - Student deliberately takes some actions and knows their consequences

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the theory of FEM and its application examples	1
Lec2	Function approximation, finite element types (classification), the conditions for convergence	2
Lec3	Finite elements - 3D (tetra)	2
Lec4	Rod finite elements, their links	2
Lec5	Finite elements for frames, the stiffness matrix deriver	2
Lec6	2D FE; plate, plate-stress, shell	2
Lec7	Methodology of FE modelling	2
Lec8	FEM numerical analyses	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Overview of laboratory classes. Introduction to dedicated software.	1
Proj2	Principles of construction of solid models (geometry simplification, the use of symmetry).	2
Proj3	Principles of construction of shell models. Effect of the accuracy of the results.	2
Proj4	Modeling the joint knuckle, welded, riveted.	2
Proj5	Modeling the spatial framework, simplifying the construction and models.	2
Proj6	Structure modeling of thin-walled cylindrical, spherical and conical structures, the use of symmetry.	2
Proj7	Analysis of vibrations, elastic stability (buckling) of thin-walled structures.	2
Proj8	Development of a simple shell model and its strength analysis.	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. project presentation
N3. multimedia presentation
N4. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	writing or oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	evaluation of the computational part of the project, oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Rusiński E., Metoda elementów skończonych. System COSMOS/M, WKiŁ Warszawa 1994
Rusinski E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE
Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wyd. PWr Wrocław 2002
Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005
Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of FEM.
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_W01, K2TR_W08	C1, C2	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7, Wy8	N3, N4
PEK_W02	K2TR_W02	C2, C3	Wy1, Wy7, Wy8	N3, N4
PEK_W03	K2TR_W08	C2, c3	Wy1, Wy7, Wy8	N3, N4
PEK_U01	K2TR_U03, K2TR_U04	C1, C2, C3	Pr1, Pr2, Pr3, Pr4, Pr5, Pr6, Pr7	N1
PEK_U02	K2TR_K01, K2TR_U10, K2TR_U13	C2, C3	Pr1, P2, Pr3, Pr4, Pr5, Pr6, Pr7	N1
PEK_U03	K2TR_U06, K2TR_U10, K2TR_U13	C2, C3	Pr8	N2
PEK_K01	K2TR_K03, K2TR_K04	C2, C3	Pr1, Pr2, Pr3, Pr4, Pr5, Pr6, Pr7, Pr8	N1
PEK_K02	K2TR_K01	C2, C3	Pr6, Pr7, Pr8	N1
PEK_K03	K2TR_K02	C2, C3	Pr6, Pr7, Pr8	N2

SUBJECT SUPERVISOR

dr inż. Jacek Karliński tel.: 71 320-29-46 email: jacek.karlinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika stosowana**
Name in English: **Applied Mechanics**
Main field of study (if applicable): **Transport**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041007**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1. Mathematical analysis (differential and integral calculus).
2. Linear algebra (matrices, determinants), geometry, trigonometry.
3. Mechanics I & mechanics II in the range of I level study.

SUBJECT OBJECTIVES

C1. C1. Knowledge of analytical methods for the application of Lagrangian mechanics in the dynamics of mechanical holonomic systems (for systems with constrains depending and not depending from time). Knowledge of vibration analysis of linear holonomic conservative systems with many degrees of freedom.
C2. Knowledge of dynamics of the rotation about a fixed point for gyroskope motion (Simplified approach). Elementary knowledge of collision theory of mass particles (elastic & nonelastic collision).
C3. Skill of individual analysis of complex mechanical systems with holonomic constrains which are not depend on time to determine : differential equations of motion, natural vibration frequency spectrum, the modal matrix. Dynamic analysis of the rotation about a fixed point & gyroskopic motion.
C4. Acquirement and consolidation of social competences containing emotional intelligence based on skills of co-operation in student group in order to efficiently solve the problem. Responsibility, honesty and fairness in behaviour, observance of customs obligatorey in of customs in academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Discrete system of masses particles with holonomic constrains. Real & virtual displacements, General equation of dynamics & the virtual work principle.
PEK_W02 - Generalized Coordinates, Constraints & Degrees of Freedom. Generalized Forces, Inertia Forces. Lagrange's Equations I i II type.
PEK_W03 - The central equation of dynamics & and Hamilton's rule. Virtual work principle. He has elementary knowledge about gyroskopic motion & collision theory.

II. Relating to skills:
PEK_U01 - He can apply the virtual work principle and d'Alembert' rule for holonomic structures.
PEK_U02 - He can derive the equations of motion for discrete systems using Lagrange's Equations I i II type & Energy conservation principle for holonomic structures.
PEK_U03 - He can determine spectrum frequency eigenvalues & modal matrix for discrete linear system of masses particles. He can analize gyroskopic motion & collision theory. He can calculate gyroskopic moment and reaction forces in supports. He is able to calculate collision coefficients in case of inelastic collision.

III. Relating to social competences:
PEK_K01 - He is able to search information and analyse them critically.
PEK_K02 - He is able to objectively evaluate arguments and rationally explain and justify his own point of view.
PEK_K03 - He is able to observe customs and rules obligatory in academic society.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Constrains classification (holonomic constraints), virtual velocities & virtual displacements.	2
Lec2	Fundamental problem of dynamics, virtual displacements, ideal constraints, general dynamics equation, virtual work principle.	2
Lec3	General dynamics equation in case of Rotational & Plane Motion (examples).	2

Lec4	Generalized coordinates. Derivation of differential equations of motion on the basis of energy conservation law expressed in generalized coordinates (examples).	2
Lec5	Generalized forces. Configuration space. Lagrange's equations (of II type).	2
Lec6	Lagrange's equations (continuation - examples of application). Lagrange's function.	2
Lec7	Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	2
Lec8	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes.	2
Lec9	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom.	2
Lec10	Dynamics of rigid body in general motion, assumptions, frame of problem. Kinematics & dynamics of motion over a fixed point (reminder fro Mechanics II), angular momentum in general motion.	2
Lec11	Dynamics equations in general motion & motion over a fixed point for rigid body (Euler's equations).	2
Lec12	Gyroscopic motion (simplified approach).	2
Lec13	Outline of collision theory of linearly elastic particles, coefficient of inelastic collision.	2
Lec14	Variational formulation of Lagrange's mechanics.	2
Lec15	Central Lagrange's equation. Fundamental integral rule of mechanics (Hamilton's rule).	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Introduction. Working out of equations dealing with real velocities & virtual displacements.	2
Cl2	Solution of statical problems by means virtual work principle.	2
Cl3	Solution of dynamical tasks by means of general dynamics equation (d' Alembert' rule).	2
Cl4	Working out of differential motion equations on the basis of principle of energy conservation and Lagrange's equations (comparison of methods & results for the sets with 1 & 2 freedom degrees).	2
Cl5	Free vibrations of conservative systems with two degrees freedom: natural frequencies, modal matrices, mode shapes.	2
Cl6	Solution of tasks concerning kinematics & dynamics rotation of rigid body over fixed point.	2
Cl7	Crediting test.	2
Cl8	Credits. Improvement of marks.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	Crediting test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	Crediting test.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. B. Gabryszewska, A. Pszonka, „Mechanika", cz.II, Kinematyka i dynamika, PWr , 1988,
2. J. Zawadzki, W. Siuta, „Mechanika ogólna", PWN, Warszawa 1971,
3. B. Skalmierski, „Mechanika", PWN, Warszawa 1982,
4. Ferdinand Beer, E. Russell Johnston, Jr., Phillip Cornwell, Vector Mechanics for Engineers: Dynamics (SI), (Lehigh University, University of Connecticut, Rose-Hulman Institute of Technology), McGraw-Hill, London 2013.

SECONDARY LITERATURE
1. M. Kulisiewicz, St. Piesiak, „Metodologia modelowania i identyfikacji mechanicznych układów dynamicznych", PWr. 1994,
2. J. Leyko , „Mechanika ogólna", WNT, Warszawa 1980,
3. J. Giergiel, „Mechanika ogólna", WNT, Warszawa 1980.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Applied Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2TR_W02	C1, C2	Lec1 to Lec15	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K2TR_U11	C3	Cl1 to Cl8	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2TR_K02	C4	Lec1 to Lec15, Cl1 to Cl8	N1, N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy teleinformatyczne**
Name in English: **IT systems in transport**
Main field of study (if applicable): **Transport**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. One has knowledge of the basic structure of a computer for home use.
2. One uses Internet resources, and specialized software (such as AutoCAD, Matlab).

SUBJECT OBJECTIVES

C1. Understanding the principles of the latest communication technologies, particularly for transport.
C2. Understanding the principles of global communication networks.
C3. Understanding the basic data communications protocols, used in transport.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Explains the principle of the latest communication technologies, particularly for transport.
PEK_W02 - Explains the principle of operation in the global communications network.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - He can think and act in a creative and entrepreneurial, using the latest communication technologies.
PEK_K02 - One understands the need for the formulation and communication to the public - with the use of ICT - information and opinions on the performance of transport.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Servers for service.	2
Lec2	PSTN network.	2
Lec3	ISDN network.	2
Lec4	1st an 2nd mobile phone generations: GSM, UMTS.	2
Lec5	4th generation systems: LTE, WiMAX.	2
Lec6	Multimedia satellite systems.	2
Lec7	Satellite navigation systems (GLONASS, GPS).	2
Lec8	Intelligent Urban Traffic Control systems.	2
Lec9	Security of ICT systems.	2
Lec10	Introduction to TCP/IP protocol.	2
Lec11	IPv4 addressing.	2
Lec12	IPv6 addressing.	2
Lec13	Ethernet.	2
Lec14	WiFi network.	2
Lec15	Trends in ICT.	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. problem discussion
N3. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Exam
F2	PEK_W02	Exam
P = 1/2F1+1/2F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Silberschatz A., Peterson J. L., Gagne G., Podstawy systemów operacyjnych, Wydawnictwa Naukowo Techniczne, Warszawa 2005.
[2] Stevens W. R., Biblia TCP/IP. Tom 1. Protokoły, Wydawnictwo RM, Warszawa 1998.
[3] Sportack M. A. Podstawy Adresowania IP. Mikom, Warszawa 2008.
[4] Bradford R., Podstawy Sieci Komputerowych. WKiŁ, Warszawa 2009.
[5] Global Positioning System. http://www.gps.gov.
[6] Naval Oceanography Portal. http://www.usno.navy.mil/USNO/time/gps/current-gps-constellation.
[7] Telematyka Transportu, http://www.it.pw.edu.pl/twt/loader.php?page=telematyka.
[8] Jamroz K., Oskarbski J., Zarządzaniem Bezpieczeństwem Ruchu Drogowego w systemi TriStar. Gambit 2006.

SECONDARY LITERATURE
[1] University of Minnesota ITS Institute. http://www.its.umn.edu.
[2] Bartczak K. Scenariusze rozwoju ITS w polskim transporcie drogowym w latach 2008-2013 cz.1. Przegląd ITS, nr 1

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
IT systems in transport
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_W11	C1	Wy2 Wy3 Wy6 Wy10 Wy 12 Wy13 Wy14	N3
PEK_W02	K2TR_W12	C2	Wy4 Wy5 Wy6 Wy7 Wy10 Wy 11 Wy12 Wy13 Wy14 Wy15	N2 N3

PEK_K01	K2TR_K01, K2TR_K04	C1 C2 C3	Wy1 Wy2 Wy3 Wy4 Wy5 Wy6 Wy7 Wy8 Wy9 Wy10 Wy11 Wy12 Wy13 Wy14 Wy15	N1 N2 N3
PEK_K02	K2TR_K02, K2TR_W10	C1 C2 C3	Wy1 Wy2 Wy3 Wy4 Wy5 Wy6 Wy7 Wy8 Wy9 Wy10 Wy11 Wy12 Wy13 Wy14 Wy15	N1 N2 N3

SUBJECT SUPERVISOR
dr inż. Radosław Wróbel tel.: 71 347-79-18 email: radoslaw.wrobel@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy transportu wodnego i rurociągowego**
Name in English: **Water transport systems and pipelines**
Main field of study (if applicable): **Transport**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041011**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ordered knowledge of the management of transportation systems.
2. Ordered knowledge of the construction and operation of transport means.

SUBJECT OBJECTIVES

C1. Understanding the principles and organization of the maritime transport, inland navigation and pipeline transportation.
C2. Understanding the relationship between the weather, the hydro conditions and organization's policies of inland navigation.
C3. Transport task scheduling skills using water transport system.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Recognizes factors affecting the operating principles of water transport system.
PEK_W02 - Student is able to recognize the impact of external factors on the operation of water transport systems.
PEK_W03 - Identifies and distinguishes the elements and factors affecting the operation of a pipelines system.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Understands the need for continuous training.
PEK_K02 - Recognizes the effects of the technology impact on the environment and related social responsibility of the technique.
PEK_K03 - Can think and act in an entrepreneurial manner.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role and importance of maritime transport in the global economy. Structure and direction of movement of goods to world trade	2
Lec2	Means of transport and loading units in maritime transport	2
Lec3	Classic systems in maritime transport - tramping, liner shipping	2
Lec4	The development of the maritime transport, integrated transport chains	2
Lec5	Impact of harbor infrastructure on development of maritime transport systems	2
Lec6	The rules of operation and management practices in maritime transport operators	2
Lec7	The principles and criteria for selection the voyage route in maritime transport. The assessment methods of the impact of weather conditions on the cost of shipping	2
Lec8	Maritime transportation system in Poland	1
Lec9	Inland navigation, its role in the transport system of the EU and Poland	2
Lec10	Inland transportation system - the pushed system	2
Lec11	Trends in the development of inland water transport systems in the EU and selected worldwide countries	2
Lec12	Effect of hydrotechnical parameters on the system and costs in inland waterway transportation	2
Lec13	Integrated waterway transportation - combined transportation, intermodal transportation, multimodal transportation	2
Lec14	Pipeline transportation and its role in trade	2
Lec15	Pipeline transportation systems, costs and safety in the pipeline transportation	2
Lec16	Final test	1
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

W. Rydzykowski, K. Wojewódzka-Król: Transport PWN Warszawa 2007.
B. Wisnicki: Vadwmecum konteneryzacji, Szczecin, 2006.
K. Ficoń: Logistyka morska, Warszawa, 2010.

SECONDARY LITERATURE

K. Wojewódzka -Król, R. Rolbiecki, W. Rydzykowski: Transport wodny śródlądowy, Uniwersytet Gdański, Gdańsk 2007.
Henry Liu: Pipeline Engineering, Lewis Publishers, 2003.
J. Kulczyk, J. Winter: Śródlądowy transport wodny, Politechnika Wrocławska, 2003.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Water transport systems and pipelines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_W05, K2TR_W07, K2TR_W10	C1, C2, C3	Lec1-Lec16	N1, N2
PEK_W02	K2TR_W03, K2TR_W07, K2TR_W10	C1, C2, C3	Lec1-Lec16	N1, N2

PEK_W03	K2TR_W04, K2TR_W07, K2TR_W10	C1, C2, C3	Lec1-Lec16	N1, N2
PEK_K01, PEK_K02, PEK_K03	K2TR_K01, K2TR_K02, K2TR_K03	C1, C2, C3,	Lec1-Lec16	N1, N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jan Kulczyk tel.: 71 320-25-70 email: Jan.Kulczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka systemu transportowego**
Name in English: **Diagnostics of transportation system**
Main field of study (if applicable): **Transport**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041012**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in the field of mechanics and strength of materials.
2. Object knowledge. Physics. Statistics.

SUBJECT OBJECTIVES

C1. Acquiring knowledge of the methods of diagnosing technical state of transportation systems.
C2. Acquiring designing skills, technical implementation, deployment and usage of diagnostic systems in means of transport.
C3. Acquiring of an ability to organize work in a team and to fulfil own specified tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a detailed knowledge in the field of the technical condition of transportation systems.
PEK_W02 - Has detailed knowledge of the methods and techniques used in the diagnosing of the technical state of components of a transportation system.
PEK_W03 - Has a detailed knowledge in the field of latest diagnostic methods and their possible developments in relation to transportation equipment.

II. Relating to skills:
PEK_U01 - Can carry out tests on means of transportation, make reports of these measurements and present the results.
PEK_U02 - Can search information available in the literature in the field of diagnostic tests and apply them for a specific research task.
PEK_U03 - Can carry out research individually and in a development team.

III. Relating to social competences:
PEK_K01 - Can think creatively.
PEK_K02 - Can organize work for others in a project group, as well as fulfil the assigned tasks in the group.
PEK_K03 - Can determine how to perform a research task.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, assessment rules and literature. Initial issues.	2
Lec2	Problems of designing of means of transportation.	2
Lec3	Diagnostic system: components, rules of formulation.	2
Lec4	Diagnozer. Formulation and examples in typical transportation systems.	2
Lec5	Diagnosing of widespread transportation systems.	2
Lec6	Components of a diagnostic system.	2
Lec7	Identification of time-dependable diagnostic parameters.	2
Lec8	Selection of components of diagnostic system.	2
Lec9	Diagnostic algorithms.	2
Lec10	Possiblities for application of common diagnostic tools for specific examples of transportation systems.	2
Lec11	Determination of criteria for evaluation and selection of diagnostic tools for a given transportation system.	2
Lec12	Selection of information system and supporting software tools for typical objects, processes and diagnosed systems .	2
Lec13	Integrated diagnostic system for means of transportation.	2
Lec14	Trends in means of transportation diagnosing.	2
Lec15	Summary of the lectures, discussion of final examination issues, additional explanations.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction to laboratory classes. Presentation of basic diagnostic tools.	2
Lab2	Diagnosing of sliding bearing in a selected transportation device.	2
Lab3	Tests on resonance of elements of driving units in transportation means.	2
Lab4	Evaluation of acoustic danger during operation of transportation means.	2
Lab5	Acoustic diagnosing ofa granular materials screw conveyor unit.	2
Lab6	Differential diagnosing of a driving unit of a roller conveyor.	2
Lab7	Diagnosing of a driving unit of a bucket conveyor.	2
Lab8	Diagnosis of rolling friction nodes in simple transportation systems.	2
Lab9	Application of thermovision in diagnosing of technical state of transporting devices.	2
Lab10	Application of non-destructive testing in diagnosing of technical state of transporting devices.	2
Lab11	Tests on power transmission unit in transporting devices - part I.	2
Lab12	Tests on power transmission unit in transporting devices - part II.	2
Lab13	Diagnosing of technical state of elastic elements used in transportation means.	2
Lab14	Tests on hydraulic drives in transportation means.	2
Lab15	Summary of laboratory classes. Credits.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. traditional lecture with the use of transparencies and slides
N3. laboratory experiment
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Final test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Participation in problem discussions, laboratory classes reports, quizzes.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bartelmus W., Machinery Diagnostics, Surface mining, Slask Publishing House, Katowice, 1998 (in Polish).
[2] Cempel Cz., Vibroacoutic Diagnostics of Machinery. PWN, Warszawa, 1989 (in Polish).
[3] Cempel Cz., Applied DiagnosticsWibroakustyka stosowana. PWN, Warszawa, 1989 (in Polish).
[4] [red.] Żółtowski B., Cempel Cz., Engineering machine diagnostics. WNITE, Radom, 2004 (in Polish).

SECONDARY LITERATURE

[1] Bartelmus W., Condition monitoring of open cast mining machinery. Wroclaw University of Technology Publishing House, Wrocław, 2006.
[2] Przystupa F. W., Diagnosing Process in a evolving technical system. Wroclaw University of Technology Publishing House, Wrocław, 1999 (in Polish).
[3] Radkowski S., Vibroacoustic diagnostics of low-energy failures. WIE, Warszawa-Radom, 2002 (in Polish).
[4] Rao J. S., Vibratory condition monitoring of machines, CRC Press, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diagnostics of transportation system
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_W07, K2TR_W08	C1	Lec1 - Lec15	N1, N2
PEK_W02	K2TR_W07, K2TR_W08	C1	Lec1 - Lec15	N1, N2
PEK_W03	K2TR_W07, K2TR_W08, K2TR_W10	C1	Lec13 - Lec15	N1, N2
PEK_U01	K2TR_U03, K2TR_U04, K2TR_U08	C2	Lab1 - Lab15	N3, N4
PEK_U02	K2TR_U01	C2	Lab1 - Lab15	N3, N4
PEK_U03	K2TR_U02	C2, C3	Lab1 - Lab15	N3, N4

PEK_K01	K2TR_K01	C2	Lab1 - Lab15	N3, N4
PEK_K02	K2TR_K03	C3	Lab1 - Lab15	N3, N4
PEK_K03	K2TR_K01, K2TR_K04	C2, C3	Lab1 - Lab15	N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Franciszek Przystupa tel.: 71 320-21-55 email: franciszek.przystupa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie procesów transportowych**
Name in English: **Transportation processes modelling**
Main field of study (if applicable): **Transport**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of management, designing and testing logistics processes and systems
2. Knowledge of spreadsheet, e.g.Excel
3. Basic knowledge of operations research

SUBJECT OBJECTIVES

C1. Developing the knowledge of the areas of transport systems modeling methodology and transformation of transport processes into mathematical models and simulation
C2. Mastering the skills of planning and designing of logistics systems with special emphasis on tools to support the work of logistics/forwarder
C3. master to problem-solving skills related to the design of random transport processes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has the knowledge of modeling transport processes

II. Relating to skills:
PEK_U01 - Student can obtain information from literature, databases and other sources, including their development, interpretation and critical assessment
PEK_U02 - Student is able to formulate and test hypotheses related to the modeling and design transport elements, processes and systems

III. Relating to social competences:
PEK_K01 - The student able to prioritize appropriately for specific tasks and problems
PEK_K02 - Student can think and act in a creative way

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to modeling. Objectives, possibilities and limitations of modeling. The stages of construction and testing of models.	2
Lec2	Graphical representation methods of transport processes.	2
Lec3	The distribution of flows in transport networks.	2
Lec4	Analytical models of transport processes: forecasting the development of transport systems.	2
Lec5	Dynamic programming.	2
Lec6	Introduction to simulation modeling. Generating pseudo-random numbers.	2
Lec7	Designing and development of the algorithm and simulation program.	2
Lec8	Examples of simulation models for simulating the dynamics of transport processes.	2
Lec9	Collection and analysis of input data for modeling.	2
Lec10	The verification and evaluation of the results of simulations. The model testing.	2
Lec11	Markov processes.	2
Lec12	Introduction to the queuing theory: the process of birth and death.	2
Lec13	Discussion of examples of the queuing theory: systems of M/M/m type without queue.	2
Lec14	Discussion of examples of the queuing theory: systems of M/M/m type with queue.	2
Lec15	Final test.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Discussion of laboratory plan, requirements, terms and conditions of the course completion. Presentation of selected case studies based on newspaper articles.	2

Proj2	Identifying and defining the purpose of modeling, data input, output and model constraints for a given process.	2
Proj3	Traffic chart as a tool to optimize the transport process.	2
Proj4	Modeling transit in a network with limited bandwidth.	2
Proj5	Planning transportation needs in the distribution network.	2
Proj6	Selecting the option of transport process realization - using dynamic programming methods.	2
Proj7	Simulation of passenger travel between points in the network.	2
Proj8	Discussion of the group project, observation of the modeled system, planning the work of the group.	2
Proj9	The choice of modelling method, preparing scheme of the model.	2
Proj10	Construction of the model in a computer program.	2
Proj11	Measurements of the actual system (field work).	2
Proj12	Model verification.	2
Proj13	Model testing.	2
Proj14	A multimedia presentation of the project results.	2
Proj15	Course completion	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for project class
N5. self-study and preparation for the test completion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	evaluation of the written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02, PEK_K01, PEK_K02	evaluation of the tasks carried out in the classroom project
F2	PEK_W01, PEK_U01, PEK_U02	evaluation of the written test
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Chaberek M, Modelowanie procesów i systemów logistycznych.Cz. 1., Wyd. U.G. Gdansk, 20012. Modelowanie systemów i procesów transportowych /Jerzy Leszczyński. Warszawa : Oficyna Wydawnicza Politechniki Warszawskiej, 1999.3. Modelowanie procesów transportowych i logistycznych.Cz. 1 /[red. Dariusz Pyza]. Warszawa : Oficyna Wydawnicza Politechniki Warszawskiej, 2009.4. Modelowanie procesów transportowych i logistycznych.Cz. 2 /[red. Dariusz Pyza]. Warszawa : Oficyna Wydawnicza Politechniki Warszawskiej, 2009.5. Komar Z., Wolek C., Inżynieria ruchu drogowego. Wybrane zagadnienia.,Wydawnictwo Politechniki Wrocławskiej, 1994

SECONDARY LITERATURE

1. Grajewski P., Organizacja procesowa, PWE, 20072. MODELOWANIE PROCESOW TRANSPORTOWYCH : CWICZENIA PROJEKTOWE I LABORATORYJNE /LEON SKOCZYNSKI, IRENA SZCZEPANIK. Warszawa : POLITECHNIKA WARSZAWSKA, 1991.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Transportation processes modelling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_W03	C1	Le.1, Le.2, Le.3, Le.4, Le.5, Le.6, Le.7, Le.8, Le.9, Le.10, Le.11, Le.12, Le.13, Le.14, Le.15	N1, N2, N5
PEK_U01, PEK_U02	K2TR_U01, K2TR_U10	C1, C2, C3	Le.1, Le.2, Le.3, Le.4, Le.5, Le.6, Le.7, Le.8, Le.9, Le.10, Le.11, Le.12, Le.13, Le.14, Le.15, Pr1, Pr2, Pr3, Pr4, Pr5, Pr 6, Pr7, Pr8, Pr9, Pr10, Pr11, Pr12, Pr13, Pr14, Pr15	N1, N2, N3, N4
PEK_K01, PEK_K02	K2TR_K01, K2TR_K03	C2, C3	Pr1, Pr2, Pr3, Pr4, Pr5, Pr 6, Pr7, Pr8, Pr9, Pr10, Pr11, Pr12, Pr13, Pr14, Pr15	N2, N4

SUBJECT SUPERVISOR

dr inż. Anna Jodejko-Pietruczuk tel.: 71 320-28-17 email: Anna.Jodejko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka układów bezpieczeństwa w środkach transportu**
Name in English: **Diagnosis of safety systems in transport**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Protection and Service of Transportation Means**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the construction of transport systems and the function of each of these measures.
2. Ability to exercise independent laboratory, supported by elemental efficiency
manual
3. Ideas for group work and skill of its execution

SUBJECT OBJECTIVES

C1. Knowledge and understanding of the methods of testing and evaluation of security systems in transport.
C2. Understanding the criteria for assessing safety systems in transport.
C3. The ability to draw conclusions, evaluation and interpretation of test results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Learning methods of testing the security systems in transport.
PEK_W02 - Understanding the assessment criteria and parameters characterizing the safety systems.
PEK_W03 - He knows and identifies safety systems in transport.

II. Relating to skills:
PEK_U01 - Able to perform analyzes of selected safety systems in transport
PEK_U02 - Analyzes the results of the tests performed as part of the laboratory
PEK_U03 - Calculates and interprets the results of laboratory tests

III. Relating to social competences:
PEK_K01 - He understands the need for continuous training
PEK_K02 - Is aware of the importance, responsibility and impact of activities in the transport engineering
PEK_K03 - Understand the safety aspects related to the construction of transport

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic information about the ingredients for Road Safety	2
Lec2	Test methods and criteria for assessing the safety of the steering	2
Lec3	Test methods and criteria for assessing the safety of the brake system	2
Lec4	Test methods and criteria for assessing the safety chassis	2
Lec5	Test methods and criteria for assessing outdoor lighting	2
Lec6	Test methods and criteria for evaluation of the support structure of the vehicle	2
Lec7	Test methods and criteria for evaluation of vehicle passive safety	2
Lec8	The development of measurement systems security systems of transport.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Identification of the basic structural units of a motor vehicle	2
Lab2	Studies to determine the parameters and elements of the steering	2
Lab3	Research components and determine the parameters of the braking system	2
Lab4	Studies to determine the parameters of components and chassis	2
Lab5	Studies to determine the parameters of components and lighting	2
Lab6	Evaluation and identification of passive safety	2
Lab7	Testing and assessment of the support structure	2
Lab8	The assessment of the safety of the vehicle	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. report preparation
N5. quiz

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	quiz, a report from the laboratory
F2	PEK_U01, PEK_U02, PEK_U03	quiz, a report from the laboratory
F3	PEK_U01, PEK_U02, PEK_U03	quiz, a report from the laboratory
F4	PEK_U01, PEK_U02, PEK_U03	quiz, a report from the laboratory
F5	PEK_U01, PEK_U02, PEK_U03	quiz, a report from the laboratory
F6	PEK_U01, PEK_U02, PEK_U03	quiz, a report from the laboratory
F7	PEK_U01, PEK_U02, PEK_U03	quiz, a report from the laboratory
F8	PEK_U01, PEK_U02, PEK_U03	quiz, a report from the laboratory
P = (F1+F2+F3+F4+F5+F6+F7+F8)/8		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Kazimierz Sitek, Stanislaw Syta bench testing and diagnostics. Optics, Warsaw, 2011

Integrated safety and comfort. The collective work. Bosch technical information.

SECONDARY LITERATURE

Jerzy Wicher. Vehicle safety and traffic. Optics, Warsaw, 2012.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diagnosis of safety systems in transport
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_BIŚT_K02, K2TR_W07	C1	Wy1 - Wy8	N1, N2
PEK_W02	K2TR_BIŚT_U01	C2	Wy1 - Wy8	N1, N2
PEK_W03	K2TR_BIŚT_W01	C3	Wy1 - Wy8	N1, N2
PEK_U01	K2TR_U03	C1	La1 - La8	N2, N3
PEK_U02	K2TR_BIŚT_U01	C3	La1 - La8	N4, N5
PEK_U03	K2TR_U21	C3	La1 - La8	N4, N5
PEK_K01	K2TR_K02	C1, C2, C3	Wy8, La8	N1, N3
PEK_K02	K2TR_K02	C1, C2, C3	Wy8, La8	N1, N3
PEK_K03	K2TR_W10	C1, C2, C3	Wy8, La8	N1, N3

SUBJECT SUPERVISOR

dr inż. Wojciech Ambroszko tel.: 71 347-79-18 email: wojciech.ambroszko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo środków transportu**
Name in English: **The safety of transport**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Protection and Service of Transportation Means**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of passive and active safety of transport.
2. Knowledge of the transport infrastructure.
3. Skills of individual and group laboratory working.

SUBJECT OBJECTIVES

C1. To gain expanded knowledge of the safety of transport.
C2. To gain knowledge of the description and methods of accident reconstruction.
C3. To acquire the means and methods to improve the safety of transport

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has knowledge of the transportation safety.
PEK_W02 - Is able describes the traffic incidents.
PEK_W03 - Is able to characterize the safety of different means of transport.

II. Relating to skills:
PEK_U01 - Is able to estimate the safety of transport.
PEK_U02 - Is able to describe traffic accident
PEK_U03 - Is able to calculate and analyze obtained results.

III. Relating to social competences:
PEK_K01 - Is able to think and act in a creative and enterprising way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Safety of transport, regulation and standards	2
Lec2	The safety of air transport	2
Lec3	The safety of water transport	2
Lec4	The safety of rail transport	2
Lec5	The safety of road transport	2
Lec6	Hazards in traffic on the basis of statistics of road accidents	2
Lec7	Traffic user as the most common cause of the incidents	2
Lec8	Influence of transport infrastructure on the decision taking	2
Lec9	Characteristics of road accidents	2
Lec10	Problems of reconstruction of road accidents	2
Lec11	Description of road accidents	3
Lec12	Computer Aided accident reconstruction	2
Lec13	Measures taken to improve the safety of transport	2
Lec14	Application of intelligent traffic control to improve safety of transport	3
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Analysis of incidents causes in the transport	2
Lab2	Technical analysis of road accidents	2
Lab3	Reconstruction of road accidents	2
Lab4	Vehicle collisions	2
Lab5	Analysis of reconstructed crossroads with regard to road safety	2
Lab6	Analysis of accident with pedestrian	2
Lab7	Reconstruction of accident with pedestrian	3

	Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. traditional lecture with the use of transparencies and slides N3. problem exercises N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	report, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Prochowski L. et al.: Podstawy rekonstrukcji wypadków drogowych. WKŁ Warszawa 2008
Krystek R. red pracy zbiorowej Zintegrowany system bezpieczeństwa transportu Tom I Diagnoza bezpieczeństwa transportu w PolsceWKŁ Warszawa 2009.
Unarski J., Zębala J.: Zbiór podstawowych wzorów i równań stosowanych w analizie wypadków drogowych. Wydanie 2, Wydawnictwo – Instytut Ekspertyz Sądowych, Kraków 2012
Wicher J.:Bezpieczeństwo samochodów i ruchu drogowego, Wydawnictwo Komunikacji i Łącznośći, Warszawa 2001

SECONDARY LITERATURE

Wierciński J., Reza A.: Wypadki drogowe. Vademecum biegłego sądowego Wydanie 2 uaktualnione, Wydawnictwo – Instytut Ekspertyz Sądowych Krakw 2008
Wach W.: Symulacja wypadków drogowych w programie PC-Crash. Instytut Ekspertyz Sądowych Kraków 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The safety of transport
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2TR_BIŚT_W01, K2TR_BIŚT_W02, K2TR_W07	C1, C2, C3	Lec1-Lec14	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K2TR_BIŚT_U02, K2TR_BIŚT_W01	C1, C2, C3	La1-La7	N3,N4

SUBJECT SUPERVISOR

dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologia napraw środków transportu**
Name in English: **Technology of means of transport repair**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Protection and Service of Transportation Means**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the construction of automotive vehicles
2. Basics of production technology
3. Knowledge of basic methods of automotive vehicles repair

SUBJECT OBJECTIVES

C1. Presentation of technology repair and regeneration of automotive vehicles
C2. Familiarization of students with the methods of measurement and repair techniques of automotive bodies
C3. Presentation technology of chipless forming and machining, regeneration of used surfaces and protective coatings and decorative

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge of the technology for the repair automotive vehicles taking into account the regeneration of its components
PEK_W02 - It has knowledge of the operation, reliability, and means of transpor safety

II. Relating to skills:
PEK_U01 - He can to analyze the possibility of the automotive bodies repair
PEK_U02 - Can obtain information from literature, databases, engineering standards and other sources, can integrate the information, make their interpretation, and draw conclusions

III. Relating to social competences:
PEK_K01 - He can think and act in a creative and entrepreneurial

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Weldability of materials used in the construction of transport	2
Lec2	Methods of welding in the repair technology of means of transport	2
Lec3	Resistance pressure joining and friction welding in the means of transport repair	2
Lec4	Methods for hardfacing and thermal spraying in the repair of machines	2
Lec5	Acceptance testing of welded joints. Quality systems in welding.	2
Lec6	Modern materials used in the construction automotive vehicles	2
Lec7	The methods of measurement and repair techniques of automotive bodies	2
Lec8	Methods for repair of medium and small damage body of a car	2
Lec9	Deformation of vehicles	4
Lec10	Fatique wear of motor vehicles	2
Lec11	Disassembly and assembly of motor vehicles. Cleaning and washing the parts. Methods for cleaning components	2
Lec12	Properties of physicochemical and stereometric of regenerated surface layers of vehicle parts	2
Lec13	Methods for high-speed machining, hard machining, rapid prototyping	2
Lec14	Manufacturing and technological ways to increase the fatigue strength of engine components	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Repair of aluminum constructions welding and soldering methods	2
Lab2	Quality assessment of welded joints, welded and brazed	2
Lab3	Preparation of the measuring position Master Liner	2
Lab4	Measurements of chassis basis points	2

Lab5	Measurements of Mc Pherson points	2
Lab6	Test the quality of the geometrical structure of the cylinder liners for combustion engines	2
Lab7	The wear tests and assessment of suitability for regeneration of selected elements of the combustion engine	2
Lab8	Surfacing and spraying powder on the base of nickel and cobalt	2
		Total hours: 16

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	short test, oral response
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B.Raatz, Nowoczesne technologie pomiarów i napraw karoserii powypadkowych. Troton, 2005
[2] A.Tobota, Naprawy powypadkowe nadwozi a bezpieczeństwo. Nawigator PWr. 1998
[3] Praca zbiorowa pod red. Jana Pilarczyka, Poradnik inżyniera. Spawalnictwo. T2. WNT W-wa 2005r

SECONDARY LITERATURE
[1] Klimpel Andrzej, Napawanie i natryskiwanie cieplne. WNT W-wa 2008r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technology of means of transport repair
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2TR_BIŚT_W03, K2TR_W07	C1, C2, C3	Lec1-Lec14	N1
PEK_U01, PEK_U02	K2TR_BIŚT_U03, K2TR_U01	C1, C2, C3	Lab1-Lab8	N2, N3
PEK_K01, PEK_K02	K2TR_BIŚT_K01	C1, C2, C3	Lec1-Lec14, Lab1-Lab8	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Karol Jaśkiewicz tel.: 21-72 email: karol.jaskiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania nieniszczące**
Name in English: **Non Destructive Testing**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Protection and Service of Transportation Means**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **TRM041120**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		15
Number of hours of total student workload (CNPS)			30		30
Form of crediting			Crediting with grade		Crediting with grade
Group of courses					X
Number of ECTS points			1		1
including number of ECTS points for practical (P) classes			1		1
including number of ECTS points for direct teacher-student contact (BK) classes			0.7		0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the basic mechanical properties of engineering materials, ordered knowledge about the types of metallic materials engineering - their construction, properties, applications and selection rules.
2. Abilities to read and interpret drawings and diagrams used in the technical documentation, abilities to do the technical documentation.

SUBJECT OBJECTIVES

C1. Getting knowledge of non-destructive testing methods used in modern technology.
C2. Getting to know the different methods of NDT: visual, liquid penetrant, magnetic-particle, ultrasonic, radiographic, etc.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student can explain the advantages and limitations of selected methods of non-destructive testing.
PEK_W02 - Student is able to propose a method for non-destructive testing for a structural component or means of transportation(eg car, crane, container extraction, welded, pressure vessels, etc.).
PEK_W03 - Student is able to identify and assess potential risks of detected flaws.

II. Relating to skills:
PEK_U01 - Applying non-destructive testing methods to evaluate selected means of transportation
PEK_U02 - Ability to prepare the protocol of non-destructive examinations.
PEK_U03 - Ability to do selected non-destructive testing and asses its results.

III. Relating to social competences:
PEK_K01 - Ability to explain the results of research and assess them critically.
PEK_K02 - Student can objectively evaluate arguments rationally explain them and justify his point of view using the knowledge of non-destructive testing.
PEK_K03 - Knowing the rules of team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Principles of assessment. Visual examination.	2
Lab2	Liquid penetrant testing	2
Lab3	Magnetic-particle testing	2
Lab4	Radiographic testing	2
Lab5	Ultrasonic testing of welding joints , part 1	2
Lab6	Ultrasonic testing, part II. Assessment the size of flaw by ultrasonic testing.	2
Lab7	Ultrasonic testing of spot welds using 2D arrays. Test grade.	3
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Course consists of the themes in the field of non-destructive testing selected by the teacher. For each class 3 students presents the topic chosen by the teacher. The final evaluation includes: preparation of substantive speaker, the form (quality) of a multimedia presentation, knowledge about the presented topic.	15
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. multimedia presentation
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	short quiz, laboratory report,
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	presentation, participation in discussions
P = F1+F1L		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Non Destructive Testing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2TR_BIŚT_W01, K2TR_BIŚT_W03	C1, C2	La1 - La7	N1,N2
PEK_U01 - PEK_U03	K2TR_BIŚT_U01, K2TR_BIŚT_U03	C1, C2	La1 - La7, Se1	N1-N3
PEK_K01 - PEK_K03	K2TR_K03, K2TR_K04	C1, C2	Se1	N3

SUBJECT SUPERVISOR
dr inż. Marcin Korzeniowski tel.: 42-55 email: marcin.korzeniowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Gospodarka energią w systemach transportowych**
Name in English: **Managing Energy in Transport Systems**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Protection and Service of Transportation Means**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **TRM041121**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		15			15
Number of hours of total student workload (CNPS)		30			30
Form of crediting		Crediting with grade			Crediting with grade
Group of courses					
Number of ECTS points		1			1
including number of ECTS points for practical (P) classes		1			1
including number of ECTS points for direct teacher-student contact (BK) classes		0.7			0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Lack of prerequisites

SUBJECT OBJECTIVES

C1. The issues of energy balance in transport systems.
C2. Renewable and alternative energy sources.
C3. The principles of optimization of transport due to the minimization of cumulative energy consumption.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Getting the skills of balancing energy in transport systems using the methods and mathematical models.

PEK_U02 - Analysis and prediction of the environmental impact of transport systems.

PEK_U03 - Acquisition of literature data and interpretation them properly due to evaluation of energy consumption in transport systems.

III. Relating to social competences:

PEK_K01 - Clear and ethical formation of opinions on transport systems, especially their energy consumption.

PEK_K02 - Work creatively in the management of transport systems, especially in the field of energy management in such systems.

PEK_K03 - Strengthening the responsibility for the own work and get respect for the work and activities of another man.

PROGRAMME CONTENT

Form of classes – Classes		Number of hours
Cl1	Energy consumption of the motor vehicle in the design phase.	2
Cl2	Energy consumption of the motor vehicle in the production process.	2
Cl3	Operational energy consumption of the vehicle driven by internal combustion.	2
Cl4	Operational energy consumption of the vehicle with hybrid drive.	2
Cl5	Effect of recycling on the cumulative energy consumption of the motor vehicle.	2
Cl6	The environmental effect of road transport supply with alternative fuels.	2
Cl7	Optimization of the road transport system due to the cumulative energy consumption.	3
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	The structure of the transport systems.	3
Sem2	Basic and non-conventional sources of energy used in transport systems.	2
Sem3	Energy balance of transhipment and landing.	2
Sem4	Energy balance in land transport (road and rail).	2
Sem5	Energy balance in air transport.	2
Sem6	Energy balance in water transport and hydro-transport.	2
Sem7	Energy economy in transport systems according to the legal requirements.	2
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. self study - self studies and preparation for examination N3. problem exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K02	involvement (class activity) F1 = (A1 + ... + A7) / 7
F2	PEK_U01, PEK_K01	written test
P = 0,4F1+0,6F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_U04; PEK_U04; PEK_K02; PEK_K03	activity in the classroom F1= (A1+…+A7)/7
F2	PEK_K01; PEK_K02; PEK_K03;	Presentation (P) plus report (R) F2 = (P + R) / 2
P = 0,2F1+0,8F8		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Bibrowski Z. Energochłonność skumulowana, PWN 1998
Burniewicz J. i inni Ekonomika transportu. Wydawnictwo Uniwersytetu Gdańskiego 1993
Gronowicz J. Gospodarka energetyczna w transporcie drogowym, Wydawnictwo Politechniki Poznańskiej 2004
Korzeń Zb. Logistyczne systemy transportu i magazynowania, Biblioteka logistyczna 1998
Sala A. Zmniejszenie energochłonności, Wydawnictwo MCNEMT Radom 1993
Sitka W. Energochłonność ruchu samochodów, WNT 1997

SECONDARY LITERATURE

Krawiec F. Odnawialne źrodła energii w świetle globalnego kryzysu energetycznego, DIFIN 2010
Kuciński K. Energia w czasach kryzysu, DIFIN 2006
Neider J. Transport międzynarodowy, PWE 2011
Nowakowski T. Metodyka prognozowania niezawodności obiektów mechanicznych,Oficyna Wydawnicza Politechniki Wrocławskiej 1999.
Prochowski L, Żuchowski A. Technika transportu ładunku, WKiŁ 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Managing Energy in Transport Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2TR_U06	C1, C3	Cl1 to Cl7; Sem1 to Sem7	N1, N2, N3
PEK_U02	K2TR_U09	C2	Cl1; Cl5 to Cl7	N2
PEK_U03	K2TR_U01, K2TR_U03, K2TR_U07	C1, C2, C3	Cl1 to Cl7; Sem1 to Sem7	N2, N3
PEK_K01	K2TR_BIŚT_K02, K2TR_K02	C1, C3	Cl1 to Cl7; Sem1 to Sem7	N1, N2, N3
PEK_K02	K2TR_BIŚT_K01, K2TR_K01, K2TR_K04	C1	Cll7; Sem7	N2, N3
PEK_K03	K2TR_K03	C1, C3	Cl1 to Cl7	N3

SUBJECT SUPERVISOR

dr hab. inż. Zbigniew Sroka tel.: 71 347-79-18 email: Zbigniew.Sroka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Niekonwencjonalne źródła napędu pojazdów**
Name in English: **Unconventional energy sources for motor vehicles**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Protection and Service of Transportation Means**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **TRM041122**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	15
Number of hours of total student workload (CNPS)				30	30
Form of crediting				Crediting with grade	Crediting with grade
Group of courses					
Number of ECTS points				1	1
including number of ECTS points for practical (P) classes				1	1
including number of ECTS points for direct teacher-student contact (BK) classes				0.7	0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the construction and operation of the means of transport, in line with the subject of the means of transport, carried on the transport stage I Wrocław University of Technology Faculty of Mechanical Engineering.
2. Knowledge and skills in accordance with the objects; Ecology and Environment Passenger Transport Freight Transport and implemented at the transport level Wroclaw University of Technology Faculty of Mechanical Engineering.
3. Basic knowledge of technologies and development trends in technology drive modes, rozumieniach essential to social and political conditions and other non-technical engineering activities necessary to the understanding of the social functions of communication in the business.

SUBJECT OBJECTIVES

C1. To deepen the understanding of the operation of the means of transport in the ecology of transport through the acquisition of new knowledge about the development trends and the most important new developments in the field of non-conventional sources of vehicle propulsion.
C2. Expand your knowledge of mathematics and mechanics employed in the implementation of the new techniques used in solving complex engineering tasks in the field of non-conventional sources of vehicle propulsion.
C3. Establish a basic understanding of technologies and development trends in vehicle propulsion technology, necessary to rozumieniach social and political conditions and other non-technical engineering activities necessary to the understanding of the social functions of communication in the business.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Characterize the knowledge of operating modes of transport in the ecology of transport by clarifying new knowledge about the development trends and the most important new developments in the field of non-conventional sources of vehicle propulsion.
PEK_W02 - Show knowledge of mathematics and mechanics used in the implementation of the new techniques used in solving complex engineering tasks in the field of non-conventional sources of power proposed vehicles.
PEK_W03 - Define basic knowledge of the technologies and development trends in vehicle propulsion technology needed to rozumieniach social and political conditions and other non-technical engineering activities in the ecology of transportation, necessary to understand the social functions of communication in the business.

II. Relating to skills:
PEK_U01 - As a result of the course, the student should be able
Analyze knowledge of operating modes in the ecology of transport through the acquisition of new knowledge about the development trends and the most important new developments in the field of non-conventional propulsion of vehicles
PEK_U02 - Apply knowledge of mathematics and mechanics used in the implementation of the new techniques used in solving complex engineering tasks in the field of designing unconventional sources of vehicle propulsion.
PEK_U03 - Use the basic knowledge about the technologies and development trends in vehicle propulsion technology needed to rozumieniach social and political conditions and other non-technical engineering activities needed to understand the social functions of communication in the business.

III. Relating to social competences:
PEK_K01 - A student who has completed the course:
Is aware of the importance and responsibility of action engineer with a master's degree, the direction of transport, in terms of the impact of transportation systems on man and his environment,
PEK_K02 - He can think and act in a creative way. Able to prioritize appropriately to fulfill the given task.
PEK_K03 - He understands the need for the formulation and communication to the public - including through the mass media - the information and opinions on the performance of transport and other aspects of transport engineering; shall endeavor to provide such information and Pets Pets as commonly understood, presenting different points of view.

PROGRAMME CONTENT

Form of classes – Project	Number of hours

Proj1	Analysis and development of construction of the propulsion system of non-conventional sources of power.	2
Proj2	Analysis and development of construction building with unconventional propulsion power source for the selected vehicle.	2
Proj3	The choice selected, unconventional sources of energy consumption in the drive to a predetermined movement of the selected type of vehicle.	2
Proj4	Development of the construction of the propulsion system of non-conventional power source.	2
Proj5	Powertrain design with unconventional power source.	2
Proj6	Project building with unconventional propulsion source for the selected type of vehicle.	2
Proj7	Visualization building with unconventional propulsion source for the selected type of vehicle.	2
Proj8	List of all developed project documentation.	1
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Analysis of means of transport and the choice of the type of vehicle to perform the selected task transport (transport).	2
Sem2	Rate the energy intensity of movement of the selected type of vehicle to perform the selected task transport (transport).	2
Sem3	Analysis of development trends and the most important new developments in the field of non-conventional power sources selected type of vehicle.	2
Sem4	Develop an array of morphological and creating on the basis of non-conventional propulsion power source of the selected type of vehicle.	2
Sem5	SWOT analysis of the selected drive solutions with unconventional propulsion for the selected type of vehicle.	2
Sem6	Feasibility study ecological balance of the selected type of vehicle with a conventional and unconventional sources proposed in its propulsion system.	2
Sem7	Acquisition of data necessary to comply with the ecological balance and the development of the balance sheet.	2
Sem8	Report the main results of the work carried out on developments in drive technology, means of transport, which is necessary to rozumieniach social and political conditions and other non-technical engineering activities necessary to the understanding of the social functions of communication in the business.	1
		Total hours: 15

TEACHING TOOLS USED

N1. problem discussion
N2. tutorials
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03 PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Readiness Assessment Project
P = P1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03 PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Participation in discussions of problem
F2	PEK_W01, PEK_W02, PEK_W03 PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Report
P = 0,2XP1+0,8XP2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
SITNIK Lech, J.; Ekopaliwa silnikowe, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2004, s 336,
MERKISZ Jerzy, PIELECHA Jacek, RADZIMIRSKI Krzysztof; Emisja zanieczyszczeń motoryzacyjnych w świetle nowych przepisów Unii Europejskiej. Wydawnictwo Komunikacji i Łączności. Warszawa 2012, s. 220.

SECONDARY LITERATURE
KAŹMIERCZAK Andrzej i Inni; Silniki pojazdów samochodowych. Wydawnictwo REA, Warszawa 2010.
zasoby internetowe
SIŁKA Wojciech; teoria ruchu samochodu. Wydawnictwo Naukowo Tecgniczne, Warszawa 2002, s. 329

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Unconventional energy sources for motor vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_W06, K2TR_W07, K2TR_W10	C1	Pr1, Pr2, Se1, Se2, Se3	N1, N2, N3, N4
PEK_W02	K2TR_W01, K2TR_W02, K2TR_W08	C2	Pr3, Pr4, Pr5, Pr6, Se4, Se5, Se6, Se7	N1, N2, N3, N4
PEK_W03	K2TR_W09, K2TR_W11, K2TR_W12	C3	Pr7, Pr8, Se8	N1, N2, N3, N4
PEK_U01	K2TR_U01, K2TR_U05	C1	Pr1, Pr2, Se1, Se2, Se3	N1, N2, N3, N4
PEK_U02	K2TR_U03, K2TR_U06, K2TR_U07, K2TR_U10, K2TR_U13, K2TR_U16	C2	Pr3, Pr4, Pr5, Pr6, Se4, Se5, Se6, Se7	N1, N2, N3, N4
PEK_U03	K2TR_U04, K2TR_U09, K2TR_U13, K2TR_U14, K2TR_U17	C3	Pr7, Pr8, Se8	N1, N2, N3, N4
PEK_K01	K2TR_K03	C1, C2, C3	Pr1, Pr2, Se1, Se2, Se3	N1, N2, N3, N4
PEK_K02	K2TR_K04	C2	Pr3, Pr4, Pr5, Pr6, Se4, Se5, Se6, Se7	N1, N2, N3, N4
PEK_K03	K2TR_K02	C3	Pr7, Pr8, Se8	N1, N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Lech Sitnik tel.: 71 347-79-18 email: lech.sitnik@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Nowoczesne metody kosztorysowania wycen pojazdów**
Name in English: **Modern methods of costing and valuation of vehicle repairs**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Protection and Service of Transportation Means**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **TRM041123**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				15	15
Number of hours of total student workload (CNPS)				30	30
Form of crediting				Crediting with grade	Crediting with grade
Group of courses					
Number of ECTS points				1	1
including number of ECTS points for practical (P) classes				1	1
including number of ECTS points for direct teacher-student contact (BK) classes				0.7	0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the construction of transport
2. Ideas for group work and skill of its execution
3. Basic knowledge of the specific market for automotive vehicles

SUBJECT OBJECTIVES

C1. Learning the methods and rules for determining the market value of the vehicle
C2. Understanding the factors affecting the market value of the vehicle
C3. Learning methods of costing repair of motor vehicles

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Characterization methods of valuation of the market value
PEK_W02 - Factors affecting the market value of the vehicle
PEK_W03 - Characterization of costing systems

II. Relating to skills:
PEK_U01 - Ability to prepare the data to produce a calculation of the market value
PEK_U02 - Ability to prepare data for vehicle repair costing
PEK_U03 - Ability to estimate the market value of the vehicle

III. Relating to social competences:
PEK_K01 - He understands the need for continuous training
PEK_K02 - Is aware of the importance, responsibility and impact of activities in the transport engineerin
PEK_K03 - Understand the safety aspects related to the construction of transport

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		1
Lab6		1
Lab7		1
Lab8		2
Lab9		2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Analysis of the specific market for automotive vehicles	2
Proj2	Determination of value of the vehicle - the system Info-Expert	2
Proj3	Determination of value of the vehicle - the system Eurotax	2
Proj4	Directive GVO - repair of vehicles with different groups of spare parts	2
Proj5	The case of the so-called. total loss	1
Proj6	Methods for determining the value of the so-called. residues	1
Proj7	The loss of value of the vehicle - the method of determining	1
Proj8	Calculation of vehicle repairs - Audatex system	2
Proj9	Calculation of vehicle repairs - system Eurotax	2
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Basic implementation of pricing and costing of Automotive Repair	2
Sem2	Numerical costing systems used in Europe and in the world	2
Sem3	Systems numerical valuations of vehicles used in Europe and in the world	2
Sem4	The quality of spare parts in the process of costing	2
Sem5	Market valuation of the vehicles produced in Europe	2
Sem6	Market valuation of the vehicles manufactured in the USA	2
Sem7	Standard and optional equipment vehicles	1
Sem8	Rules valuations of vehicles with bodywork specialist	2
		Total hours: 15

TEACHING TOOLS USED

N1. calculation exercises
N2. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U02	
F3	PEK_U03	
P =		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	The report of the project
F2	PEK_U02	The report of the project
F3	PEK_U03	The report of the project
P = (F1+F2+F3)/3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	The delivery of the paper
F2	PEK_W02	The delivery of the paper
F3	PEK_W03	The delivery of the paper
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Instructions Audatex systems, Eurotax, Info-Expert.
Conference materials and their own faculty

SECONDARY LITERATURE
monthly Auto Service, Auto Expert Auto Repair

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modern methods of costing and valuation of vehicle repairs
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_U12	C1	Pr2, Pr3	N1, N2
PEK_W02	K2TR_BIŚT_K01	C2	Pr2, Pr3	N1, N2
PEK_W03	K2TR_BIŚT_W03, K2TR_K04	C3	Pr8, Pr9	N1, N2
PEK_U01	K2TR_U03	C1, C2	Pr1, Pr2, Pr3	N1
PEK_U02	K2TR_BIŚT_W03	C3	Pr8, Pr9	N1, N2
PEK_U03	K2TR_BIŚT_W03	C1, C2	Pr2, Pr3, Se3	N1, N2
PEK_K01	K2TR_U14	C1, C2, C3	Pr1, Se1	N1, N2
PEK_K02	K2TR_BIŚT_K02	C1, C2, C3	Pr1, Se1	N1, N2

PEK_K03	K2TR_BIŚT_U03, K2TR_BIŚT_W01	C1, C2, C3	Pr1, Se1	N1, N2

SUBJECT SUPERVISOR
dr inż. Wojciech Ambroszko tel.: 71 347-79-18 email: wojciech.ambroszko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Środki i metody ratownictwa drogowego**
Name in English: **Methods of traffic emergency service**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Protection and Service of Transportation Means**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **TRM041124**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			15		15
Number of hours of total student workload (CNPS)			30		30
Form of crediting			Crediting with grade		Crediting with grade
Group of courses					
Number of ECTS points			1		1
including number of ECTS points for practical (P) classes			1		1
including number of ECTS points for direct teacher-student contact (BK) classes			0.7		0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the transport infrastructure
2. Basics of road traffic safety
3. Basics of the safety rules in transportation

SUBJECT OBJECTIVES

C1. The problems of traffic emergency service
C2. Acquire basic knowledge of the functioning of life saving emergency services and rescue system organization
C3. To acquaint the participants with the rules of the national emergency system and the recommendations for road rescue training

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge on road traffic safety, traffic emergency service end functioning of emergency services
PEK_W02 - It has knowledge of the operation, reliability, and means of transpor safety
PEK_W03 - Student has ordered knowledge in the field of active and passive safety of transport

II. Relating to skills:
PEK_U01 - Able to estimate the safety of means of transport
PEK_U02 - Is able to use regulations and recommendations on road traffic safety
PEK_U03 - Can obtain information from literature, databases, engineering standards and other sources, can integrate the information, make their interpretation, and draw conclusions

III. Relating to social competences:
PEK_K01 - He can think and act in a creative and entrepreneurial
PEK_K02 - He understands the need for the formulation and communication to the public information and opinions on the planning and operation of transport systems

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Construction and use of light vehicles special in emergency road	2
Lab2	The application of mechanical and hydraulic equipment	2
Lab3	Cargo protection during the transport, handling and lifting	2
Lab4	Techniques of oil pollution removing from the soil and water	2
Lab5	Accident scene protection and the rescue operations	2
Lab6	The application of emergency equipment	2
Lab7	Organization and management of rescue	3
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	The origins and development of traffic emergency service	1
Sem2	The division and application of road rescue vehicles	2
Sem3	Equipment of technical rescue vehicles	2
Sem4	The computer system for emergency notification	2
Sem5	Analysis and evaluation of emergency system in Poland and comparision to the system in selected European countries	2
Sem6	Lifesaving tasks	2
Sem7	The influence of new vehicles' construction on the rescue operations	2
Sem8	Accident and first aid	2
		Total hours: 15

TEACHING TOOLS USED

N1. project presentation
N2. problem exercises
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	oral response, the report
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Participation in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]Grzegorczyk K., Hancyk B., Buchar R., Towary niebezpieczne w transporcie drogowym – ADR 2007-2009
[2] U. Cimolino, J. Heck, Ch. Linde, H. Springer, J. Südmersen, Ratownictwo techniczne podczas wypadków z udziałem samochodów ciężarowych
[3] Ciećkiewicz J., Benin-Goren O., Guła P., Krzowski K., Nakonieczny S., NiteckiJ., Ra-townictwo medyczne w wypadkach masowych. Górnicki Wydawnictwo Medyczne 2005.

SECONDARY LITERATURE
[1] Ustawa o transporcie drogowym z dnia 6 września 2001 r. o transporcie drogowym. Dz.U.07.125.874 z póź. zm.
[2] USTAWA z dnia 28 października 2002 r. o przewozie drogowym towarów niebezpiecz-nych. 02.199.1671 z póź. zm.
[3] D. Gil, Sprzęt ratowniczy. SP PSP w Bydgoszcz, 2004
[4] B. Stachowiak, Budowa i wykorzystanie w działalności ratowniczej PSP lekkich samo-chodów ratownictwa drogowego, Poznań 1996

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods of traffic emergency service
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2TR_BIŚT_W01, K2TR_BIŚT_W02, K2TR_W07	C1, C2, C3	Sem1-Sem8	N1, N3
PEK_U01, PEK_U02, PEK_U03	K2TR_BIŚT_U01, K2TR_BIŚT_U02, K2TR_U01	C1, C2, C3	Lab1-Lab7	N2
PEK_K01, PEK_K02,	K2TR_BIŚT_K01, K2TR_BIŚT_K02	C1, C2, C3	Sem1-Sem8, Lab1-Lab7	N1,N2, N3

SUBJECT SUPERVISOR

dr inż. Karol Jaśkiewicz tel.: 21-72 email: karol.jaskiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy transportu lotniczego**
Name in English: **Airforce transportation systems**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Transportation Systems Management and Designing**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of mathematics, the laws of physics and chemistry.
2. Ability to use and retrieve information from the literature and the Internet.
3. He understands the need for education and understanding the role of social engineer.

SUBJECT OBJECTIVES

C1. Understanding the principles and organization of air transport systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can discuss and explain the principles of operation of the air transport system within its limitations (ground handling, maintenance of specific provisions - LAR, DGR, WHA, etc.)

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - He understands the need for continuous training. Recognize the effects of the impact of technology on the environment and related social responsibility techniques. He can think and act in an entrepreneurial manner.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic knowledge of the air transport system	2
Lec2	Fundamentals of traffic engineering	2
Lec3	The role of air carriers and airports in the air transport system	2
Lec4	Ground handling of aircraft	2
Lec5	Maintenance of the aircraft	2
Lec6	The use of the aircraft - the implementation of grid connection	2
Lec7	General information concerning the carriage of goods - law (WHA, DGR, LAR, AHM, CHM, GHM), operating systems (Lufthansa Cargo - Mosaik View, Lot - CargoSpot)	2
Lec8	Technical and legal considerations in the transport of live animals (LAR regulations)	2
Lec9	Technical and legal considerations in the carriage of dangerous goods (DGR regulations)	2
Lec10	Technical and legal considerations in the carriage of other goods (General Cargo, HUM, PER). Restrictions - Embargo. Fixing charges.	2
Lec11	Technical and legal considerations in the carriage of passengers	2
Lec12	Construction of grid connections for different types of flights. General information on the Flight Plan	2
Lec13	The balance of the aircraft	2
Lec14	Incidents and accidents	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_K01	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. W. Rydzykowski, K. Wojewódzka-Król: Transport, PWN, Warszawa 2007.2. I. Szymajda, M. Polkowska: Konwencja montrealska, Liber, 2004.3. IATA: Dangerous Goods Regulation, 2012 4. IATA: Live Animals Regulations, 201 25. Lufthansa Cargo: Cargo Handling Manual, 2012 6. Lufthansa Cargo: Ground Handling Manual, 2012 7. Lufthansa Cargo: Airport Handling Manual, 2012

SECONDARY LITERATURE
1. User Manual - Mosaik View2. User Manual - CargoSpot

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Airforce transportation systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_W08, K2TR_W09, K2TR_W11	C1, C2	Lec1-Lec15	N1-N3
PEK_K01	K2TR_K01, K2TR_K02, K2TR_K03	C1, C2	Lec1-Lec15	N1-N3

SUBJECT SUPERVISOR

dr inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza ryzyka**
Name in English: **Risk Analysis**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Transportation Systems Management and Designing**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge about technical object operation.

SUBJECT OBJECTIVES

C1. Getting ready to do systemic analysis of simple transportation system and process.
C2. Getting ready to do risk analysis and assessment of simple transportation system or process.
C3. Ability to present work results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student should know methods of hazard identification and risk assessment and management.

II. Relating to skills:
PEK_U01 - Student should know how to do risk analysis and assessment of simple operation system or process.

III. Relating to social competences:
PEK_K01 - Student has awareness of safety work and has ability to dispatch the knowledge and safety behavior in technical systems.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	State of art in safety problems. Concepts, scope, risk management. Standardization.	2
Lec2	Concept of undesired event, risk, hazard.	2
Lec3	Algorithm of risk analysis and assessment.	2
Lec4	The role and place of risk analysis and assessment in industry.	2
Lec5	Methods of hazard identification (part 1).	2
Lec6	Methods of hazard identification (part 2).	2
Lec7	Methods of hazard identification (part 3).	2
Lec8	Methods of hazard identification (part 4).	2
Lec9	Large catastrophes description and analysis.	2
Lec10	Selection and defining of transportation problem to analysis.	2
Lec11	Description and identification of analysed system and process.	2
Lec12	Selection of risk analysis method and design of data sheet.	2
Lec13	Estimating a frequency and losses of undesired events.	2
Lec14	Risk assessment and safety measures.	2
Lec15	Discussion, results presentation, assessment.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises
N2. self study - preparation for project class
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	evaluation of final report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Polska Norma PN-EN 60300-3-9 Analiza ryzyka w systemach technicznych.
Villemeur A., Reliability, Availability, Maintainability and Safety Assessment. John Wiley & Sons. Chichester, New York, Brisbane, Toronto, Singapore, 1992.
IEC 60300-3-9. Dependability management – Part 3: Application guide – Section 9: Risk assessment of technological systems.

SECONDARY LITERATURE
Polska Norma PN-EN 60300-3-9. Analiza ryzyka w systemach technicznych.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Risk Analysis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_OST_W01	C1,C2	Wy1-Wy14	N1,N2
PEK_K01	K2TR_K01	C3	Wy15	N3

SUBJECT SUPERVISOR

dr hab. inż. Marek Młyńczak tel.: 71 320 38 17 email: marek.mlynczak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metodologia projektowania systemów technicznych**
Name in English: **Technical Systems Design Methodology**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Transportation Systems Management and Designing**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041205**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to manufacturability of a design and manufacturing technologies.
2. Basic knowledge in the field of materials science and strength of materials.

SUBJECT OBJECTIVES

C1. Acquiring of knowledge in the field of designing of technical systems.
C2. Acquiring of knowledge of group and the individual designing methods.
C3. Acquiring of skills in the field of heuristic methods used in designing of technical systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a detailed knowledge of individual and group designing of technical systems.
PEK_W02 - Has a detailed knowledge of existing tools used in the initial and the final stage of the designing process of technical systems and about trends in this area.
PEK_W03 - Has a detailed knowledge of the methods of assessment and classifying of developed concepts.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Can think and act creatively.
PEK_K02 - Can use tools for generation of solutions of a given problem.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, assessment rules and literature. Basic issues.	2
Lec2	Functional and computational model of system of designing, basic definitions.	2
Lec3	Methods of detailing of the goal of machinery components and assemblies and transportation systems designing.	2
Lec4	Example and practice of restoration of idea and the designing of technical systems.	2
Lec5	Limitations of designing: internal personal, organizational, technical, economic and others.	2
Lec6	Introduction to algorithmic and heuristic methods in the designing of machines.	2
Lec7	Algorithmic designing methods (morphological text table, graphic, personal; tree of solutions, tree of reconstruction problem; advanced methods).	2
Lec8	Group designing - heuristics - free association brainstorming, brainstorming inverted, Gordon synectics.	2
Lec9	Evaluation criteria of technical systems (e.g., mechanical power transmission units, belt conveyors, roller conveyors, etc.).	2
Lec10	Synthesis and scheduling of significance of evaluation criteria designed machinery components.	2
Lec11	Creating and managing intial solutions.	2
Lec12	Evaluation of the project solutions. Assessment methods: global, criterial systems, relevance criteria.	2
Lec13	Reconstruction of own designing algorithm of machinery subasseblies and parts.	2
Lec14	Methods of popularising solutions.	2
Lec15	Summary of the lectures and additional explanations.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03, PEK_K01 - PEK_K02	Final test. Participation in problem discussions.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Banathy, BH, Designing of education systems. Wroclaw University of Techonology Publishing House, Wrocław, 1994 (in Polish).
[2] Cempel Cz., The theory and engineering of systems - principles and application of system thinking. WNITE, Radom, 2008 (in Polish).
[3] Dziama A. Methodology of Machinery Design, PWN, Warszawa, 1985 (in Polish).
[4] Pahl G., Beitz W.: Engineering Design, WNT, Warszawa 1984 (in Polish).

SECONDARY LITERATURE
[1] Norton R. L.: Machine Design: An Integrated Approach. 3/E. Prentice Hall, 2006.
[2] Pahl G., Beitz W. et al. Engineering Design. A Systematic Approach. Springer, 2007.
[3] Partyka M. A. Desiging methodology - selected issues of technical designing, OpoleUniversity of Techonology Publishing House, Opole, 2001.
[4] Przystupa, F. W. (red), Systems and information technologies in researches and practice. Wroclaw University of Techonology Publishing House, Wrocław, 1996.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technical Systems Design Methodology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K2TR_OST_W03	C1, C2, C3	Lec4 - Lec12	N1, N2, N3
PEK_W02	K2TR_W03, K2TR_W05	C1, C2, C3	Lec1 - Lec15	N1, N2, N3
PEK_W03	K2TR_W03	C1, C2, C3	Lec9 - Lec12	N1, N2, N3
PEK_K01	K2TR_K01	C1, C2, C3	Lec1 - Lec15	N3
PEK_K02	K2TR_K01	C1, C2, C3	Lec1 - Lec15	N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Franciszek Przystupa tel.: 71 320-21-55 email: franciszek.przystupa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie systemów transportu wewnętrznego**
Name in English: **Design of material handling systems**
Main field of study (if applicable): **Transport**
Specialization (if applicable): **Transportation Systems Management and Designing**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **TRM041207**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematics and physics to the extent necessary for the description and analysis of the transport systems and processes
2. Ability to read and sketch diagrams presenting simple structures of systems containing handling equipment for cyclical and continuous operating
3. The ability to use a spreadsheet and perform 2D drawings using CAD

SUBJECT OBJECTIVES

C1. Knowledge of basic principles of system design for cyclic and continuous handling of all kinds of bulk materials and compact units, as well as principles for the description and analysis of material flow in these systems
C2. The acquisition of basic skills to describe and analyse materials flow in cyclic and continuous handling systems, as well as basic skills in the development of conceptual design solutions for these systems
C3. Awareness of the interrelationship between size of structure, structural solutions for handling systems, and operating parameters for the material flow in these systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic rules for the description and analysis of material flow in a cyclic and continuous internal handling systems
PEK_W02 - Has knowledge of basic design principles for internal materials handling systems of cyclic and continuous modes of operation

II. Relating to skills:
PEK_U01 - Can describe and analyze the material flow in cyclic and continuous internal handling systems, able to create diagrams of structures for these systems
PEK_U02 - Able to develop conceptual design solutions for systems of cyclic- and continuouss material handling and select their elements (cranes and conveyors) to ensure realisation of specified flows of material and loads

III. Relating to social competences:
PEK_K01 - Is aware of the relationship between the size, structural type of solutions for handling systems and operating parameters of the material flow in these systems
PEK_K02 - Recognizes the linkages adequate knowledge of mathematics and physics in the design of internal handling systems

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts and definitions, review and distribution of internal handling systems and logistical systems	2
Lec2	Methods of the material flow description in handling systems, use of block diagrams	2
Lec3	Rules for the description and analysis of material flows in handling systems	2
Lec4	Streams and principles of material flow in separation and collection subsystems	2
Lec5	Elements of separation and collection subsystems, parameters, calculation rules	2
Lec6	Selection rules of connecting nodes in the separation and collection subsystems. Rules for stacking of load streams in handling systems	2
Lec7	Control of the material flow in handling systems	2
Lec8	Strategies to control the flow of materials in separation and collection subsystems	2
Lec9	Strategies to control the flow of materials in buffer zones	2
Lec10	Scaling of processes and handling systems	2
Lec11	Rules of analysis and determination of processing effort for material flow	2
Lec12	Rules of analysis and dimensioning of handling systems	2
Lec13	Rules for the creation of logistics diagrams	2
Lec14	Stages and the main tasks in the design of the internal transport systems	2
Lec15	Examples of solutions to common tasks in the design of selected internal transport systems	2

		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Analysis of proposed project data, identification of design constraints, requirements and conditions (location, size, capacity, type and availability of energy). Selection and justification of the concept of the proposed system, the initial determination of its structure and material flow pattern, including the degree of automation and the type of materials handling means	2
Proj2	The choice of separation and collection subsystems elements in the designed system, establishing general strategies and principles of material flow controlling	2
Proj3	Sizing of the material flow process in the proposed system – calculations of the necessary number of workers with certain qualifications as well as certain types of material handling means	2
Proj4	Sizing of handling subsystems in the proposed system – determination of the feeder routes and nodes in separation and collection subsystems, determination of the location and size of the buffer zones	2
Proj5	Development of block diagrams of the proposed system (organizational and functional structures) and block diagrams of the material flow process in the proposed system (records of material flow and transportation cycles)	2
Proj6	Development of an overall layout of the proposed system - making an architectural sketch of the proposed area of system operation with transport routes and buffer zones of materials, material flows and the positioning of stationary loading equipment	2
Proj7	Checking calculations of designed system - determining the key value for the assumed streams of material supply for given histograms of reception and delivery, the development of logistics charts for selected parts of the system	2
Proj8	Checking calculations of the designed system - continuation - the development of cross-flow table for the material flow, verification of the calculated number of employees, equipment, and the actual capacity of the system	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - self studies and preparation for examination
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Answers during project presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Fijałkowski J. - Internal transport in logistic systems. Publ. Warsow University of Technology 2000r.

SECONDARY LITERATURE
[1] Korzeń Z. - Logistic systems of handling and storage. Vol.2. ILM Poznań 1998r.
[2] Catalogues of cranes and conveyors unified components offered by firms FAMAK, DEMAG, ABUS, KONE CRANES, AUMUND

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of material handling systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Transport

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2TR_OST_W03, K2TR_W08	C1	Lec1, Lec2, Lec3	N1, N2, N3
PEK_W02	K2TR_OST_W03, K2TR_W08	C1	Lec4, Lec5	N1, N2, N3
PEK_U01	K2TR_OST_U01, K2TR_U06	C2	Proj1, Proj2	N2, N3, N4
PEK_U02	K2TR_OST_U01, K2TR_U06	C2	Proj3 to Proj8	N2, N3, N4
PEK_K01, PEK_K02	K2TR_K04	C3	Lec1 to Lec15, Proj1 to Proj8	N1, N2, N3, N4

SUBJECT SUPERVISOR
dr inż. Eugeniusz Grabowski tel.: 71 320-28-89 email: Eugeniusz.Grabowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy elektrotechniki i elektroniki**
Name in English: **Fundamentals of Electrical Engineering and Electronics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPD031001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence based on the Physics courses.

SUBJECT OBJECTIVES

C1. Comprehension of the issues related to the mathematical description and physical interpretation of the phenomena accompanying the production and usage of electric fields, magnetic and electromagnetic fields.
C2. Understanding the physical phenomena occurring in materials (including in semiconductors).
C3. Introduction to the analysis of DC and AC linear and nonlinear circuits, using basic electrical engineering concepts and laws (Ohm's law, I and II Kirchhoff law).
C4. Understanding the construction's principles and applications of selected electronic components, semiconductor devices and integrated circuits (analog and digital).
C5. Acquiring the ability to choose and measure the active and passive components used in electronic applications and ability to characterize their properties/parameters.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has expertise in the field of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including the knowledge necessary to understand the basic physical phenomena occurring in electronic components and circuits and in their environment/surrounding.
PEK_W02 - The student understands the physical basis of the operation of semiconductor devices and the importance of their parameters.

II. Relating to skills:
PEK_U01 - The student has the ability to choice the materials, components and equipment's construction according to the technical requirements and operating conditions.
PEK_U02 - The student can operate the measuring equipment and can assemble measurement systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basic phenomena and laws of electrical engineering: electrification, electric charge, electric field, electric potential, voltage, source voltage: constant, variable, electric current, electric power, electrical circuits, linear, nonlinear, classical method of solving electrical circuits, magnetic fields, electric current: DC, AC, production and properties of alternating current.	2
Lec2	Signals applied in electronics: analog and digital (description of the fundamentals of the signals).	2
Lec3	Physical principles of semiconductor electronic components.	2
Lec4	P-N junction: the mechanism of the formation of the junction, the direct current I-V characteristics of the diode.	2
Lec5	Bipolar transistors: design, operation principles, configurations, static characteristics, small-signal parameters.	2
Lec6	Unipolar transistor: Field Effect Transistor, Junction Transistor - PNFET: the principle of operation, I-V characteristics, parameters.	2
Lec7	Digital Circuits: Basic logic functions, parameters. Logic gates of TTL and CMOS family: construction and parameters.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Basic methods and measuring instruments. Description of the electronic components properties. Passive Components.	3
Lab2	I-V characteristics of the p-n junction (diode: universal, stabilization, rectifier, LED).	3
Lab3	Static characteristics of the bipolar transistor.	3
Lab4	The measurements of unipolar transistors: JFET and MOSFET transistors.	3

Lab5	The measurements of digital circuits: TTL and CMOS.	3
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture (Power Point presentation)
N2. Self-study
N3. Consultations
N4. Repetition of the presented material as a preparation for the laboratory classes.
N5. Assessment of the laboratory classes: test regarding the knowledge about the topic of the exercise, report from the realized work during the classes.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Marks from tests and reports from realized exercise
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Electrical Engineering and Electronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1ZIP_W09	C1 - C4	Lec1 - Lec8	N1 - N3
PEK_U01, PEK_U02	K1ZIP_U09	C4, C5	Lab1 - Lab5	N3 - N5

SUBJECT SUPERVISOR

dr inż. Waldemar Oleszkiewicz email: waldemar.oleszkiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy elektrotechniki i elektroniki**
Name in English: **Fundamentals of Electrical Engineering and Electronics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPD032001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence based on the Physics courses.

SUBJECT OBJECTIVES

C1. Comprehension of the issues related to the mathematical description and physical interpretation of the phenomena accompanying the production and usage of electric fields, magnetic and electromagnetic fields.
C2. Understanding the physical phenomena occurring in materials (including in semiconductors).
C3. Introduction to the analysis of DC and AC linear and nonlinear circuits, using basic electrical engineering concepts and laws (Ohm's law, I and II Kirchhoff law).
C4. Understanding the construction's principles and applications of selected electronic components, semiconductor devices and integrated circuits (analog and digital).
C5. Acquiring the ability to choose and measure the active and passive components used in electronic applications and ability to characterize their properties/parameters.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has expertise in the field of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including the knowledge necessary to understand the basic physical phenomena occurring in electronic components and circuits and in their environment/surrounding.
PEK_W02 - The student understands the physical basis of the operation of semiconductor devices and the importance of their parameters.

II. Relating to skills:
PEK_U01 - The student has the ability to choice the materials, components and equipment's construction according to the technical requirements and operating conditions.
PEK_U02 - The student can operate the measuring equipment and can assemble measurement systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basic phenomena and laws of electrical engineering: electrification, electric charge, electric field, electric potential, voltage, source voltage: constant, variable, electric current, electric power, electrical circuits, linear, nonlinear, classical method of solving electrical circuits, magnetic fields, electric current: DC, AC, production and properties of alternating current.	2
Lec2	Signals applied in electronics: analog and digital (description of the fundamentals of the signals).	2
Lec3	Physical principles of semiconductor electronic components. P-N junction: the mechanism of the formation of the junction, the direct current I-V characteristics of the diode.	2
Lec4	Bipolar transistors, Unipolar transistor: Field Effect Transistor, Junction Transistor - PNFET: the principle of operation, I-V characteristics, parameters.	2
Lec5	Digital Circuits: Basic logic functions, parameters. Logic gates of TTL and CMOS family: construction and parameters. Final test.	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Basic methods and measuring instruments. Description of the electronic components properties. Passive Components. I-V characteristics of the p-n junction (diode: universal, stabilization).	3
Lab2	Static characteristics of the bipolar transistor.	3
Lab3	The measurements of unipolar transistors: JFET and MOSFET transistors.	3
Lab4	Additional term.	1
		Total hours: 10

TEACHING TOOLS USED

N1. Traditional lecture (Power Point presentation)
N2. Self-study
N3. Consultations
N4. Repetition of the presented material as a preparation for the laboratory classes
N5. Assessment of the laboratory classes: test regarding the knowledge about the topic of the exercise, report from the realized work during the classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Marks from tests and reports from realized exercise
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1984
S. Bolkowski, Teoria obwodów elektrycznych, WNT, 2003
P. Hempowicz, R. Kiełsznia, A. Piłatowicz, J. Szymczyk i inni, Elektrotechnika i elektronika dla nieelektryków, WNT, 2004

SECONDARY LITERATURE
G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010
W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984
M. Rusek, J. Pasierbiński, Elementy i układy elektroniczne w pytaniach i odpowiedziach, WNT, 1991

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Electrical Engineering and Electronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1ZIP_W09	C1 - C3	Lec1 - Lec5	N1 - N3
PEK_U01, PEK_U02	K1ZIP_U09	C4, C5	Lab1 - Lab4	N3 - N5

SUBJECT SUPERVISOR

dr inż. Waldemar Oleszkiewicz email: waldemar.oleszkiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska - geometria wykreślna**
Name in English: **Engineering graphics - descriptive geometry**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	30			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry
2. Student has ability to use of the drawing utensils.
3. Student has ability to draw basic geometric structures, such as division of a line's segment into n equal parts, plotting a regular hexagon.

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane as the basis for design recording (engineering drawing).
C2. Knowledge in the field of the geometric structures restitution based on Monge's projections.
C3. Preparation for the design recording (engineering drawing) application.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge on geometric structure mapping onto drawing's plane using Monge's projection method and elementary knowledge in the field of axonometry.
PEK_W02 - Student can indicate an appropriate solution algorithm of mapping of the position and the relationship of the geometric formations in the space, as well as identifying the measures relationship.
PEK_W03 - Student can interpret the drawing, made by the Monge's method, showing localization of the element or geometric structure in the space.

II. Relating to skills:
PEK_U01 - Student can practically apply the principles of the Monge's projection method to map the elements and geometric structures (including solids) on the drawing plane.
PEK_U02 - Student can set the size of the dimensions characterized measuring tasks of geometry.
PEK_U03 - Student can provide restitution of the geometric structure on the basis of Monge's projection and submit the result by axonometric projection.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions and principles of the parallel, rectangular projection by Monge's projection, the mapping of basic geometric elements (points, line, plane).	2
Lec2	Common elements - edges and breakdown points; parallel and perpendicular elements.	2
Lec3	Transformation of the position (rotation, revolved section, increasing of the revolved section) and the reference system transformation (additional projection plane).	2
Lec4	Solids - definitions; solid section as a set of common elements of the solid cutting plane, solid's breakdown points by a straight line.	2
Lec5	Cutting of the solids with projecting planes set - a modification of the initial solid's view, developed views.	2
Lec6	Penetration of the solids - transmission lines definition, the use of auxiliary cutting planes and reference system transformation.	2
Lec7	Projection in the three orthogonal planes; axonometry basis; completion of the missing solid projection - use of the axonometric projection.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Information on the drawing utensils and principles of the geometric structures drawing. Projection of a point and straight line, the mapping of a plane using her traces, identification of the basic elements localization in space using two orthogonal projection planes.	2

Cl2	Belonging of the basic geometric elements, completion of the missing projection; particular localization of the geometric elements.	2
Cl3	Edge as common element of two planes. Breakdown point as common element of straight line and plane. Particular cases of a common elements.	2
Cl4	Edge between flat figures (auxiliary projection planes application); breakdown point of the flat figure by straight line. Identification and construction of the parallel and orthogonal relationship between basic geometrical elements.	2
Cl5	Rotation and revolved section of the basic geometrical elements (rotation of a line's segment and plane); application of the localization transformation for measuring tasks (determination of the real size of a line's segment, angle, flat figure).	2
Cl6	Determination of the projections of plane geometrical structures with selected parameters and the desired position in space (increasing of revolved section of a plane figure). Application of the reference system transformation in measuring tasks and identification of the position (angle relative to the projecting plane, distance of the point from the plane, setting the points projections at a set distance from the plane).	2
Cl7	Test K1 (includes classes's 1 - 6 material)	2
Cl8	The mapping of the elementary solids using Monge's projection, points and lin's segments belonging to the solid's walls identification; determination of the cross sections of polyhedra with projection planes.	2
Cl9	Determination of the polyhedra cross sections cutted by arbitrary planes. Determination of the cross section of the solids with surfaces. Solid's breakdown points by lines (use of auxiliary cutting planes containing penetrating straight line) determination.	2
Cl10	Developed view of a polyhedron and solid containing ruled surface. Cutting of the solid with projection planes as a modification of the initial form of solid - cutting of the polyhedron.	2
Cl11	Cutting of a solid of revolution. Polyhedra transmission lines determination.	2
Cl12	Solids (containing surfaces) transmission lines determination.	2
Cl13	Solid mapping onto three orthogonal projection planes. Solid modyfying using projection plane.	2
Cl14	Solid mapping using axonometric projection. Determination of the missing solid projection modified by cutting planes. Relationship between Monge's projection and axonometric projection.	2
Cl15	Test K2 (includes classes's 8 - 14 material)	1
		Total hours: 29

TEACHING TOOLS USED

N1. problem lecture
N2. problem exercises
N3. tutorials
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final teat
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	test no. 1, good rating is nedeed (min. 3.0)
F2	PEK_U01, PEK_U02, PEK_U03	test no. 2, good rating is nedeed (min. 3.0)
P = [(F1+F2)/2]*4/5+F3*1/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania),
[2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998,
[3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001,
[4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005.

SECONDARY LITERATURE
[1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania),
[2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997,
[3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997,
[4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering graphics - descriptive geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W04	C1, C2, C3		N1, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U04	C1, C2, C3		N2. N3. N4

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia**
Name in English: **Chemistry**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM031002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. high school level

SUBJECT OBJECTIVES

C1. Introduction with chemistry sections usable over study of related courses (meterial scicnce, metallurgy, polymers)
C2. Introduction with basic chemical knowledge enabling of chemical rules and physicochemical properties of technical materials particularly metals, alloys and polymers
C3. The student should have basic chemical knowledge associated with structure of matter, states of matter.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student should have basic chemical knowledge associated with structure of matter, states of matter.
PEK_W02 - The student should have basic inorganic knowledge associated with the structure of metals, alloys, electron conductivity as well as basic organic knowledge associated with fuels and polymers
PEK_W03 - The student should have basic knowledge associated with the optics and nanotechnology

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The structure of matter, elements, compounds	2
Lec2	Periodic table of elements, structure, groups of elements, allotropy, concentration	2
Lec3	Chemical bonds, molecules	2
Lec4	Liquids, solids, gases	2
Lec5	Basic crystallography, unit cell, symmetry elements, crystallographic defect	2
Lec6	Solid state band theory.metals and alloys structure	2
Lec7	Selected topics of organic chemistry- fuels, polymera	4
Lec8	Basic optics - the Effects of electromagnetic waves on matter	2
Lec9	Qualifying class –test	2
		Total hours: 20

TEACHING TOOLS USED

N1. informative lecture
N2. tutorials
N3. traditional lecture with the use of transparencies and slides
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Chemical Principles, Atkins Peter William, Jones Loretta, Palgrave Macmillan

SECONDARY LITERATURE
selected web sites,

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Chemistry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 , PEK_W02, PEK_W03	K1ZIP_W02	C1, C2, C3	Lec1-Lec8	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie informacyjne**
Name in English: **Information technology**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. none

SUBJECT OBJECTIVES

C1. The harmonization of terminology in the field of information technology and to present the origins, history and current state of development of computer
C2. Strengthening the knowledge on the functioning of computers and provide general principles for constructing algorithms (computer)
C3. General guidance on the preparation of publications and technical presentations
C4. Internet and privacy on the Internet, adherence to good manners online, law on the Internet, copyright

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic principles of design and theoretical description of modern computers, knows the rules of binary arithmetic (integer and non-integer)
PEK_W02 - The student knows the basic principles of designing algorithms
PEK_W03 - The student understands the issues of intellectual property protection

II. Relating to skills:
PEK_U01 - Able to effectively use the tools to support the creation of technical publications, can separate form from content.
PEK_U02 - Students can use the available "office tools" to solve basic engineering tasks
PEK_U03 - The student can independently construct a simple algorithm solves the given simple problem.

III. Relating to social competences:
PEK_K01 - The student understands the conditions of work and keeping in touch with the Internet.
PEK_K02 - The student understands the concepts of intellectual property protection, and can comply with the law on the Internet, everyday life and work.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The requirements. Technical Publication. The content and form.	2
Lec2	Technical Publication. Automatically lists.	2
Lec3	Worksheet.	1
Lec4	Presentation	1
Lec5	Outline of the history of the development of counting and computer systems.	2
Lec6	Modern computers, binary logic, basic arithmetic, computer arithmetics.	2
Lec7	Elements of a computer system.	1
Lec8	The operating system and its role. Different types of software.	1
Lec9	Algorithms. The basic algorithmic structures (for review, the division of tasks, dynamic programming, recursion, ...).	4
Lec10	Programming languages: simple examples (passing the maze).	2
Lec11	Correctness of algorithms, "difficult" task.	2
Lec12	Interesting examples (traveling salesman problem, the problem of loading).	2
Lec13	Knowledge-based economy. Protection of Intellectual Property. The law on the Internet.	4
Lec14	Privacy on the Internet.	2
Lec15	Quiz	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Word processing: style and their modifications, illustrations, and working with a spreadsheet.	2

Proj2	Automatic tables of contents, illustrations, bibliography ...	2
Proj3	(Final) document formatting.	2
Proj4	"Complex" calculations in a spreadsheet.	2
Proj5	Spreadsheet as a database.	2
Proj6	Elements of Programming (conditional statements, loops, ...).	3
Proj7	Presentation. Template WUT.	2
Proj8	Summary and Assessment.	1
		Total hours: 16

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. individual work: preparing for test
N3. case study
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	Evaluation of completed tasks.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Algorithmics: The Spirit of Computing (3rd Edition) by David Harel and Yishai Feldman (Jun 11, 2004)

SECONDARY LITERATURE
2. Computers Ltd.: What They Really Can't Do (Popular Science) by David Harel (Dec 11, 2003)
3. Computer Networking: A Top-Down Approach (6th Edition) by James F. Kurose and Keith W. Ross (Mar 5, 2012)
4. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin and Greg Gagne (Jul 29, 2008)
5. Algorithms + Data Structures = Programs (Prentice-Hall Series in Automatic Computation) by Niklaus Wirth (Feb 1976)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Information technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W10	C1, C2, C3, C4	Lec1-Lec14	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U10, K1ZIP_U22	C1, C2, C3, C4	Proj1 - Proj7	N3, N4
PEK_K01, PEK_K02	K1ZIP_K09	C1, C2, C3, C4	Proj1 - Proj7	N3, N4

SUBJECT SUPERVISOR

dr inż. Wojciech Myszka tel.: +48(71)3202790 email: Wojciech.Myszka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika**
Name in English: **Mechanics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031008**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge, skills and competences on the level after Mathematics I and Linear algebra

SUBJECT OBJECTIVES

C1. Solving technical problems based on mechanics rules
C2. Making statical strength analysis of machines elements.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define based quantities in Mechanics (Force and momentum).
PEK_W02 - He knows the solving methods of beams and frames
PEK_W03 - He knows the Centroid of Area, the center of Gravity of a Mass, Moments of inertia

II. Relating to skills:
PEK_U01 - He is able to calculate the inner forces in the beams and frames with their diagrams
PEK_U02 - He can calculate the joints constructures (strusses)
PEK_U03 - He can determine the centroidal and principal Moments of inertia

III. Relating to social competences:
PEK_K01 - He can search information and is able to critical review it.
PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify own point of view on the base of knowledge from Mechanics
PEK_K03 - He can observe the customs and rules of the academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Curriculum. Requirements. Literature.Theory of vectors algebra, statics, degrees of freedom, supports of the rigid body	2
Lec2	Force and momentum. Principal vector and principal momentum of forces system. Statics. Conditions of static equilibrium of forces system. The change of momentum point.	2
Lec3	The resultant of any set of forces.	2
Lec4	Plane forces system. Reactions in the statically determinate systems	2
Lec5	Concurrent forces system.	2
Lec6	Conditions of static equilibrium of forces system. Plane forces system reduction.	2
Lec7	Trusses. Method of Joints.	2
Lec8	Internal forces in Beams (analytical methods, diagrams).	2
Lec9	Centroid of Area. The center of Gravity of a Mass.	2
Lec10	Moments of inertia. Product of inertia. Parallel–axis theorem.	2
Lec11	Rotation transformation of Moments of inertia, Iinertia tensor, inertia ellipsoid. The principal axes.	2
Lec12	Kinematics, motion of particle, trajectory, one–dimensional model. Velocity, acceleration.	2
Lec13	Velocity and acceleration in natural coordinates. Classification of motions	2
Lec14	Velocity and acceleration in the plane motion.	2
Lec15	Test	2
		Total hours: 30
Form of classes – Classes		Number of hours

Cl1	The examples for Conditions of static equilibrium of forces system. Plane forces system reduction.	2
Cl2	Plane forces system. Determination of reactions in the supports.	2
Cl3	Resultans for Plane forces systems. Equations of equilibrium.	2
Cl4	Analytical methods of trusses solving. Ritter’s methods.	2
Cl5	Internal forces in beams (analytical methods, diagrams).	2
Cl6	Internal forces in beams (analytical methods, diagrams). Beams with Joints.	2
Cl7	Resultant using for Internal forces in Frames.	2
Cl8	Internal forces in Frames (analytical methods, diagrams).	2
Cl9	Test 1	2
Cl10	Centroid of Area. The center of Gravity of a discrete Multi-mass structures.	2
Cl11	Determination of Moments of inertia & inertia products. Parallel–axis theorem.	2
Cl12	Determination of the centroidal and principal axes and Moments.	2
Cl13	Kinematics of particle in orthogonal coordinates.	2
Cl14	Velocity in the plane motion.	2
Cl15	Test 2	2
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides.
N2. Calculation exercises.
N3. Self study - preparation for project class.
N4. Tutorials.
N5. Self study - self studies and preparation for examination.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
F2	PEK_W01, PEK_W02, PEK_W03	oral-writing exam
P = F1 + F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Test 1, Test 2.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 1, Statics, John Wiley & Sons, Inc., New York, 1998
2. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 2, Dynamics, John Wiley & Sons, Inc., New York, 1998

SECONDARY LITERATURE

1. Mary Lunn, A First Course in Mechanics, Oxford Science Publications, Oxford 1991
2. Philip Dyke, Roger Whiteworth, Guide to Mechanics, MacMillan Press, London 1992
3. Herbert Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W03	C1	Lec1 - Lec15	N1, N4, N5
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U01, K1ZIP_U03	C2	Cl1 - Cl15	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia w produkcji przemysłowej**
Name in English: **Ecology in industrial manufacturing**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031009**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has systematized secondary school knowledge of biology, chemistry and physics; knows the principles of engineering drawing; can interpret the basic relationship between human activity and the behaviour of living organisms and the whole environment; understands the necessity of developing industry and implementing novel solution in the construction, operation and modernization of machines in accordance with the principles of sustainable development and the protection of natural resources and the environment.

SUBJECT OBJECTIVES

C1. The student is to learn about the structure and functioning of living nature, the effect of ecotoxins, and the greenhouse effect; to acquaint herself/himself with the hazards arising from the escalation of human industrial activity and with the legal regulations concerning environmental protection; to understand the environmental management systems, the ISO 14000 standard.
C2. The student is to acquaint herself/himself with the hazards involved in and the ways of acquiring energy from conventional and renewable sources and the principles of waste management – waste minimization and recycling, the LCA method.
C3. The student is to acquaint herself/himself with the principles of constructing, operating and modernizing machines, conducive to the protection of natural resources and the environment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows and understands the hazards arising from the greenhouse effect, the development of technology, energy acquisition and waste production and recycling.

PEK_W02 - The student understands the necessity of introducing environmental regulations; knows the environmental management systems; has knowledge relating to the implementation of ISO 14000.

PEK_W03 - The student knows and understands the hazards arising from the escalation of human activity; knows the principles and advantages of implementing the environment-friendly rules of constructing and operating machines.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, literature, what everyone can do to protect the environment.	2
Lec2	The sources of hazards arising from industrial activity and from the operation of machines, ecotoxins, the greenhouse effect, energy acquisition.	2
Lec3	The sources of hazards arising from industrial activity and from the operation of machines, ecotoxins, the greenhouse effect, energy acquisition.	2
Lec4	Environmental management, environmental management systems.	2
Lec5	Environmental management issues and the current standards: BS, EMAS, ISO 14000 and other.	2
Lec6	Environment-friendly methods and consequences of acquiring energy from conventional sources, hazards, trends.	2
Lec7	Environment-friendly methods of acquiring energy from renewable sources.	2
Lec8	Waste minimization, recycling, rational and eco-friendly methods of managing wastes; examples of recycling in selected branches of industry.	2
Lec9	Examples of recycling in selected branches of industry, recycling in the automotive industry.	2
Lec10	Waste management, waste sources, waste processing, energy recovery, safe storage, waste management monitoring.	2
Lec11	Environment-friendly materials in machine operation – oils, lubricants, greases.	2
Lec12	Biodegradability, toxicity, carcinogenicity and mutagenicity of consumable materials; polychlorinated biphenyls.	2
Lec13	New environment-friendly techniques in machine operation; sparing lubrication techniques, lubrication management in industry; seals and their effectiveness; the energy aspects of machine operation.	2
Lec14	The environmental aspects of the construction, use and modernization of machines.	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 , PEK_W02, PEK_W03	Written final test, oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology in industrial manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W20	C1, C2, C3	Wy1 - Wy14	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Zbigniew Wasiak tel.: 27-81 email: zbigniew.wasiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka w zastosowaniach inżynierskich**
Name in English: **Computer engineering applications**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of building and solving mathematical models of engineering problems.
2. Basic knowledge of computer and computer programming.

SUBJECT OBJECTIVES

C1. Preparation of the modern engineer to work according to the latest requirements of the application of computational tools.
C2. Gaining knowledge in the application of informatics and numerical computational techniques in tehnique.
C3. Gaining skills in selected functional programming environments, spreadsheets and computing environments for engineering applications.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Ability to program IT environment to carry out engineering calculations.
PEK_U02 - Ability to configure the IT supported calculation environment to perform engineering calculations.
PEK_U03 - The ability to connect the user interface to the database.

III. Relating to social competences:
PEK_K01 - Awareness of the role of the engineer in the manufacturing process and the need for accountability and involvement in one of the most important links of the production process in the company.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.
PEK_K03 - Understands the need for lifelong learning in the field of business engineering and professional as well social skills development.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Application of MAXIMA calculation tool.	7
Proj2	Application of GOOGLE DOCUMENTS tools	7
Proj3	EXCEL in engineering application	8
Proj4	Engineering application in Visual C++ environment	4
Proj5	Engineering application in Visual Basic environment	4
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises
N2. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Completion of project tasks and project defense
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Zbigniew Smogur, Excel w zastosowaniach inżynieryjnych, ISBN: 83-7197-641-0, HELION
2. Andrzej Stanisz, Przystępny kurs statystyki (w oparciu o program STATISTICA Pl)
3. Bogumiła Mrozek, Zbigniew Mrozek, MATLAB i Simulink. Poradnik użytkownika, HELION

SECONDARY LITERATURE
1. Maciej Gonet, Excel w obliczeniach naukowych i inżynierskich Wydanie II, ISBN: 978-83-246-3066-0, HELION
2. Dokumentacja do programu Statistica

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer engineering applications
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U10	C1 - C3	Pr1 - Pr5	N1, N2
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K09	C1 - C3	Pr1 - Pr5	N1, N2

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031011**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.
PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2

Lec2	Measurement, measurement types, method and measurement principle.	2
Lec3	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec4	Dimensions, tolerance of linear dimensions nad fits.	3
Lec5	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	3
Lec6	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec7	Tolerance and machine parts measurement.	6
Lec8	Tolerating and measurements of machines parts manufactured in the process of: casting, plastic forming, welding, plastics processing.	2
Lec9	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec10	Mehods and means of mechanization and automation of measurements.	2
Lec11	Analysis of dimension. Fundamentals of statistical control of dimensions.	2
Lec12	Fundamentals of coordinate measurement techniques.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Errors of measurement and assasement methods of measurement uncerteinaty.	2
Lab3	Measurements of linear dimensions.	2
Lab4	Measurements of angular dimensions.	2
Lab5	Direct and indirect measurements of cones.	2
Lab6	Identification and measurement of threads.	2
Lab7	Project of a tests.	2
Lab8	Assessment of the geometrical structure of the surface.	2
Lab9	Identification and measurement of cylindrical gears.	2
Lab10	Measurements of selected shape deviations.	2
Lab11	Measurements of selected displacement.	2
Lab12	Cams measurement.	2
Lab13	Measurements of machine parts with pneumatic measurement equipment.	2
Lab14	Verification of measuring instruments	2
Lab15	Coordinate masurements of machine parts.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03;	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE
[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K1ZIP_W06	C1; C2; C3; C4; C5; C6	Wy1 - Wy12	N1; N5
PEK_U01; PEK_U02; PEK_U03	K1ZIP_U06	C1; C2; C3; C4; C5; C6	La1 - La15	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03	K1ZIP_K04, K1ZIP_K05	C1; C2; C3; C4; C5; C6	La1 - La15	N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania mechanizmów**
Name in English: **Basics of mechanisms design**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	90			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	3			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of mathematics, physics and mechanics
2. ability to solve basic problems of mathematical analysis and the ability to describe the basic physical phenomena

SUBJECT OBJECTIVES

C1. Understanding the basic principles of construction and methods of analysis, modeling and design machines
C2. Understanding the properties of selected groups of planar and spatial mechanisms (linkages, gears, cams and manipulators)

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has a theoretical knowledge of analysis of kinematic system
PEK_W02 - has a theoretical knowledge of design of kinematic systems

II. Relating to skills:
PEK_U01 - The ability to define the basic elements of mechanism
PEK_U02 - The ability to build a computer model of the mechanism and ability to perform simulation researches
PEK_U03 - Ability to analyze of kinematics and kinetostatics of mechanisms using vector, analytical and computer methods

III. Relating to social competences:
PEK_K01 - a sense of responsibility for their own work and the willingness to comply with the rules work in a team and to take responsibility for collaborative tasks
PEK_K02 - Understands the impact of engineering

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview of machines and mechanisms, basics of structural analysis	2
Lec2	Structural analysis of mechanisms - mobility, local mobility, constraints	2
Lec3	Methods for the type synthesis of mechanisms	2
Lec4	Kinematic analysis of mechanisms - methods for determining the new positions, centers of rotation	2
Lec5	Kinematic analysis of mechanisms - methods for determining the velocity and acceleration	2
Lec6	Elements of dynamic analysis - forces in kinematic systems (inertial forces, the active forces, the forces in joints)	2
Lec7	Elements of dynamic analysis - Kinetostatics (vector method)	3
Lec8	Linkage mechanisms - property characterization, analysis and application	3
Lec9	Planetary gear mechanisms - analysis, characteristics, applications	2
Lec10	Manipulators (serial, parallel) -construction, characteristics, applications, kinematics manipulators	3
Lec11	Cam mechanisms- characteristics, applications, analysis and design	3
Lec12	The geometric synthesis of linkage mechanisms	2
Lec13	Test	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Structural analysis of mechanisms (class of joints, rules of schematization, mobility of mechanisms (project and short test)	3
Proj2	Basics of computer modeling of mechanisms in program SAM (Simulation and Analysis of Mechanism)	2
Proj3	Advanced modeling of mechanisms in the program SAM (dimensions, drives)	2

Proj4	Linkages mechanisms - kinematic analysis (vector method), (project and short test)	2
Proj5	Modeling and computer simulations of linkage mechanisms (project)	2
Proj6	Linkages mechanisms - kinetostatic analysis (vector method), (project and short test)	2
Proj7	Modeling and computer simulations of planetary gear mechanisms (project)	2
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. tutorials
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02	Evaluation of the project, Evaluation of the short test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of mechanisms design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1ZIP_W05	C1, C2	Le1-Le12	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U05	C1, C2	Pr1-Pr7	N2, N3, N4
PEK_K01, PEK_K02	K1ZIP_K04, K1ZIP_K09	C1, C2	Pr1-Pr7	N2, N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Bałchanowski tel.: 71 320-27-10 email: jacek.balchanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Procesy i techniki wytwarzania I**
Name in English: **The processes and manufacturing techniques I**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031017**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should has a basic knowledge about the basic mechanical properties of engineering materials; has ordered knowledge about the types of metallic engineering materials - their structure, properties, applications and principles of selection; has detailed knowledge about the structures of steel and cast iron, the principles of classification and labeling; has a basic knowledge about heat and thermo-chemical treatment, has a knowledge about alloy steels and non-ferrous metals and alloys. Has a theoretical knowledge about circuitry. Can analyze the macroscopic fractures, microstructure of materials, technological defects; is able to determine the characteristics of the microstructure of metallic materials; is able to identify the phases on the basis of equilibrium diagrams; can distinguish between the microstructure in terms of carbon content in steel, the influence of heat treatment; can read and interpret the drawings and diagrams used in technical documentation

SUBJECT OBJECTIVES

C1. To familiarize students with the processes and manufacturing techniques of production from the liquid metal, through the plastic molding and welding techniques.
C2. Acquisition of knowledge about the basic techniques of chipless processing and skills of parameters selection of these processes.
C3. The acquisition and consolidation of social skills including emotional intelligence involving the ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in the acting; observance of customs in academia environment and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic technologies of casting
PEK_W02 - Knows the basic technologies of plastic forming of elements
PEK_W03 - Knows the basic methods of welding and process parameters, and has the knowledge about the applications of welding processes, bonding and brazing in the manufacture of products.

II. Relating to skills:
PEK_U01 - Can choose a suitable casting technology and define the basic parameters of the process.
PEK_U02 - Can choose the technology of plastic forming and define the basic parameters of the process.
PEK_U03 - Can choose the appropriate method of joining the elements of the product and to determine the basic parameters of the process.

III. Relating to social competences:
PEK_K01 - Searching for the information and critical analysis,
PEK_K02 - Objective evaluation of arguments to justify, the rational translation and his own point of view using the knowledge about the casting, plastic forming and welding.
PEK_K03 - Observance the customs and rules of the academic environment,

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Description of the specifics of the manufacturing techniques, basic concepts and algorithms for the manufacture of casts	2
Lec2	Materials used for the production of molding and core sands as well as methods for producing and testing the properties of these sands.	2
Lec3	Methods for manual and automatic production of foundry molds and mold cores. Production of molds and cores from the chemo-and thermohardening sands	2
Lec4	Production of castings in permanent molds,	2
Lec5	Melting of the casting alloys and heat treatment of castings. Test.	2
Lec6	Effect of the strain on the structure and properties of the material.	2
Lec7	Cold and hot forming	2
Lec8	Sheet metal,	2

Lec9	volume machining	2
Lec10	Metal Forming Tools	2
Lec11	The types of joints and welds, welding positions, gas welding	2
Lec12	Arc welding with coated electrode, in protective gases (MAG, MIG, TIG) and under the flux	2
Lec13	Soldering and Brazing	2
Lec14	Resistance and friction welding	2
Lec15	Thermal cutting and welding stresses	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Sprawy organizacyjne. Study of the materials and molding sands. Technology of full mold.	2
Lab2	Hand and machine production of foundry molds and cores.	2
Lab3	Production of castings in forms of chemo-and thermohardening sands	2
Lab4	Production of castings in permanent molds	2
Lab5	Study the properties of alloys.	2
Lab6	Cold deformation and annealing of metals	2
Lab7	Rolling the metal sheets and profiles	2
Lab8	Metallurgical extrusion of machinery parts	2
Lab9	Manufacturing the metal products in the process of drawing	2
Lab10	Punching-cutting, bending and stamping	2
Lab11	Health and safety of welding, gas welding, thermal cutting	2
Lab12	Arc welding with coated electrode, in protective gases (MAG, MIG, TIG) and under the flux	2
Lab13	Resistance and friction welding.	2
Lab14	Soldering and Brazing	2
Lab15	Hidden arc welding, Welding stresses	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	entrance test- short test, quiz, oral answers, written tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000Granat K. Laboratorium z odlewnictwa, skrypt PWr., Wrocław 2007 Gronostajski J., Obróbka plastyczna metali, Wrocław 1974 http://www.metalplast.pwr.wroc.pl/instrukcje.html Ambroziak A. (red.): Techniki Wytwarzania. Spawalnictwo. Laboratorium. Pwr, Wrocław 2011, http://Www.Dbc.Wroc.Pl/Content/7156/Techniki_Wytwarzania_Spawalnictwo_A.Ambroziak_Linkowane.Pdf

SECONDARY LITERATURE
Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986Romanowski P., Poradnik obróbki plastycznej na zimno, Wydawnictwo Naukowo- Techniczne, W-wa 1976Pilarczyk J. (red.): Poradnik Inżyniera. Spawalnictwo. T. I i II, WNT Warszawa, 2003, 2005Klimpel A.: Spawanie, Zgrzewanie i Ciecie Metali., WNT, Warszawa, 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The processes and manufacturing techniques I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W08	C1, C2	Lec1 - Lec15	N1, N4, N5

PEK_U01, PEK_U02, PEK_U03	K1ZIP_U08	C1, C2, C3	Lab1-Lab15	N2, N3
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K04	C3	Lab1-Lab15	N4, N5

SUBJECT SUPERVISOR

dr inż. Wiesław Derlukiewicz tel.: 27-38 email: wieslaw.derlukiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**
Name in English: **Strength of materials**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031018**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2	1	1		
Number of hours of total student workload (CNPS)	90	30	60		
Form of crediting	Examination	Crediting with grade	Crediting with grade		
Group of courses					
Number of ECTS points	3	1	2		
including number of ECTS points for practical (P) classes		1	2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	0.7	1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of higher mathematics
2. Knowledge of the elements of material engineering
3. Knowledge of the elements of material engineering

SUBJECT OBJECTIVES

C1. Learning the elements and scope of application of the mechanics of uniform and non-uniform deformable objects
C2. Acquiring the skills of calculating tension
C3. Acquiring the skills of experimental determination of the mechanical properties of materials and their application to determine permissible stresses

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The students are able to recognise the type of loading and calculate the tensions for simple instances of loads and/or a determined length of fracture
PEK_W02 - The students are able to propose the basic criteria for evaluating material resistance to damage manifested in excessive strain and/or fracture caused by overloading or subcritical fracture development
PEK_W03 - The students are able to specify the basic options for preventing and/or controlling the fracture of material both during the production and processing, and its exploitation relating to skills

II. Relating to skills:
PEK_U01 - The students know how to calculate strain, stress, and the critical fracture length for simple method of loading
PEK_U02 - The students know how to experimentally determine the values of basic mechanical properties and use them to determine the admissible load level

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts of strength of materials. Types of defects and the criteria of their classification. The subject matter of the studies. External and internal forces. Definition of stress. The Saint-Venant's principle. The system of units applied in strength-related calculations. Simple cases of loading: tension and compression	2
Lec2	Simple cases of loading. Stress and strain analysis	2
Lec3	Simple cases of loading: shearing. Torsion of rods of circular section.	2
Lec4	Simple cases of loading. Free torsion of rods of any cross-section shape. Moments of inertia of plain figures.	2
Lec5	Bending	2
Lec6	Complex strength. Strength hypothesis.	2
Lec7	Complex strength. Basic examples of complex strength.	2
Lec8	Bending line of beams	2
Lec9	Statically indeterminate and complex instances of bending beams	2
Lec10	Buckling. Fatigue.	2
Lec11	Fracture of materials. Introduction to fracture mechanics. Testing resistance to unstable crack development in the plane strain condition. The advantages of the knowledge of KIC.	2
Lec12	The criteria and principles of applying fracture mechanics to design safe high-pressure devices	2
Lec13	Creep fracture. Testing resistance to creep fracture. The principles of evaluating and predicting the life (durability) of materials working in the creep conditions.	2

Lec14	Testing resistance to ductile/shear fracture. Introduction to shear fracture mesomechanics. The criteria for preventing and/or controlling shear fracture development. / Examples of the application of fracture mesomechanics in controlling the mechanical processes of the processing of materials	2
Lec15	The principles of material selection depending on their function, the imposed requirements (restrictions) and the aim. The material indices. The diagrams of properties and their application during the selection of materials.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Statistically determinate rod systems, thermally loaded and loaded with axial forces	2
Cl2	Statistically indeterminate systems during tension and compression	2
Cl3	Torsion of rods of circular section. Calculating helical springs.	2
Cl4	Pure and technological shearing. Calculating rivet, welded, clevis and key fasteners.	2
Cl5	Bending, determining normal stresses	2
Cl6	Calculating obliquely bent beams	1
Cl7	Application of the diagrams displaying the properties of materials and the maps of fracture mechanisms for multi-criteria selection of the strength properties of materials	2
Cl8	Test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction	2
Lab2	Metals and plastics tension test	2
Lab3	Measurement of strains using the electric resistance wire strain gauge	2
Lab4	Testing fatigue strength	2
Lab5	Strength tests in complex stress conditions – torsion with bending	2
Lab6	Buckling – experimental determination of the critical force of columns. Compression test	2
		Total hours: 12

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02,	Oral answers, (written) test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01	entrance test, report on laboratory classes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Niezgodziński M. E., Niezgodziński T.: Wytrzymałość materiałów. PWN, Warszawa 1998.Niezgodziński M. E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. WNT, Warszawa 1996.Niezgodziński M. E., Niezgodziński T.: Zadania z wytrzymałości materiałów. WNT, Warszawa 1997..Neimitz A.: Mechanika pękania. PWN, Warszawa 1998.Dzidowski E. S.: Mechanizm pękania poślizgowego w aspekcie dekohezji sterowanej metali. Wyd.PWr., Wrocław 1990.Dzidowski E. S.: Physical concept of shear fracture mesomechanism and its applications. Central European Journal of Engineering, 2011, nr 1(3), s. 217-233.Dzidowski E. S.: Jak projektować, wytwarzać i eksploatować rury do bezpiecznej pracy pod ciśnieniem. Rudy i Metale, 2008, nr 11, s. 714-721.

SECONDARY LITERATURE

Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974.Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W03	C1	lec1-lec15	N1
PEK_U01, PEK_U02	K1ZIP_U03	C2	cl1-cl7, la 1-6	N2

SUBJECT SUPERVISOR

dr hab. inż. Edward Dzidowski email: edward.dzidowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska 3D**
Name in English: **3D Engineering Graphics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031019**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			30	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses				X	
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in the use of CAD systems to creative and innovative design

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students should be know the rules of the modeling 3D of the machines parts and assemblies with using CAD systems
PEK_W02 - Students should be know the methods of analysis and testing the parameters of machines and equipment carried on 3D virtual models (virtual prototypes).
PEK_W03 - Students should be know the using of CAD systems for creative and innovative design.

II. Relating to skills:
PEK_U01 - Students should be able to build 3D models of machine parts
PEK_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEK_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:
PEK_K01 - Student gains the skills to take responsibility for their work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	CAx systems for design. Virtual prototyping.	2
Lec2	3D geometry modeling - parts. Solid and surface models.	2
Lec3	3D modeling - assemblies. Relationships, bonds, adaptability and variability of the model.	2
Lec4	The analysis of the virtual prototype. The analysis of the prototype on the virtual model (kinematic, dynamic).	2
Lec5	The model presentations. The methodology of the engineer work. Organization of work of the design team (data exchange formats, teamwork)	2
Lec6	Creative design	2
Lec7	Innovation and quality in the design	2
Lec8	Completion of the course	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - Advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	Basic solid modeling - Advanced operations on 2D sketches - function relationships of parameters, solid modeling with rotation, solid editing - shell models	2

Proj5	Basic solid modeling - solid modeling with rotation, one and multibody modeling	2
Proj6	Advanced solid operations - sweep, loft, split, scroll	2
Proj7	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj8	The project of assembly: preparing to create an assembly- parts assembling, bonds and relationships in the assembly	2
Proj9	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj10	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj11	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults, loads analysis	2
Proj12	The project of assembly: loads analysis, reactions and forces at the nodes, the presentation of the model	2
Proj13	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings	2
Proj14	The project of assembly: 2D technical drawings of assembly - assembly drawings	2
Proj15	Completion of the course: work during classes	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. self study - preparation for project class
N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = FW		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01	test, participate in problem discussions
P = 0,4*F1+0,6*FW		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
[2]Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE
[1]http://autodesk-inventor-pl.typepad.com/
[2]http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
3D Engineering Graphics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1ZIP_W04, K1ZIP_W05	C3	Wy1 - Wy7	N1, N2
PEK_U01 - PEK_U03	K1ZIP_U04, K1ZIP_U05, K1ZIP_U35	C1, C2	Pr1 - Pr14	N3, N4
PEK_K01	K1ZIP_K07	C3	Pr1 - Pr14	N1, N2

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania maszyn**
Name in English: **Fundamentals of Machine's Engineering Design**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031020**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	90			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	3			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge:
- student has knowledge on the fundamentals of mechanics, strength of materials and materials technology;
- student knows the basic rules of the technical drawing.
2. Skills:
- student can use the knowledge on mechanics, strength of materials and materials technology in practice;
- the student can graphically present technical objects.
3. Competences:
- the student understands and is aware of what the technological activity is and how it influences the environment.

SUBJECT OBJECTIVES

C1. To familiarize students with the design and operation principle of basic machine components, units and systems.
C2. To familiarize students with the rules of the engineering design process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the classes, the student is supposed to be able to recognize and select the basic machine elements, units and systems.
PEK_W02 - As a result of the classes, the student is supposed to be able to present the basic rules of the engineering design process.

II. Relating to skills:
PEK_U01 - As a result of the course, the student should be able to prepare the technical drawings of basic mechanical components, units and systems.
PEK_U02 - As a result of the classes, the student is supposed to be able select and to make engineering calculations of the basic machine elements, units and systems .

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Engineering design process.	2
Lec2	Welded joints.	2
Lec3	Load-carrying structures.	2
Lec4	Screw joints and mechanisms.	2
Lec5	Axes and shafts.	2
Lec6	Bearings and sealings.	2
Lec7	Machine shaft system.	2
Lec8	Couplings.	2
Lec9	Cylindrical gears.	2
Lec10	Bevel and worm gears.	2
Lec11	Belt transmissions.	2
Lec12	Drive systems.	2
Lec13	Fluid power elements and systems.	2
Lec14	An example of practical designing of a machine or a device.	2
Lec15	Reserve.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Development of the design assumptions for the built machine or device	2
Proj2	Analysis of the problem (group work): -determination of the quantitative data and the operational conditions, -generation of the conceptual solutions, -selection of the criteria and evaluation of the concepts, -selection of the final solution.	8
Proj3	Making the basic engineering calculations (individual work)	8

Proj4	Making the technical documentation (individual work): -assembly drawing (handwritten draft and a CAD software drawing), -working drawings (made by means of CAD software).	10
Proj5	Summary and conclusions	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Partial evaluation of the project
P = F2 + F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Osiński Z. i inni: Podstawy konstrukcji maszyn, PWN, Warszawa 1999,
2. Dietrich M. i inni: Podstawy konstrukcji maszyn. T.1-3, WNT, Warszawa 1995

SECONDARY LITERATURE

1. Pahl G., Beitz W.: Nauka konstruowania, WNT, Warszawa 1984,
2. Kurmaz L., Kurmaz O.: Projektowanie węzłów i części maszyn, Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machine's Engineering Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1ZIP_W04, K1ZIP_W05	C1, C2	Lec2-Lec13, Lec15	N1, N2, N3, N4
PEK_U01, PEK_U02	K1ZIP_U05	C1, C2	Proj1-Proj5	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jarosław Stryczek tel.: 71 320-20-70 email: Jaroslaw.Stryczek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przetwórstwo tworzyw sztucznych**
Name in English: **Processing of plastics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031022**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of the material and mechanical properties of engineering materials

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge on the classification, properties, and methods of processing plastics.
C2. Acquisition of skills identification and selection of polymeric materials for technical applications.
C3. The acquisition and consolidation of social skills including emotional intelligence skills relying on cooperation in the group of students with a view to effective problem solving. Responsibility, honesty and fairness in the procedure observance force in academia and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - knows the types and basic properties of polymeric materials
PEK_W02 - knows the basic method of processing of polymeric materials
PEK_W03 - has knowledge of the basics and applications of polymeric materials processing

II. Relating to skills:
PEK_U01 - able to identify polymeric materials
PEK_U02 - processing method is able to select the type of polymeric material
PEK_U03 - able to select a polymer material for technical applications

III. Relating to social competences:
PEK_K01 - search for information and its critical analysis
PEK_K02 - objectively examine the arguments, rational translations and justify their own point of view, using knowledge of plastic processing
PEK_K03 - observance and rules in academia

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Definitions of polymers and plastics. Methods for the preparation of polymers. The chemical and physical structure of polymers. Basic concepts of polymer materials.	2
Lec2	Modification of polymers. Types and effects of additives on the properties of plastics. Properties of polymeric materials for the metal.	2
Lec3	Construction, variety, properties and applications of selected polymers.	4
Lec4	Classification of methods of plastics processing. Methods of preparation. Selected methods of direct forming.	2
Lec5	Plastic extrusion technology. Variations of the process extrusion. Calendering.	2
Lec6	Plastic injection molding technology.	2
Lec7	Defects of injection molding products. Influence of process parameters on defect injection molded parts.	2
Lec8	Methods for forming the intermediate plastics.	2
Lec9	Processing of plastics - finishing methods.	2
Lec10	Polymer composites.	2
Lec11	Issues relating to the exploitation and consumption of polymeric materials.	4
Lec12	The problem of plastic waste. Classification of waste. Methods of polymer waste.	4
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. Identification of plastics.	2
Lab2	Methods of joining of plastic products.	2
Lab3	Molding of plastics products.	2

Lab4	Extrusion technology.	2
Lab5	Compression and thermoforming technology.	2
Lab6	Injection molding technology.	2
Lab7	The study of friction and abrasive wear of polymeric materials.	2
Lab8	Supplementary classes.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
N4. tutorials
N5. laboratory experiment, showing methods of plastics processing, display selected research methods

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written and oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03; PEK_K01, PEK_K02, PEK_K03	quick quiz, oral answer, laboratory reports, written tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Robert Sikora, tytuł: Processing of macromolecular materials, Wydawnictwo Edukacyjne Zofii Dobkowskiej, rok: 1993

SECONDARY LITERATURE
K.Wilczynski, tytuł: Processing of plastics

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Processing of plastics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W02, K1ZIP_W08, K1ZIP_W27	C1	Lec1-Lec12	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03;	K1ZIP_U02, K1ZIP_U08	C1, C2	Lab1-Lab8	N2, N4, N5
PEK_K02	K1ZIP_K02	C3	Lab1-Lab8	N2, N4, N5

SUBJECT SUPERVISOR

dr inż. Joanna Pach tel.: 71-320-42-78 email: joanna.pach@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszyny i urządzenia technologiczne**
Name in English: **Technological machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031023**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge relating to the design-construction process and the structure and working of machine components and units.
2. The student has sound knowledge relating to the basic manufacturing techniques and the role of technological machines.
3. The student can read and interpret the figures and schematics used in machine engineering documentation.

SUBJECT OBJECTIVES

C1. The student is to learn the structure of principal technological machines, especially their drive, control and measuring systems.
C2. The student is to learn the basic technical-operational characteristics of modern technological machines.
C3. The student is to learn the principles and possibilities of using technological machines to perform specific machining tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the structure and principles of operation of modern technological machines, especially their kinematics and the principles of controlling their operation
PEK_W02 - The student knows the principles of selecting technological machines to perform specific machining tasks.
PEK_W03 - The student knows the basic testing methods used to assess the condition of technological machines.

II. Relating to skills:
PEK_U01 - The student can evaluate technological machines from the point of view of their suitability for specific machining tasks.
PEK_U02 - The student can define how a technological machine is to function.
PEK_U03 - The student can determine the basic parameters characterizing the operation of a technological machine.

III. Relating to social competences:
PEK_K01 - The student knows how to search for and use the literature recommended for the course and acquire knowledge on her/his own.
PEK_K02 - The student can exploit basic knowledge relating to the methods of controlling the operation of technological machines.
PEK_K03 - The student understands the necessity of systematic and unassisted work in order to master the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Significance and development of manufacturing technology. General characteristics of manufacturing machines and their classification. Technical and operational parameters. Basic requirements.	2
Lec2	Geometrical and kinematic structures of the machines. Parts, mechanisms and components of manufacturing machines: bodies, spindle and guiding assemblies, tooling and workpiece systems.	2
Lec3	Main drive and feeding systems of modern manufacturing machines (basic requirements, exemplary solutions). Measurement, diagnostics and supervision systems.	4
Lec4	Basics of automatic control of manufacturing machines. Classification of control systems (NC, CNC, DNC, AC and PLC systems). Elements of programming CNC machines.	2
Lec5	Cutting machine tools for machining rotating surfaces - lathes. The technical and utility characteristics and function of the machines. Automated turning machines	4
Lec6	Cutting machine tools for machining rotating and flat surfaces - drills, milling machines, boring machines. The technical and utility characteristics and function of the machines.	2
Lec7	Cutting machine tools for machining rotating and flat surfaces - grinders, planers and slotters. The technical and utility characteristics and function of the machines.	2

Lec8	Machine tools for special technical shapes (threads and teeth) – their structural components and technological function. Multitasking machines (in-line transfer machines).	2
Lec9	Machines for electrical discharge and laser machining - technical & usable features and purpose of the machines.	2
Lec10	Selected structures of NC machines for chipless machining (technical & usable features and purpose of the machines).	2
Lec11	CNC machining centres, autonomous machining stations. The role of robots and manipulators in production automation.	2
Lec12	Multimachine robotized manufacturing systems. Computer-integrated manufacturing systems (CIM).	2
Lec13	Trends in development of CNC manufacturing machines (machines for HSC machining, hexapods, intelligent and hybrid machine tools).	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	The checking of the geometric accuracy of the cutting machine tool, using the lathe as an example.	2
Lab2	The measurement of power losses during non-load operation and the overall efficiency of a machine.	2
Lab3	The assessment of machine loudness.	2
Lab4	The change of rotational motion to rectilinear motion in technological machines.	2
Lab5	Measurements of energy losses in spindle rolling bearings.	2
Lab6	The accuracy of fixing the slidable machine units.	2
Lab7	Selected problems relating to the dynamic properties of machine tools.	2
Lab8	Laboratory crediting.	1
		Total hours: 15

TEACHING TOOLS USED

N1. the traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written examination.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_U02, PEK_K03	Short tests on the particular laboratory topics.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warszawa, 2000.
Kosmol J.: Automation of machine tools and machining. WNT, Warszawa, 2000.
Honczarenko J.: Numerically controlled machine tools. WNT, Warszawa, 2009.
Wrotny L. T.: Machine tools for metal cutting. WNT, Warszawa, 1979.
Białek M. : Technological machines. Oficyna Wydawnicza Politechniki Warszawskiej, 1995.

SECONDARY LITERATURE

Paderewski K.: Vademecum of machine tools. WNT, Warszawa, 1979.
Dmochowski J., Uzarowicz A.: Machining operations and machine tools. PWN, Warszawa, 1980.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technological machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W08	C1, C2, C3	Wy1 - Wy13	N1, N2, N4
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U12	C1, C2, C3	La1 - La7	N2, N3
PEK_K01, PEK_U02, PEK_K03	K1ZIP_K04	C1, C2, C3	La1 - La8	N1 -N4

SUBJECT SUPERVISOR
dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekonometria**
Name in English: **Econometrics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of probability theory.
2. Statistical sampling: statistical sample term, statistical experiment design, sample results presentation, statistics calculations from the sample and populations structure.
3. Matrix analysis.

SUBJECT OBJECTIVES

C1. Gaining knowledge, including applicational aspects, from the econometrical modeling.
C2. Gaining ability to interpret quantitative and qualitative results on the basis of conducted calculations.
C3. Gaining skills in the optimal set of explanatory variables for the econometric model selection , econometric model building,model verification on the basis of tests.
C4. Gaining skills in the scope of regression equation assessment.
C5. Gaining skills how to think and act creatively and logically, how to solve given problems, defining priorities in order to execute given task

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows types and application of the econometrical models, explanatory variables classification and explanatory variable selection metohods.
PEK_W02 - Knows assumptions regarding the random component in the LSM method and tests allowing to verify the efficiency of LSM-estimate.
PEK_W03 - Knows the ways of regression equation assessment

II. Relating to skills:
PEK_U01 - Can select explanatory variables do teh econometrical model. on the basis of the variables can biuld the model, and subsequently can verify the model's correctness.
PEK_U02 - Can interpret the parameters, graphs, results - both quantitative and qualitative.
PEK_U03 - Can conduct calculations with the use of computer software enabling indepth data analysis .

III. Relating to social competences:
PEK_K01 - Can think and act in a creative way.
PEK_K02 - Can draw logical conclusions and can properly solve given problem.
PEK_K03 - Can properly define priorities that serve the execution of the given task.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Econometrics and econometrical model - the terms. The subject of the econometrical modeling and econometrical modeling applications.	2
Lec2	Repetition regarding regression analysis knowledge, including: parameters estimation - Least Squere Method, correlation analysis - Pearson's coefficient.	2
Lec3	Econometrical models classification. Models variables classification.	2
Lec4	Regression equation assessment - estimated parameters precision, equation fitting to the empirical data.	2
Lec5	Autocorrelation of the random component- Durbin-Watson test, normality of the random component - Shapiro-Wilk test.	2
Lec6	Randomness of the random component verification: series test, symmetry of the random component - symmetry test, homoscedasticity of the random component - Goldfeld-Quandt test.	2
Lec7	Explanatory variable selection metohods - intruduction.	2
Lec8	Explanatory variable selection metohods: Hellwig's method, graph method, analysis of correlation coefficients.	2
Lec9	Information criteria as a basis of model selection (AIC, BIC).	2
Lec10	Information entropy - Shannon's theorem.	2
Lec11	Software aiding econometrical calculations - introduction.	2
Lec12	Statistica software- - basic commands, results interpretation.	2
Lec13	R language software - basic commands, results interpretation.	2
Lec14	Econometrics in the production engineering aplication.	2
Lec15	Test	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Organizational issues. Parameters estimation, correlation analysis - tasks.	2
Proj2	Estimated parameters precision assessment. Equation fitting to the empirical data - tasks.	2
Proj3	Autocorrelation of the random component- Durbin-Watson test, normality of the random component - Shapiro-Wilk test.	2
Proj4	Randomness of the random component verification: series test, symmetry of the random component - symmetry test, homoscedasticity of the random component - Goldfeld-Quandt test.	2
Proj5	Explanatory variable selection metohods: Hellwig's method, graph method, analysis of correlation coefficients.	2
Proj6	R language software - basic commands usage, calculations.	2
Proj7	R language software - tasks. Test.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. Computer software
N4. problem exercises
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03;	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1		
P =		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02, PEK_U03 ; PEK_K01, PEK_K02, PEK_K03;	entry test, oral answers, written exams, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Dziechciarz J., Ekonometria. Metody, przykłady, zadania, Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu, Wrocław 2002,
Kukuła K., Wprowadzenie do ekonometrii w przykładach i zadaniach, Wydawnictwo Naukowe PWN, Warszawa 1999,
Gajda J., Ekonometria, Wydawnictwo C.H. Beck, Warszawa 2004,
Welfe A., Ekonometria, Polskie wydawnictwo Ekonomiczne, Warszawa 2003,
Gruszczyński M., Podgórska M., Ekonometria, Szkoła Główna Handlowa w Warszawie, Warszawa 2003

SECONDARY LITERATURE

Statystyczna analiza danych z wykorzystaniem programu R /red. nauk. Marek Walesiak, Eugeniusz Gatnar ; [aut. Andrzej Bąk et al.] Warszawa: Wydawnictwo Naukowe PWN, 2009,
Ekonometria i badania operacyjne :podręcznik dla studiów licencjackich /red. nauk. Marek Gruszczyński, Tomasz Kuszewski, Maria Podgórska ; aut. Anna Decewicz [et al.]. Warszawa : Wydawnictwo Naukowe PWN, 2009,
Statystyka dla inżynierów /Witold Klonecki. Warszawa : Wydawnictwo Naukowe PWN, 1999,
Nowak R., Statystyka dla fizyków, Wydawnictwa Naukowe PWN, Warszawa 2002
Shannon E. C., A Mathematical Theory of Communication, The Bell System Technical Journal, Vol. 27, lipiec, październik, 1948,
T. Bednarski, F. Borowicz, On inconsistency of Hellwig's variable choice method in regression models, Discussiones Mathematicae Probability and Statistics 29 (2009),
Arnold T. W., Uninformative Parameters and Model Selection Using Akaike's Information Criterion, Journal of Wildlife Management 74(6):1175–1178; 2010; DOI: 10.2193/2009-367,
Chow G.C., Ekonometria, Wydawnictwo Naukowe PWN, Warszawa 1995
Mercik J., Szmigiel C., Ekonometria, Wyższa Szkoła Zarządzania i Finansów we Wrocławiu, Wrocław 2000,
Peracchi F., Econometrics, Jonh Wiley & Sons Ltd, Chichester, West Sussex 2001,
Hellwig Z., Problem optymalnego wyboru predykant, Przegląd statystyczny, R.XVI, zeszyt 3-4, 1969
Baye M., Managerial economics and business strategy, Boston McGraw Hill, 2009,
Chiang A.C., Podstawy ekonomii matematycznej, Państwowe Wydawnictwo Ekonomiczne, Warszawa 1994,
Theil H., Zasady ekonometrii, Państwowe Wydawnictwo Naukowe, Warszawa 1979

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Econometrics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W01	C1	Wy1 - Wy15	N1, N5
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U01	C2,C3,C4	Pr1 - Pr7	N2 ,N3, N4, N5
PEK_K01, PEK_U02 PEK_K03	K1ZIP_K05	C5	Pr1 - Pr7	N2 ,N3, N4, N5

SUBJECT SUPERVISOR
dr inż. Maria Rosienkiewicz tel.: 43 84 email: maria.rosienkiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy logistyki**
Name in English: **Fundamentals of logistics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031031**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the organization and operation of the production enterprise

SUBJECT OBJECTIVES

C1. To familiarize students with the basic tasks of logistics business processes.
C2. Some specific models and methods used in the design and evaluation of logistics systems.
C3. Characterization of core technology and material flow logistics information systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the structure of the logistics system, its components and the relationships between them.
PEK_W02 - He knows the methods and strategies of managing logistics processes in the enterprise

II. Relating to skills:
PEK_U01 - It can be used for selected models and methods for the design, management and evaluation of logistics system.
PEK_U02 - He can choose the material flow technology and information flow

III. Relating to social competences:
PEK_K01 - Able to present opinions on the social and environmental impact of the operation of the supply chain.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	History of the development of logistics. Basic concepts and definitions.	2
Lec2	System and logistics process, structure. classification criteria	2
Lec3	Strategies for managing logistics processes; Just In Time.	2
Lec4	Logistics supply. Inventory management.	2
Lec5	Logistics of production. Range of computer support: MRP I, MRP II, ERP.	2
Lec6	Logistics distribution. Demand forecasting	2
Lec7	Reverse logistics. Ecologistics	2
Lec8	Information technology, automatic identification method.	2
Lec9	Information Technology, Electronic Data Interchange.	2
Lec10	Packaging. Basic functions. Logistic label.	2
Lec11	Technologies of storage.	2
Lec12	Handling technology	2
Lec13	Transport technologies. Linear infrastructure .	2
Lec14	Logistics centers. Point infrastructure .	2
Lec15	Logistics optional; examples: peacekeeping, health, public events.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Introduction to exercise. Overview of the exemplary embodiment of the supply chain	2
Cl2	Inventory management. Classification ABC / XYZ.	2
Cl3	Forecasting demand	2
Cl4	Selection of inventory control system	2
Cl5	Simulation of a Kanban production system	2
Cl6	Transport management in the context of supply chain	2

Cl7	Storage. Summary of activities.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem exercises
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Written exam - test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01	test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Ballou R.H. Business :ogistics / Supply Chain Management. Pearson Education Inc. 2004.
Logistyka. Red. D. Kisperska_Moroń, S. Krzyżaniak. ILiM, Poznań 2009.
Logistyka. Teoria i praktyka.Tom I i II. Red. S. Krawczyk. Difin, Warszawa 2011.

SECONDARY LITERATURE
Zając P.: CRM - Zarządzanie relacjami z klientem w logistyce dystrybucji. Navigator 17. Oficyna Wydaw. Politechniki Wrocławskiej, Wrocław 2007.
Kwaśniowski S., Nowakowski T., Zając M.: Trasnport intermodalny w sieciach logistycznych. Navigator 18. Oficyna Wydaw. Politechniki Wrocławskiej, Wrocław 2008.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of logistics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ZIP_W17	C1, C3	Lec1, Lec2, Lec8 - Lec15	N1
PEK_W02	K1ZIP_W17	C2	Lec2 - Lec7	N1
PEK_U01	K1ZIP_U17	C2	Cl1 - Cl7	N2, N3
PEK_U02	K1ZIP_U17	C2	Cl1 - Cl7	N2, N3
PEK_K01	K1ZIP_K02	C1	Cl1 - Cl7	N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Tomasz Nowakowski tel.: 71 320-35-11 email: Tomasz.Nowakowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy informatyczne w zarządzaniu przedsiębiorstwem**
Name in English: **Information systems in the enterprise management**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031033**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the operation of the business in terms of materials management.
2. The ability to acquire information from the documents and their interpretation.
3. Computer skills.

SUBJECT OBJECTIVES

C1. Introduction to the problems of integrated management systems
C2. Getting the student from the basic knowledge of the mode of action and implementation of MRP II and ERP
C3. Acquisition of basic umiętności using MRP II and ERP

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of integrated manufacturing systems
PEK_W02 - Knowledge of the concepts used in Integrated Information System - stuktura production, purchasing position, route and schedule of technology
PEK_W03 - Knowledge of Integrated Information System applications in production

II. Relating to skills:
PEK_U01 - Ability to use integrated management system, for example IFS Application
PEK_U02 - Ability to use technology production structure
PEK_U03 - Ability to design a technological route in Integrated Information System

III. Relating to social competences:
PEK_K01 - Able to work in a group, went through various roles in the organization of enterprises
PEK_K02 - Recognizes the importance of data quality in Integrated Information System

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Batch, Characteristics of the production cycle	2
Lec2	Stocks Production, Production Planning	2
Lec3	Management Information Systems, MRP I and MRP II	4
Lec4	Workflow systems	2
Lec5	CASE * Method, function hierarchy diagrams	2
Lec6	Methods for identifying the functions of the company, depending on the function diagrams, entity relationship diagrams	3
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Preliminary information on the operation of IFS Applications. Generating companies in IFS Applications. Defining the structure of production.	2
Proj2	Defining the position of purchase. Defining costs. Sales.	2
Proj3	Entering data storage products. Define the product structure.	2
Proj4	Defining the position of product in different production lines. Routes production.	5
Proj5	Entry of items in shopping. Generate schedule. Generating MRP report.	2
Proj6	Generating MRP report.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem exercises
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02	Presentation and defense of the MRP report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Zintegrowany system zarządzania przedsiębiorstwem IFS Applications : ćwiczenia z obsługi : wybrane moduły : praca zbiorowa / pod red. Leszka Kiełtyki ; Politechnika Częstochowska.
2. Oracle : system zarządzania bazą danych : podręcznik użytkownika / Michał Lentner. Warszawa : Akademicka Oficyna Wydawnicza EXIT, 2001.

SECONDARY LITERATURE
SAP - zrozumieć system ERP / Jerzy Auksztol, Piotr Balwierz, Magdalena Chomuszko. Warszawa : Wydawnictwo Naukowe PWN, 2012.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Information systems in the enterprise management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W10, K1ZIP_W15	C1, C2, C3	Lec1 - Lec6	N1, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U15, K1ZIP_U23	C2, C3	Pr1 - Pr6	N3
PEK_K01, PEK_K02	K1ZIP_K11	C3	Pr1 - Pr6	N3

SUBJECT SUPERVISOR

dr inż. Arkadiusz Kowalski tel.: 37-10 email: arkadiusz.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ergonomia i BHP**
Name in English: **Ergonomics and safety**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ZPM031102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases	2
Lec3	estimate of professional risk on work positions	2
Lec4	Ergonomics as interdisciplinary science	2
Lec5	Labor biomechanics - science about threats for employee health discovering, being result of executable work	2
Lec6	Dangerous and harmful agents in work environment - mechanical agents and electric power	2
Lec7	Dangerous and harmful agents in work environment - noise, vibrations and lighting	2
Lec8	Dangerous and harmful agents in work environment - chemical and biological agents	2
Lec9	First pre-medical aid	2
Lec10	Fire protection	2
Lec11	Threats and work protection at transport manual labour	2
Lec12	Heights work and closed-containers work as especially dangerous works.	2
Lec13	Sitting work geometry, computer work stand.	2
Lec14	Breaks at work, shift work. Stress at work.	2
Lec15	Work physiology. Work environment microclimate. Ventilation and air conditioning at accomodation.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE
D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ergonomics and safety
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ZIP_W21	C1	Lec1, Lec2, Lec3, Lec9, Lec10, Lec11, Lec12, Lec14, Lec15	N1, N2, N3, N4
PEK_W02	K1ZIP_W21, K1ZIP_W24, K1ZIP_W25	C2	Lec4, Lec5, Lec13	N1, N2, N3, N4
PEK_W03	K1ZIP_W20, K1ZIP_W21	C3	Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Prawo patentowe**
Name in English: **Patent law**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ZPM031103**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				10
Number of hours of total student workload (CNPS)	30				30
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	1				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in the area of production management and services, accounting and finance.
2. General knowledge in the field of innovation.

SUBJECT OBJECTIVES

C1. Awareness of the need to protect their wealth through legal channels.
C2. To familiarize students with the law in the area of protection of inventions and utility models in Poland and abroad.
C3. Description of the patent examples.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Indicate the need of protection of by legal means
PEK_W02 - Describe the law in the field of inventions and utility models in Poland and abroad.

II. Relating to skills:
PEK_U01 - Utilize knowledge of intellectual property protection
PEK_U02 - Posłużyć się prawem w obszarze ochrony własności intelektualnej w celu zabezpieczenia swoich przywilejów związanych z wykonywanym zawodem.

III. Relating to social competences:
PEK_K01 - Understands the need and knows the possibility of lifelong learning (studies II and III degree, postgraduate courses) - raising professional competence as well as personal and social
PEK_K02 - Understand the legal aspects and effects of engineering activities.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to protection of inventions and utility models	2
Lec2	The protection of inventions and utility models under the national law	5
Lec3	The protection of inventions and utility models under the international law	4
Lec4	Sources of patent information	2
Lec5	Examples of descriptions of utility models and inventions	2
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Prepare and present a multimedia presentation issue related to the student's chosen topic in the area of intellectual property protection.	15
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. case study
N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	test
P = kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Evaluation of the report
P = raport, prezentacja multimedialna		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Poradnik wynalazcy, Andrzej Pyrża, Warszawa 2008Własność intelektualna i przemysłowa, Aldona Małgorzata Dereń, Oficyna Wyd. PWSZ w Nysie, 2007Ochrona własności intelektualnej, Grzegorz Michniewicz, 2010

SECONDARY LITERATURE

Opis patentowy jako źródło informacji, Małgorzata Gajos, Wyd. Uniwersytetu Śląskiego, Katowice 2000.Co wiesz o wynalazczości, Z. Koczara, Z. Patrzałek, Instytut Wy. CRZZ, 1979

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Patent law
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1ZIP_W22, K1ZIP_W26	C1, C2	Lec1-lec5	N1, N3
PEK_U01, PEK_U02	K1ZIP_U22, K1ZIP_U26	C3	Se1	N2
PEK_K01, PEK_K02	K1ZIP_K01, K1ZIP_K09	c3	Se1	n2

SUBJECT SUPERVISOR
dr inż. Krzysztof Kędzia tel.: 71 320-26-67 email: krzysztof.kedzia@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowe zarządzanie eksploatacją i utrzymaniem ruchu maszyn i urządzeń**
Name in English: **Computer aided operation and maintenance management of machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ZPM031107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	15	
Number of hours of total student workload (CNPS)	60		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge of the structure and operation of machine elements and units and the principles of matching and constructing tchem.
2. The student has basic knowledge of materials science, metrology and information science.
3. The student has sound knowledge relating to the principal manufacturing techniques and the role of technological machines.

SUBJECT OBJECTIVES

C1. The student is to learn the general rules concerning the use, maintenance and repair of machines.
C2. The student is to learn the general methods and tools of the computer support of maintenance processes.
C3. The student is to learn the possibilities of managing machine operation and planning and managing repairs in the enterprise.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the range of maintenance actions, the general principles of selecting a maintenance strategy and the ways of organizing maintenance actions.
PEK_W02 - The student knows the basic problems relating to the management of operation and maintenance in industrial plants.
PEK_W03 - The student knows the basic characteristics and capacities of the computer systems aiding the planning of service-repair tasks, stock management and service-repair personnel management.

II. Relating to skills:
PEK_U01 - The student can exploit the acquired knowledge to formulate technical, organizational and economic actions relating to the operation of manufacturing machines and equipment.
PEK_U02 - The student can develop general assumptions for selected maintenance strategies.
PEK_U03 - The student can use modern IT tools for the computer management of operation processes.

III. Relating to social competences:
PEK_K01 - The student knows how to search for and use the literature recommended for the course and acquire knowledge on her/his own.
PEK_K02 - The student can use modern IT tools.
PEK_K03 - The student understands the necessity of systematic and unassisted work in order to master the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introductory problems relating to operation of technological systems (operation ability, its measures and indicators). Physicochemical basis of machine and equipment operation. The role of technical diagnostics.	4
Lec2	Operational models and principles of operation control. Basic reliability definitions and terms.	2
Lec3	Basic problems relating to maintenance (tasks, strategies and trends). The essence of the Total Productive Maintenance (TPM) system - framework and supporting pillars, ratings.	4
Lec4	Maintenance versus enterprise management (ERP systems). The role and importance of maintenance planning. The role and organization of the Maintenance Department.	2
Lec5	Models and organizational structures of maintenance services. Activities of maintenance services. Cost related problems.	2
Lec6	Introduction to computer-aided maintenance management. Classification and characterization of tools. The information structure and practical properties of CMMS class systems.	4
Lec7	Presentation of selected CMMS systems – the basic modules, the range of application. The selection criteria.	4
Lec8	Computer support of the planning and carrying out of machine and equipment service-repair work. Examples of applications.	2

Lec9	Principles of implementing systems in industrial practice (benefits and problems). Practical examples.	4
Lec10	Course crediting.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction. The presentation of a selected CMMS system – the user interface, the basic modules, the practical properties.	4
Proj2	The identification of operational objects and resources. The operational structure. Data logging.	2
Proj3	The planning of operational actions and instructions. Keeping records of material and human resources.	2
Proj4	The planning and carrying out of tasks. The development of instructions for operational actions.	2
Proj5	The planning of employee workloads. The generation of cards with tasks for maintenance objects.	2
Proj6	Stock management. Analyses and reports. The management of engineering documentation.	2
Proj7	Course crediting.	1
		Total hours: 15

TEACHING TOOLS USED

N1. The traditional lecture with the use of transparencies and slides.
N2. Tutorials.
N3. Self-study.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_K02, PEK_W03	Final test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	The grading of the tasks carried out as part of the particular topics.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Base of operation of machinery and equipment. Wyd. WSiP. Warszawa, 2007.
Słowiński B.: Engineering of machines maintenance. Wyd. Pol. Koszalińskiej. Koszalin, 2011.
Kaźmierczak J.: The operation of technical systems. Wyd. Pol. Śląskiej. Gliwice, 2000.

SECONDARY LITERATURE

Hebda M.: Elements of operation theory of technical systems. Wyd. MCNEMT. Radom, 1990.
Żółtowski B.: The basics of machine diagnostics. Wyd. ATR Bydgoszcz. Bydgoszcz, 1996.
Honczarenko J.: Flexible manufacturing automation. Obrabiarki i systemy obróbkowe. WNT Warszawa, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer aided operation and maintenance management of machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_K02, PEK_W03	K1ZIP_W11	C1, C2, C3	Wy1 - Wy9	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U11	C1, C2, C3	Pr1 - Pr6	N3
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K10	C1, C2, C3	Pr1 - Pr6	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie przedsięwzięciem**
Name in English: **Management of an undertaking**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ZPM031110**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Familiarizing oneself with today's knowledge of project management.
C2. Learning the proper preparation of the project.
C3. Learning the proper supervision of the execution of the project.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of the project life cycle
PEK_W02 - Knowledge about management of objectives, integration of tasks, time and cost
PEK_W03 - Knowledge about quality and risk management as well as human resources and expenses management

II. Relating to skills:
PEK_U01 - Ability to prepare the project (technical development of the project).
PEK_U02 - Ability to supervise the implementation of the project.
PEK_U03 - Ability to manage of a project management in a methodical way.

III. Relating to social competences:
PEK_K01 - Awareness of the role of the engineer in the planning of projects and the need for accountability and involvement in one of the most important links in the enterprise management process.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.
PEK_K03 - Understands the need for lifelong learning in the field of business engineering and professional as well as social skills development.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The life cycle of the project: Initiation, Planning, Commissioning, Control and Monitoring, Closure	4
Lec2	Integration management	4
Lec3	Goals management	4
Lec4	Management of time and costs	6
Lec5	Management of quality and risk	6
Lec6	Management of human ressources and expenses	6
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Split into project groups and selection of project topic	1
Proj2	Presentation of a subject, goal and range of the project	2
Proj3	Communication	2
Proj4	Detailed goals and analysis of project feasibility	2
Proj5	Activities and ressources	2
Proj6	Schedule	2
Proj7	Estimation of costs	2
Proj8	Quality and risk management	2
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. problem exercises
N3. self study - preparation for project class
N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02, PEK_K03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Completion of project task
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. „A Guide to the Project Management Body of Knowledge: Third Edition (PMBOK Guide)", Project Management Institute, 2004, ISBN: 193069945X

SECONDARY LITERATURE
2. Nancy Mingus „Management of projects"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management of an undertaking
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W14	C1	Lec1 - Lec6	N4
PEK_U01, PEK_U03	K1ZIP_U19	C2	Pr1 - Pr8	N1, N2, N3
PEK_U02	K1ZIP_U14	C3	Pr1 - Pr8	N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K09		Lec1	N4

SUBJECT SUPERVISOR

dr inż. Joanna Gąbka tel.: 41-84 email: joanna.gabka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Operacyjne sterowanie wytwarzaniem**
Name in English: **Operational control of manufacturing**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ZPM031201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the operation of the manufacturing enterprise.
2. Knowledge of technological processes in manufacturing.
3. Computer skills (Windows).

SUBJECT OBJECTIVES

C1. Get to know the essence of manufacturing operational control in various industries.
C2. Getting familiar with the methods and problems of scheduling of production orders
C3. Gathering scheduling skills using a dedicated IT tool.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of the principles and methods of construction schedules for production orders.
PEK_W02 - Knowledge of the basic criteria for optimizing schedules.
PEK_W03 - Knowledge of scheduling strategies in companies from various industries.

II. Relating to skills:
PEK_U01 - Ability to prepare a schedule for production orders.
PEK_U02 - Ability to use IT tools for building schedules.
PEK_U03 - Ability to apply schedule optimization based on selected criteria.

III. Relating to social competences:
PEK_K01 - Awareness of the role of the engineer in the planning of production and demand for accountability and involvement in one of the most important links of the production process in the company.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.
PEK_K03 - Understands the need for lifelong learning in the field of business engineering and professional and social skills development.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Manufacturing operational control in various industrial sectors.	2
Lec2	Methods and techniques of manufacturing operational control.	2
Lec3	Scheduling of production orders on the example of selected information tool.	2
Lec4	Scheduling methods using a chosen IT tool	2
Lec5	An example of operational control of manufacturing in a chosem manufacturing company	2
Lec6	Scheduling algorithms and methods to optimize scheduling	2
Lec7	An example of operational control of manufacturing in a chosem manufacturing company	2
Lec8	Methods for production data acquisition	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Establishing a simple schedule.	2
Proj2	Shortening the time of production orders in the prepared schedule.	2
Proj3	Scheduling of assembling processes.	2
Proj4	Self construction of a schedule and the use of known methods of shortening the lead time.	2
Proj5	Construction and comparison of different versions of the schedule.	2
Proj6	Modifying the schedule as a result of failure or planned maintenance activities	2
Proj7	The use of optimization algorithms to schedule production orders	2
Proj8	Modification of the schedule as a result of the current time data obtained from production	1

	Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. problem exercises
N3. traditional lecture with the use of transparencies and slides
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Completion of project task.
F2	PEk_K01, PEK_K02, PEK_K03	Project defense
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Czesław Smutnicki, Algorytmy szeregowania, Akademicka Oficyna Wydawnicza EXIT, ISBN: 83-87674-39-7
2. Muhlemann A., Oakland J., Lockyer K.: Zarządzanie Produkcja i Usługi, Wydawnictwo Naukowe PWN, Warszawa 2001

SECONDARY LITERATURE
1. Brzeziński M.: Organizacja i sterowanie produkcją, Placet, Warszawa 2002
2. Durlik I.: Organizacja i zarządzanie produkcją, Warszawa 2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operational control of manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_ZPW_W02	C1, C2	Lect1 - Lec8	N1, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U15, K1ZIP_ZPW_U02	C3	Pr1 - Pr8	N2, N4
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K07	C1	Pr1 - Pr8	N3

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo, normowanie i ergonomia w organizacji pracy**
Name in English: **Safety, standarization and ergonomics in work organization**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ZPM031202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases	2
Lec3	Estimate of professional risk on work positions	2
Lec4	Ergonomics as interdisciplinary science	2
Lec5	Labor biomechanics - science about threats for employee health discovering, being result of executable wor	2
Lec6	Dangerous and harmful agents in work environment - mechanical agents and electric power	2
Lec7	Dangerous and harmful agents in work environment - noise, vibrations and lighting	2
Lec8	Dangerous and harmful agents in work environment - chemical and biological agents	2
Lec9	First pre-medical aid	2
Lec10	Fire protection	2
Lec11	Threats and work protection at transport manual labour	2
Lec12	Heights work and closed-containers work as especially dangerous works.	2
Lec13	Sitting work geometry, computer work stand.	2
Lec14	Breaks at work, shift work. Stress at work.	2
Lec15	Work physiology. Work environment microclimate. Ventilation and air conditioning at accomodation.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE
D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Safety, standarization and ergonomics in work organization
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ZIP_W21	C1	Lec1, Lec2, Lec3, Lec9, Lec10, Lec11, Lec12, Lec14, Lec15	N1, N2, N3, N4
PEK_W02	K1ZIP_W21, K1ZIP_W24, K1ZIP_W25	C2	Lec4, Lec5, Lec13	N1, N2, N3, N4
PEK_W03	K1ZIP_W20, K1ZIP_W21	C3	Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ochrona własności intelektualnej**
Name in English: **Protecting intellectual property**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **ZPM031204**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				15
Number of hours of total student workload (CNPS)	30				30
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	1				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge in the field of innovation.
2. Basic knowledge in the area of accounting and finance
3. General knowledge of business law and marketing.

SUBJECT OBJECTIVES

C1. The aim of the course is to learn the basic message of a functioning legal system, intellectual property protection, and various forms of property: copyright, patents, utility models, and industrial, etc.
C2. The acquisition of basic skills notification of descriptions of inventions and utility models, and industrial, etc.
C3. Ability to use patent information.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of patent information
PEK_W02 - Is able to assess the patentability
PEK_W03 - Has knowledge of plagiarism

II. Relating to skills:
PEK_U01 - Knows the procedure for the examination of patent applications and utility models.
PEK_U02 - Knows about the dangers of unlicensed software use
PEK_U03 - Can evaluate engineering work from plagiarism point of view

III. Relating to social competences:
PEK_K01 - Teamwork ability
PEK_K02 - Understand the legal aspects and effects of engineering activities.
PEK_K03 - Understands the need and knows the possibility of lifelong learning (studies II and III degree, postgraduate courses) - raising professional competence as well as personal and social

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Podstawowe pojecia ochrony własnosci intelektualnej. Badania, nauka,wiedza, odkrycie, wynalazek, innowacje i innowacyjnosc, zastrzeżenie patentowe, wzory użytkowe, wzory przemysłowe.	2
Lec2	The test procedure of patent and utility model.	2
Lec3	Rating patentability. Description of the application of the invention	2
Lec4	Patent information: sources and collections of patent documentation and literature, access to information and databases of Patent Office.	2
Lec5	Trademarks and their legal protection. The copyright of literary and artistic works.	2
Lec6	Intellectual property protection of software. Organizations involved in the collective management of copyright.	2
Lec7	Protection of intellectual property databases and domains.	2
Lec8	Plagiarism and engineering thesis- comparison.	1
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Seminars will include the preparation of paper which discuss specific issues related to the protection of intellectual property. The task of the other group members will be questions and discussion posts. The student prepare report in which presents the choosen problem. The report should include the conclusions of the discussion.	15
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	written reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Autor: Pyr.a R., tytuł: Poradnik wynalazcy , wydawnictwo: Urzad Patentowy RP, rok:2008Autor: Golat A.M., tytuł: Własnosc intelektualna i przemysłowa, wydawnictwo: C.H. Becke,rok: 2005Autor: Deren A.M., tytuł: Własnosc intelektualna i przemysłowa, wydawnictwo:Kompendium wiedzy. Ofic. Wyd. PWSzZ Nysa, rok: 2007Autor: Staszko W. (red.), tytuł: Ochrona patentowa, wydawnictwo: Wyd. UniwersytetuSlaskiego, rok: 1983Autor: Sieniów T., Włodarczyk W., tytuł: Własnosci intelektualne w społeczenstwieinformacyjnym, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2001Autor: Adamczak A., Gedłek M., tytuł: Znaki towarowe w działalnosci małych i srednichprzedsiebiorstw, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2009Autor: Adamczak A., Dobosz E., Gedłek M., tytuł: Wzory przemysłowe w działalnoscimałych i srednich przedsiebiorstw, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2009

SECONDARY LITERATURE

Autor: Gajos M., tytuł: Opis patentowy jako zródło informacji, wydawnictwo: Wyd.Uniwersytetu Slaskiego, rok: 2000Autor: Lowe P., tytuł: Zarzadzanie technologia. Mo.liwosci poznawcze i szanse,wydawnictwo: Wyd. Slaskie, rok: 1999Autor: Jeziorow J., tytuł: Wrocławski "Kodeks dobrych praktyk w zakresie korzystania zwyników pracy intelektualnej., wydawnictwo: Urzad Marszałkowski WojewództwaDolnoslaskiego, rok: 2010Autor: Golat R., tytuł: Prawo autorskie. Poradnik dla twórców., wydawnictwo: DomWydawniczy ABC., rok: 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Protecting intellectual property
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W22	C1, C2, C3	Lec1-Lec8	N1
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U22	C1, C2, C3	Se1	N2
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K01, K1ZIP_K09	C1, C2, C3	Se1	N2

SUBJECT SUPERVISOR

dr inż. Zygmunt Domagała tel.: 71 320-27-85 email: Zygmunt.Domagala@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Eksploatacja systemów produkcyjnych**
Name in English: **Operation of production systems**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM031209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	15	
Number of hours of total student workload (CNPS)	60		30	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		1	1	
including number of ECTS points for practical (P) classes			1	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge relating to the structure and operation of machine elements and units and knows the principles of matching and constructing them.
2. The student has basic knowledge of materials science, metrology and information science.
3. The student has sound knowledge relating to the principal manufacturing techniques and the role of technological machines.

SUBJECT OBJECTIVES

C1. The student is to learn the general rules concerning the use, maintenance and repair of machines.
C2. The student is to learn the basic diagnostic methods of testing the condition of machines.
C3. The student is to learn the possibilities of managing machine operation and planning and managing repairs in the enterprise.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic rules concerning the use, maintenance and repair of manufacturing machines and equipment.
PEK_W02 - The student knows the range of maintenance actions, the general principles of selecting a maintenance strategy and the ways of organizing maintenance actions.
PEK_W03 - The student knows the basic characteristics and capacities of the computer systems aiding the planning of service-repair tasks, stock management and service-repair personnel management.

II. Relating to skills:
PEK_U01 - The student can exploit the acquired knowledge to formulate technical, organizational and economic actions relating to the operation of manufacturing machines and equipment.
PEK_U02 - The student can develop general assumptions for repair work.
PEK_U03 - The student can use modern IT tools for the computer management of operation processes.

III. Relating to social competences:
PEK_K01 - The student knows how to search for and use the literature recommended for the course and acquire knowledge on her/his own.
PEK_K02 - The student can use modern IT tools.
PEK_K03 - The student understands the necessity of systematic and unassisted work in order to master the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Technological machines and devices - current development trends. Basic operation requirements (flexibility, productivity, capability, accuracy and other). The cause-effect analysis of machine breakdowns.	2
Lec2	Basic problems relating to operation maintenance of machines (operation, operation theory, operational requirements). Reliability definitions and terms.	2
Lec3	Operational models and the principles of operation maintenance control. Operation maintenance strategies. A set of rules governing the operation maintenance of machines.	4
Lec4	Physicochemical basics of machine operation (friction, wear, lubrication). Oil economy.	2
Lec5	Types of repairs (running, average, major). The EU directives concerning machine repairs.	2
Lec6	The role of manufacturing machine acceptance tests. Machine diagnostics. Technical and economic aspects of machines modernization.	4
Lec7	Basic problems related to maintenance (tasks, strategies and trends). The essence of the Total Productive Maintenance (TPM) system - framework and supporting pillars, ratings.	4
Lec8	Role and importance of maintenance organization and planning. The classification and characterization of the tools aiding maintenance management.	4

Lec9	CMMS class operation management supporting information systems (the requirements and functions of selected systems, the system selection criteria). Implementation of the systems in industrial practice.	4
Lec10	Course crediting.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction. The presentation of a selected CMMS system – the user interface, the basic modules.	4
Proj2	The identification of maintenance objects for selected machines and equipment. The building of an operational structure.	2
Proj3	A statement of operation actions, instructions and necessary materials.	2
Proj4	The definition of inspection (checking and lubricating) routes.	2
Proj5	The planning of employee workloads. The generation of cards with tasks for maintenance objects.	2
Proj6	Stock management for spare parts: the spare parts card, stock levels.	2
Proj7	Course crediting.	1
		Total hours: 15

TEACHING TOOLS USED

N1. The traditional lecture with the use of transparencies and slides.
N2. Tutorials.
N3. Self-study.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	The grading of tasks carried out as part the particular topics.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Base of operation of machinery and equipment. Wyd. WSiP. Warszawa, 2007.
Słowiński B.: Engineering of machines maintenance. Wyd. Pol. Koszalińskiej. Koszalin, 2011.
Kaźmierczak J.: The operation of technical systems. Wyd. Pol. Śląskiej. Gliwice, 2000.

SECONDARY LITERATURE

Hebda M.: Elements of operation theory of technical systems. Wyd. MCNEMT. Radom, 1990.
Żółtowski B.: The basics of machine diagnostics. Wyd. ATR Bydgoszcz. Bydgoszcz, 1996.
Honczarenko J.: Flexible manufacturing automation. Obrabiarki i systemy obróbkowe. WNT Warszawa, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation of production systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W11	C1, C2, C3	Wy1 - Wy9	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U11	C1, C2, C3	Pr1 - Pr6	N3
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K10	C1, C2, C3	Pr1 - Pr6	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska - geometria wykreślna**
Name in English: **Engineering graphics - descriptive geometry**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10	20			
Number of hours of total student workload (CNPS)	30	60			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry.
2. Student has ability to use of the drawing utensils.
3. Student has ability to draw basic geometric structures, such as division of a line's segment into n equal parts, plotting a regular hexagon.

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane as the basis for design recording (engineering drawing).
C2. Knowledge of the geometric structures restitution based on Monge's projections.
C3. Acquisition of the practical skills to apply Monge's method for geometric structures mapping on the drawing's plane.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered knowledge on geometric structure mapping onto drawing's plane using Monge's projection method and elementary knowledge in the field of axonometry.
PEK_W02 - Student can indicate an appropriate solution algorithm of mapping of the position and the relationship tasks between geometric structures in the space.
PEK_W03 - Student has knowledge on restitution basis of the geometric structures represented by Monge's projections.

II. Relating to skills:
PEK_U01 - Student can practically apply the principles of the Monge's projection method to map the elements and geometric structures (including solids) on the drawing's plane.
PEK_U02 - Student can set the actual sizes characterized the measuring taska of the descriptive geometry.
PEK_U03 - Student is able to interpret the drawing, made by the Monge's method, showing the position of the geometric structure in the space.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basi definitions and principles of the parallel and orthogonal projection by Monge, the mapping of basic geometric elements (point, line, plane).	2
Lec2	Edges and breakdown points. Transformation of the position (rotation, revolved section) and the reference system. Solids - definitions.	2
Lec3	Section of the solid (with projecting plane) as a set of the common solid's and cutting plane points, breakdown points of a solid by straight line, cutting of a solid by set of the cutting planes.	2
Lec4	Penetration of the solids - transmission line definitions, the use of auxiliary cutting planes and reference system transformation. Projections onto three orthogonal planes.	2
Lec5	Completing the missing solid's projection - use of the axonometric projection. Final test (1 hr.).	2
		Total hours: 10

Form of classes – Classes		Number of hours
Cl1	Information on the drawing utensils and principles of the geoemtric constructions drawing. Projection of a point and a straight line, the mapping of a plane using her traces; localization of the basic elements in the space using two orthogonal projection planes.	2
Cl2	Belonging of the basic geometric elements, completion of the missing projection. Edge as a set of common points of two planes.	2
Cl3	Breakdown point as a common point of a line and plane. the edge between flat figures. Identification and construction of parallel and perpendicular relationship of basic geoemtric elements.	2

Cl4	Rotation and revolved section of basic geometric elements (line's segment, plane) - application for measuring tasks solving (actual size of the line's segment, an angle of a plane figure determination).	2
Cl5	Reference system transformation application in measuring tasks and localization identification. The mappuing of elementary solids using Monge's projection, points and straight lines belonging to the solid's walls.	2
Cl6	Determination of the croos sectionas of polyhedra and solids of revolution cutted by projection planes.	2
Cl7	Determination of a transmission line of the polyhedra. Transmission line determination of the solids of revolution.	2
Cl8	Mapping the solid on three orthogonal planes. Solid modyfying by projecting plane.	2
Cl9	Solid mapping with axonometric projection. Determination of the missing projection of the solid modified by cutting planes. Relationship between Monge's projections and axonometric view.	2
Cl10	Final test	2
		Total hours: 20

TEACHING TOOLS USED

N1. problem lecture
N2. problem exercises
N3. self study - preparation for project class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Final test, good rating is nedeed (min. 3.0); positive evaluation of the 4 projects (sheets) - F2

P = F1*3/4+F2*1/4

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania),
[2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998,
[3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001,
[4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005

SECONDARY LITERATURE

[1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania),
[2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997,
[3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997,
[4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering graphics - descriptive geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W04	C1, C2, C3	Lec1 - Lec 5	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U04	C1, C2, C3	Cl1 - Cl9	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia**
Name in English: **Chemistry**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM032002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. high school level

SUBJECT OBJECTIVES

C1. Introduction with chemistry sections usable over study of related courses (meterial scicnce, metallurgy, polymers)
C2. Introduction with basic chemical knowledge enabling of chemical rules and physicochemical properties of technical materials particularly metals, alloys and polymers
C3. Providing opportunities for students to combine their knowledge of chemistry with other disciplines (ecology, physics, meterial scicnce)

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student should have basic chemical knowledge associated with structure of matter, states of matter.
PEK_W02 - The student should have basic inorganic knowledge associated with the structure of metals, alloys, electron conductivity as well as basic organic knowledge associated with fuels and polymers
PEK_W03 - The student should have basic knowledge associated with the optics and nanotechnology

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The structure of atom, matter, elements, compounds	4
Lec2	Periodic table of elements, structure, groups of elements, allotropy, concentration	4
Lec3	Chemical bonds, molecules	4
Lec4	The states of matter - Liquids, solids, gases	4
Lec5	Basic crystallography, unit cell, symmetry elements, crystallographic defect	4
Lec6	Solid state band theory.metals and alloys structure	2
Lec7	Selected topics of organic chemistry - fuels and polymers.	4
Lec8	Basic optics - the effects of electromagnetic waves on matter	2
Lec9	Qualifying class –test	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. traditional lecture with the use of transparencies and slides
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Chemistry, Michell J. Sienlo and Robert A. Plane, both of Cornell University, Ithaca, New York.

SECONDARY LITERATURE
selected web sites,

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Chemistry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W02	C1, C2, C3	Lec1 -Lec8	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika**
Name in English: **Mechanics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032008**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	20			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge, skills and competences on the level after Mathematics I and Linear algebra

SUBJECT OBJECTIVES

C1. Solving technical problems on the basis of mechanics rules.
C2. Making statical strength analysis of machines elements.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with
a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define basic quantities in Mechanics (Force and momentum).
PEK_W02 - He knows the solving methods of beams and frames.
PEK_W03 - He knows the Centroid of Area, the center of Gravity of a Mass, Moments of inertia.

II. Relating to skills:
PEK_U01 - He is able to calculate the inner forces in the beams and frames with their diagrams.
PEK_U02 - He can calculate the joints constructures (strusses).
PEK_U03 - He can determine the centroidal and principal Moments of inertia

III. Relating to social competences:
PEK_K01 - He can search information and is able to review it critically.
PEK_K02 - He can objectively evaluate the arguments as well as rationally explain and justify the own point of view on the
base of knowledge from Mechanics.
PEK_K03 - He can observe customs and rules of academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Curriculum. Requirements. Literature.Theory of vectors algebra, statics, degrees of freedom, supports of the rigid body	1
Lec2	Force and momentum. Principal vector and principal momentum of forces system. Statics. Conditions of static equilibrium of forces system. The change of momentum point.	1
Lec3	The resultant of any set of forces.	1
Lec4	Plane forces system. Reactions in the statically determinate systems	1
Lec5	Concurrent forces system.	1
Lec6	Conditions of static equilibrium of forces system. Plane forces system reduction.	1
Lec7	Trusses. Method of Joints.	2
Lec8	Internal forces in Beams (analytical methods, diagrams).	2
Lec9	Centroid of Area. The center of Gravity of a Mass.	1
Lec10	Moments of inertia. Product of inertia. Parallel–axis theorem.	2
Lec11	Rotation transformation of Moments of inertia, Iinertia tensor, inertia ellipsoid. Principal axes.	2
Lec12	Kinematics, motion of particle, trajectory, one–dimensional model. Velocity, acceleration.	1
Lec13	Velocity and acceleration in natural coordinates. Classification of motions	1
Lec14	Velocity and acceleration in the plane motion.	1
Lec15	Test	2
		Total hours: 20

Form of classes – Classes		Number of hours
Cl1	The examples for Conditions of static equilibrium of forces system. Plane forces system reduction.	1
Cl2	Plane forces system. Determination of reactions in the supports.	1
Cl3	Resultans for Plane forces systems. Equations of equilibrium.	1
Cl4	Analytical methods of trusses solving. The Ritter’s methods.	1
Cl5	Internal forces in beams (analytical methods, diagrams).	2
Cl6	Internal forces in beams (analytical methods, diagrams). Beams with Joints.	2
Cl7	Resultant using for Internal forces in Frames.	1
Cl8	Internal forces in Frames (analytical methods, diagrams).	1
Cl9	Test 1.	2
Cl10	Centroid of Area. The center of Gravity of discrete Multi-mass structures.	1
Cl11	Determination of Moments of inertia & inertia products. Parallel–axis theorem.	2
Cl12	Determination of the centroidal and Principal axes and Moments.	1
Cl13	Kinematics of particle in orthogonal coordinates.	1
Cl14	Velocity in a plane motion.	1
Cl15	Test 2	2
		Total hours: 20

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides.
N2. Calculation exercises.
N3. Self study - preparation for project class.
N4. Tutorials.
N5. Self study - self studies and preparation for examination.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
F2	PEK_W01, PEK_W02, PEK_W03	oral-writing exam
P = F1+ F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	oral answers, test 1, test 2.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 1, Statics, John Wiley & Sons, Inc., New York, 1998
2. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 2, Dynamics, John Wiley & Sons, Inc., New York, 1998

SECONDARY LITERATURE
1. Mary Lunn, A First Course in Mechanics, Oxford Science Publications, Oxford 1991
2. Philip Dyke, Roger Whiteworth, Guide to Mechanics, MacMillan Press, London 1992
3. Herbert Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W03	C1	Lec1 - Lec15	N1, N4, N5
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U01, K1ZIP_U03	C2	Cl1 - Cl15	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Mieczysław Szata tel.: 71-320-31-38 email: mieczyslaw.szata@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia w produkcji przemysłowej**
Name in English: **Ecology in industrial manufacturing**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032009**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has systematized secondary school knowledge of biology, chemistry and physics; knows the principles of engineering drawing.
2. Can interpret the basic relationship between human activity and the behaviour of living organisms and the whole environment.
3. Implementing novel solution in the construction, operation and modernization of machines in accordance with the principles of sustainable development and the protection of natural resources and the environment.

SUBJECT OBJECTIVES

C1. The student is to learn about the structure and functioning of living nature, the effect of ecotoxins, and the greenhouse effect; to acquaint herself/himself with the hazards arising from the escalation of human industrial activity and with the legal regulations concerning environmental protection; to understand the environmental management systems, the ISO 14000 standard.
C2. The student is to acquaint herself/himself with the hazards involved in and the ways of acquiring energy from conventional and renewable sources and the principles of waste management – waste minimization and recycling, the LCA method.
C3. The student is to acquaint herself/himself with the principles of constructing, operating and modernizing machines, conducive to the protection of natural resources and the environment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows and understands the hazards arising from the greenhouse effect, the development of technology, energy acquisition and waste production and recycling.

PEK_W02 - The student understands the necessity of introducing environmental regulations; knows the environmental management systems; has knowledge relating to the implementation of ISO 14000.

PEK_W03 - The student knows and understands the hazards arising from the escalation of human activity; knows the principles and advantages of implementing the environment-friendly rules of constructing and operating machines.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, literature, what everyone can do to protect the environment; the hazards arising from industrial activity, ecotoxins, the greenhouse effect.	2
Lec2	The international conventions and the Polish Laws relating to environmental protection; environmental management.	2
Lec3	Environmental management systems, the current standards: BS, EMAS, ISO 14000 and other.	2
Lec4	Environmental consequences of acquiring energy from conventional sources, hazards.	2
Lec5	Environment-friendly methods of acquiring energy from renewable sources.	2
Lec6	Waste minimization, recycling, rational and eco-friendly way of managing wastes; examples of recycling in selected branches of industr	2
Lec7	Recycling in the automotive industry; waste management, waste processing, energy recovery, safe storage	2
Lec8	Environment-friendly materials in machine operation – oils, lubricants, greases; biodegradability, toxicity, carcinogenicity and mutagenicity of consumable materials; PCB.	2
Lec9	New environment-friendly techniques in machine operation; seals; the energy aspects of machine operation; the environmental aspects of the construction, use and modernization of machines.	2
Lec10	Final test.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 , PEK_W02, PEK_W03	Written final test, oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Konspekty przekazane przez prowadzącego,
2. Lewandowski W: Proekologiczne odnawialne źródła energii, WNT W-wa 2010,
3. Mackenzie A., i inni: Ekologia, PWN W-wa 2009,
3. Nierzwicki W: Zarządzanie środowiskowe, Polskie Wyd. Ekonomiczne, W-wa 2006,
4. Rosik-Dulewska Cz: Podstawy gospodarki odpadami, PWN 2007

SECONDARY LITERATURE
Czasopisma: "Czysta Energia", „Utrzymanie ruchu", „Recykling", „Nasze Środowisko" , "Ekotechnika"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology in industrial manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W20	C1, C2, C3	Wy1 - Wy10	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Zbigniew Wasiak tel.: 27-81 email: zbigniew.wasiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka w zastosowaniach inżynierskich**
Name in English: **Computer engineering applications**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of building and solving mathematical models of engineering problems.
2. Basic knowledge of computer and computer programming.

SUBJECT OBJECTIVES

C1. Preparation of the modern engineer to work according to the latest requirements of the application of computational tools.
C2. Gaining knowledge in the application of informatics and numerical computational techniques in tehnique.
C3. Gaining skills in selected functional programming environments, spreadsheets and computing environments for engineering applications.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Ability to program IT environment to carry out engineering calculations.
PEK_U02 - Ability to configure the IT supported calculation environment to perform engineering calculations.
PEK_U03 - The ability to connect the user interface to the database.

III. Relating to social competences:
PEK_K01 - Awareness of the role of the engineer in the manufacturing process and the need for accountability and involvement in one of the most important links of the production process in the company.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.
PEK_K03 - Understand the need for lifelong learning in the field of business engineering and professional as well social skills development.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Application of MAXIMA calculation tool.	6
Proj2	Application of GOOGLE DOCUMENTS tools	6
Proj3	EXCEL in engineering application	8
		Total hours: 20

TEACHING TOOLS USED

N1. problem exercises
N2. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03,	Performance of project tasks
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Zbigniew Smogur, Excel w zastosowaniach inżynieryjnych, ISBN: 83-7197-641-0, HELION
2. Andrzej Stanisz, Przystępny kurs statystyki (w oparciu o program STATISTICA Pl)
3. Bogumiła Mrozek, Zbigniew Mrozek, MATLAB i Simulink. Poradnik użytkownika, HELION

SECONDARY LITERATURE

1. Maciej Gonet, Excel w obliczeniach naukowych i inżynierskich Wydanie II, ISBN: 978-83-246-3066-0, HELION
2. Dokumentacja do programu Statistica

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer engineering applications
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U10	C3	Pr1 - Pr3	N1, N2
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K09	C1, C2, C3	Pr1 - Pr3	N1, N2

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032011**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.
PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	1

Lec2	Measurement, measurement types, method and measurement principle.	1
Lec3	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec4	Dimensions, tolerance of linear dimensions nad fits.	2
Lec5	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	2
Lec6	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec7	Tolerance and machine parts measurement.	2
Lec8	Tolerating and measurements of machines parts manufactured in the process of: casting, plastic forming, welding, plastics processing.	2
Lec9	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec10	hods and means of mechanization and automation of measurements.	2
Lec11	Analysis of dimension. Fundamentals of statistical control of dimensions.	1
Lec12	Fundamentals of coordinate measurement techniques.	1
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Measurements of linear dimensions.	2
Lab3	Measurements of angular dimensions.	2
Lab4	Direct and indirect measurements of cones.	2
Lab5	Identification and measurement of threads.	2
Lab6	Assessment of the geometrical structure of the surface.	2
Lab7	Identification and measurement of cylindrical gears.	2
Lab8	Measurements of selected shape deviations.	2
Lab9	Measurements of selected displacement.	2
Lab10	Measurements of machine parts with pneumatic measurement equipment.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03;	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03; PEK_K01; PEK_K02; PEK_K03;	report on laboratory exercises, test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE
[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01; PEK_W02; PEK_W03	K1ZIP_W06	C1; C2; C3; C4; C5; C6	Wy1 - Wy12	N1; N5
PEK_U01; PEK_U02; PEK_U03	K1ZIP_U06	C1; C2; C3; C4; C5; C6	Wy1 - Wy12	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03	K1ZIP_K04, K1ZIP_K05	C1; C2; C3; C4; C5; C6	La1 - La10	N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania mechanizmów**
Name in English: **Basics of mechanism design**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	3			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of mathematics, physics and mechanics
2. ability to solve basic problems of mathematical analysis and the ability to describe the basic physical phenomena

SUBJECT OBJECTIVES

C1. Understanding the basic principles of construction and methods of analysis, modeling and design machines
C2. Understanding the properties of selected groups of planar and spatial mechanisms (linkages, gears, cams and manipulators)

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has a theoretical knowledge of analysis of kinematic system
PEK_W02 - has a theoretical knowledge of design of kinematic systems

II. Relating to skills:
PEK_U01 - The ability to define the basic elements of mechanism
PEK_U02 - The ability to build a computer model of the mechanism and ability to perform simulation researches
PEK_U03 - Ability to analyze of kinematics and kinetostatics of mechanisms using vector, analytical and computer methods

III. Relating to social competences:
PEK_K01 - a sense of responsibility for their own work and the willingness to comply with the rules work in a team and to take responsibility for collaborative tasks
PEK_K02 - Understands the impact of engineering

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview of machines and mechanisms, basics of structural analysis	3
Lec2	Methods for the type synthesis of mechanisms	2
Lec3	Kinematic analysis of mechanisms - methods for determining the new positions, velocities and accelerations	3
Lec4	Elements of dynamic analysis - forces in kinematic systems, kinetostatics (vector method)	3
Lec5	Linkage mechanisms - property characterization, analysis and application	2
Lec6	Manipulators (serial, parallel) -construction, characteristics, applications, kinematics manipulators	2
Lec7	Planetary gear mechanisms - analysis, characteristics, applications	2
Lec8	Cam mechanisms- characteristics, applications, analysis and design	2
Lec9	Test	1
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Structural analysis of mechanisms (class of joints, rules of schematization, mobility of mechanisms (project and short test)	2
Proj2	Basics of computer modeling of mechanisms in program SAM (Simulation and Analysis of Mechanism)	2
Proj3	Linkages mechanisms - kinematic analysis (vector method), (project and short test)	2
Proj4	Modeling and computer simulations of linkage mechanisms (project)	2
Proj5	Modeling and computer simulations of planetary gear mechanisms (project)	2
		Total hours: 10

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. self study - preparation for project class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02	Evaluation of the project, Evaluation of the short test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Gronowicz A. i inni: Teoria maszyn i mechanizmów. Zestaw problemów analizy i projektowania. Oficyna wydawnicza PWr. Wrocław 2000.
2. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna wydawnicza PWr. Wrocław 2003.
3. Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna wydawnicza PWr. Wrocław 1996.

SECONDARY LITERATURE
1. Morecki A., Knapczyk J., Kędzior K..: Teoria mechanizmów i manipulatorów. WNT 2002
2. Olędzki A.: Podstawy teorii maszyn i mechanizmów. WNT 1987
3. Miller S.: Układy kinematyczne. Podstawy projektowania. WNT 1988.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of mechanism design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1ZIP_W05	C1, C2	Le1-Le8	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U05	C1, C2	Pr1 - Pr5	N2, N3, N4
PEK_K01, PEK_K02	K1ZIP_K04, K1ZIP_K09	C1, C2	Pr1 - Pr5	N2, N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Bałchanowski tel.: 71 320-27-10 email: jacek.balchanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Procesy i techniki wytwarzania I**
Name in English: **The processes and manufacturing techniques I**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032017**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should has a basic knowledge about the basic mechanical properties of engineering materials; has ordered knowledge about the types of metallic engineering materials - their structure, properties, applications and principles of selection; has detailed knowledge about the structures of steel and cast iron, the principles of classification and labeling; has a basic knowledge about heat and thermo-chemical treatment, has a knowledge about alloy steels and non-ferrous metals and alloys. It can analyze the macroscopic fractures, microstructure of materials, technological defects; is able to determine the characteristics of the microstructure of metallic materials; is able to identify the phases on the basis of equilibrium diagrams; can distinguish between the microstructure in terms of carbon content in steel, the influence of heat treatment; can read and interpret the drawings and diagrams used in technical documentation

SUBJECT OBJECTIVES

C1. To familiarize students with the processes and manufacturing techniques of production from the liquid metal, through the plastic molding and welding techniques.
C2. Acquisition of knowledge about the basic techniques of chipless processing and skills of parameters selection of these processes .
C3. The acquisition and consolidation of social skills including emotional intelligence involving the ability to work in a group of students with a view to effective problem solving. Responsibility, honesty and fairness in the acting; observance of customs in academia environment and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic technologies of casting
PEK_W02 - Knows the basic technologies of plastic forming of elements
PEK_W03 - Knows the basic methods of welding and process parameters, and has the knowledge about the applications of welding processes, bonding and brazing in the manufacture of products.

II. Relating to skills:
PEK_U01 - Can choose a suitable casting technology and define the basic parameters of the process.
PEK_U02 - Can choose the technology of plastic forming and define the basic parameters of the process.
PEK_U03 - Can choose the appropriate method of joining the elements of the product and to determine the basic parameters of the process.

III. Relating to social competences:
PEK_K01 - Searching for the information and critical analysis,
PEK_K02 - Objective evaluation of arguments to justify, the rational translation and his own point of view using the knowledge about the casting, plastic forming and welding.
PEK_K03 - Observance with the customs and rules of the academic environment,

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts and algorithms for the manufacture of casts, materials used for the production of molding and core sands as well as methods for producing and testing the properties of these sands.	2
Lec2	Methods for manual and automatic production of foundry molds and mold cores. Production of molds and cores from the chemo-and thermohardening sands	2
Lec3	Production of castings in permanent molds, casting alloys.	2
Lec4	Effect of strain on the structure and properties of the material. Cold and hot forming	2
Lec5	Sheet metal, volume machining	2
Lec6	Metal Forming Tools	2
Lec7	The types of joints and welds, welding positions, gas welding	2

Lec8	Arc welding with coated electrode, in protective gases (MAG, MIG, TIG) and under the flux	2
Lec9	Soldering and Brazing	2
Lec10	Resistance and friction welding. Final Test.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Study of the materials and molding sands. hHnd and machine production of foundry molds and cores.	2
Lab2	Production of castings in forms of chemo-and thermohardening sands	2
Lab3	Production of castings in permanent molds, study the properties of alloys.	2
Lab4	Cold deformation and annealing of metals Rolling the metal sheets and profiles	2
Lab5	Metallurgical extrusion of machinery parts, fabrication of metal products in the process of drawing	2
Lab6	Punching-cutting, bending and stamping	2
Lab7	Health and safety of welding, gas welding, thermal cutting	2
Lab8	Arc welding with coated electrode, in protective gases (MAG, MIG, TIG) and under the flux	2
Lab9	Resistance and friction welding.	2
Lab10	Soldering and Brazing, welding stresses, Final lab test	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final test
P = P		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	entrance test- short test, quiz, oral answers, written tests
P = F		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000Granat K. Laboratorium z odlewnictwa, skrypt PWr., Wrocław 2007 Gronostajski J., Obróbka plastyczna metali, Wrocław 1974 http://www.metalplast.pwr.wroc.pl/instrukcje.html Ambroziak A. (red.): Techniki Wytwarzania. Spawalnictwo. Laboratorium. Pwr, Wrocław 2011, http://Www.Dbc. Wroc.Pl/Content/7156/Techniki_Wytwarzania_Spawalnictwo_A.Ambroziak_Linkowane.Pdf

SECONDARY LITERATURE
Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986Romanowski P., Poradnik obróbki plastycznej na zimno, Wydawnictwo Naukowo- Techniczne, W-wa 1976Pilarczyk J. (red.): Poradnik Inżyniera. Spawalnictwo. T. I i II, WNT Warszawa, 2003, 2005Klimpel A.: Spawanie, Zgrzewanie i Ciecie Metali., WNT, Warszawa, 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The processes and manufacturing techniques I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W08	C1, C2	Lec1 - Lec10	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U08	C1, C2, C3	Lab1- Lab10	N2, N3
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K04	C3	Lab1- Lab10	N4

SUBJECT SUPERVISOR

dr inż. Wiesław Derlukiewicz tel.: 27-38 email: wieslaw.derlukiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska 3D**
Name in English: **3D Engineering Graphics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032019**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			20	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses				X	
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and skills in the use of CAD systems to creative and innovative design

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students should be know the rules of the modeling 3D of the machines parts and assemblies with using CAD systems
PEK_W02 - Students should be know the methods of analysis and testing the parameters of machines and equipment carried on 3D virtual models (virtual prototypes).
PEK_W03 - Students should be know the using of CAD systems for creative and innovative design.

II. Relating to skills:
PEK_U01 - Students should be able to build 3D models of machine parts
PEK_U02 - Students should be able to build 3D models of the machines parts and assemblies and verify models and their parameters
PEK_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:
PEK_K01 - Student gains the skills to take responsibility for their work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	CAx systems for design. Virtual prototyping. 3D geometry modeling - parts. Solid and surface models.	2
Lec2	3D modeling - assemblies. Relationships, bonds, adaptability and variability of the model.	2
Lec3	The analysis of the virtual prototype. The analysis of the prototype on the virtual model (kinematic, dynamic).	2
Lec4	Creative design. Innovation and quality in the design	2
Lec5	The model presentations. The methodology of the engineer work. Organization of work of the design team (data exchange formats, teamwork). Completion of the course	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	The project of assembly: the concept,solid modeling with rotation, one and multibody modeling	2
Proj5	The project of assembly: solid operations - sweep, loft, split, scroll	2
Proj6	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2

Proj7	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj8	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults.	2
Proj9	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings, assembly drawings	2
Proj10	Completion of the course: work during classes	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. self study - preparation for project class
N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = FW		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01	test, participate in problem discussions
P = 0,4*F1+0,6*FW		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1]Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
[2]Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE

[1]http://autodesk-inventor-pl.typepad.com/
[2]http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
3D Engineering Graphics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1ZIP_W04, K1ZIP_W05	C3	Wy1 - Wy5	N1, N2
PEK_U01 - PEK_U03	K1ZIP_U04, K1ZIP_U05, K1ZIP_U35	C1, C2	Pr1 - Pr9	N3, N4
PEK_K01	K1ZIP_K07	C3	Pr1 - Pr9	N1, N2

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania maszyn**
Name in English: **Fundamentals of Machine's Engineering Design**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032020**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			20	
Number of hours of total student workload (CNPS)	90			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	3			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge:
- student has knowledge on the fundamentals of mechanics, strength of materials and materials technology;
- student knows the basic rules of the technical drawing.
2. Skills:
- student can use the knowledge on mechanics, strength of materials and materials technology in practice;
- the student can graphically present technical objects.
3. Competences:
- the student understands and is aware of what the technological activity is and how it influences the environment.

SUBJECT OBJECTIVES

C1. To familiarize students with the design and operation principle of basic machine components, units and systems.
C2. To familiarize students with the rules of the engineering design process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the classes, the student should be able to recognize and select the basic machine elements, units and systems.
PEK_W02 - As a result of the classes, the student should be able to present the basic rules of the engineering design process.

II. Relating to skills:
PEK_U01 - As a result of the course, the student should be able to prepare the technical drawings of basic mechanical components, units and systems.
PEK_U02 - As a result of the classes, the student should be able to select and to make engineering calculations of the basic machine elements, units and systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Engineering design process.	1
Lec2	Welded joints.	2
Lec3	Load-carrying structures.	1
Lec4	Screw joints and mechanisms.	2
Lec5	Axes and shafts.	2
Lec6	Bearings and sealings.	2
Lec7	Couplings and breaks.	2
Lec8	Gear transmissions.	4
Lec9	Belt transmissions.	2
Lec10	An example of practical designing of a machine or a device.	2
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Development of the design assumptions for the built drive system	2
Proj2	Analysis of the problem, determination of the quantitative data and the operational conditions	2
Proj3	Making the basic engineering calculations and selection of elements for the built drive system	6
Proj4	Making the technical documentation comprised of the assembly drawing and at least one working drawing as a handwritten draft and drawings made by means of CAD software	8
Proj5	Summary and conclusions	2
		Total hours: 20

TEACHING TOOLS USED

N1. informative lecture
N2. tutorials
N3. traditional lecture with the use of transparencies and slides
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Partial evaluation of the project
P = F1 + F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Osiński Z. i inni: Podstawy konstrukcji maszyn, PWN, Warszawa 1999,
2. Dietrich M. i inni: Podstawy konstrukcji maszyn. T.1-3, WNT, Warszawa 1995

SECONDARY LITERATURE
1. Pahl G., Beitz W.: Nauka konstruowania, WNT, Warszawa 1984,
2. Kurmaz L., Kurmaz O.: Projektowanie węzłów i części maszyn, Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machine's Engineering Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1ZIP_W04, K1ZIP_W05	C1, C2	Lec1-Lec10	N1, N2, N3, N4
PEK_U01, PEK_U02	K1ZIP_U05	C2	Proj1-Proj5	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jarosław Stryczek tel.: 71 320-20-70 email: Jaroslaw.Stryczek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przetwórstwo tworzyw sztucznych**
Name in English: **Processing of plastics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032022**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	30		60		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of the material and mechanical properties of engineering materials

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge on the classification, properties, and methods of processing plastics.
C2. Acquisition of skills identification and selection of polymeric materials for technical applications.
C3. The acquisition and consolidation of social skills including emotional intelligence skills relying on cooperation in the group of students with a view to effective problem solving. Responsibility, honesty and fairness in the procedure observance force in academia and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - knows the types and basic properties of polymeric materials
PEK_W02 - knows the basic method of processing of polymeric materials
PEK_W03 - has knowledge of the basics and applications of polymeric materials processing

II. Relating to skills:
PEK_U01 - able to identify polymeric materials
PEK_U02 - processing method is able to select the type of polymeric material
PEK_U03 - able to select a polymer material for technical applications

III. Relating to social competences:
PEK_K01 - search for information and its critical analysis
PEK_K02 - objectively examine the arguments, rational translations and justify their own point of view, using knowledge of plastic processing
PEK_K03 - observance and rules in academia

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Definitions of polymers and plastics. Methods for the preparation of polymers. The chemical and physical structure of polymers. Basic concepts of polymer materials.	2
Lec2	Modification of polymers. Types and effects of additives on the properties of plastics. Properties of polymeric materials for the metal.	2
Lec3	Construction, variety, properties and applications of selected polymers.	2
Lec4	Classification of methods of plastics processing. Methods of preparation. Selected methods of direct forming.	2
Lec5	Plastic extrusion technology. Variations of the process extrusion. Calendering.	2
Lec6	Plastic injection molding technology.	2
Lec7	Methods for forming the intermediate plastics. Processing of plastics - finishing methods.	2
Lec8	Issues relating to the exploitation and consumption of polymeric materials.	2
Lec9	The problem of plastic waste. Classification of waste. Methods of polymer waste.	2
Lec10	Polymer composites.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. Identification of plastics.	2
Lab2	Methods of joining of plastic products.	2
Lab3	The study of friction and abrasive wear of polymeric materials.	2
Lab4	Injection molding technology.	2

Lab5	Extrusion and thermoforming technology.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. laboratory experiment
N4. self study - preparation for laboratory class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Writting test, Oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03; PEK_K01, PEK_K02, PEK_K03	quick quiz, oral answer, laboratory reports, written tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Robert Sikora, tytuł: Processing of macromolecular materials, Wydawnictwo Edukacyjne Zofii Dobkowskiej, rok: 1993

SECONDARY LITERATURE
K.Wilczynski, tytuł: Processing of plastics

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Processing of plastics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W02, K1ZIP_W08, K1ZIP_W27	C1	Lec1-Lec10	N1, N2, N5
PEK_U01 - PEK_U03	K1ZIP_U02, K1ZIP_U08	C1, C2	Lab1-Lab5	N3, N4
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K02	C3	Lab1-Lab5	N3, N4

SUBJECT SUPERVISOR

dr inż. Joanna Pach tel.: 71-320-42-78 email: joanna.pach@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszyny i urządzenia technologiczne**
Name in English: **Technological machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032023**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge relating to the design-construction process and the structure and working of machine components and units.
2. The student has sound knowledge relating to the basic manufacturing techniques and the role of technological machines.
3. The student can read and interpret the figures and schematics used in machine engineering documentation.

SUBJECT OBJECTIVES

C1. The student is to learn the structure of principal technological machines, especially their drive, control and measuring systems.
C2. The student is to learn the basic technical-operational characteristics of modern technological machines.
C3. The student is to learn the principles and possibilities of using technological machines to perform specific machining tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the structure and principles of operation of modern technological machines, especially their kinematics and the principles of controlling their operation.
PEK_W02 - The student knows the principles of selecting technological machines to perform specific machining tasks.
PEK_W03 - The student knows the basic testing methods used to assess the condition of technological machines.

II. Relating to skills:
PEK_U01 - The student can evaluate technological machines from the point of view of their suitability for specific machining tasks.
PEK_U02 - The student can define how a technological machine is to function.
PEK_U03 - The student can determine the basic parameters characterizing the operation of a technological machine.

III. Relating to social competences:
PEK_K01 - The student knows how to search for and use the literature recommended for the course and acquire knowledge on her/his own.
PEK_K02 - The student can exploit basic knowledge relating to the methods of controlling the operation of technological machines.
PEK_K03 - The student understands the necessity of systematic and unassisted work in order to master the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Significance and development of manufacturing technology. General characteristics of manufacturing machines and their classification. Technical and operational parameters. Basic requirements.	2
Lec2	Geometrical and kinematic structures of the machines. Parts, mechanisms and components of manufacturing machines: bodies, spindle and guiding assemblies, tooling and workpiece systems.	2
Lec3	Main drive and feeding systems of modern manufacturing machines (basic requirements, exemplary solutions). Measurement, diagnostics and supervision systems.	2
Lec4	Basics of automatic control of manufacturing machines. Classification of control systems (NC, CNC, DNC, AC and PLC systems). Elements of programming CNC machines.	2
Lec5	Cutting machine tools for machining rotating and flat surfaces - lathes, drills, milling machines, boring machines. The technical and utility characteristics and function of the machines.	2
Lec6	Cutting machine tools for machining rotating and flat surfaces - grinders, planers and slotters. Machine tools for special technical shapes (threads and teeth). The technical and utility characteristics and function of the machines.	2

Lec7	Multitasking machines (in-line transfer machines). Machines for electrical discharge and laser machining. The technical and utility characteristics and function of the machines.	2
Lec8	Selected structures of NC machines for chipless machining. CNC machining centres, autonomous machining stations. The role of robots and manipulators in production automation.	2
Lec9	Multimachine robotized manufacturing systems. Computer-integrated manufacturing systems (CIM).	2
Lec10	Trends in development of CNC manufacturing machines (machines for HSC machining, hexapods, intelligent and hybrid machine tools).	2
		Total hours: 20
	Form of classes – Laboratory	Number of hours
Lab1	The measurement of power losses during non-load operation and the overall efficiency of a machine.	2
Lab2	The assessment of machine loudness	2
Lab3	The change of rotational motion to rectilinear motion in technological machines.	2
Lab4	Measurements of energy losses in spindle rolling bearings.	2
Lab5	Selected problems relating to the dynamic properties of machine tools.	2
		Total hours: 10

TEACHING TOOLS USED

N1. the traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written examination.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_U02, PEK_K03	Short tests on the particular laboratory topics.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT, Warszawa, 2000.
Kosmol J.: Automation of machine tools and machining. WNT, Warszawa, 2000.
Honczarenko J.: Numerically controlled machine tools. WNT, Warszawa, 2009.
Wrotny L. T.: Machine tools for metal cutting. WNT, Warszawa, 1979.
Białek M. : Technological machines. Oficyna Wydawnicza Politechniki Warszawskiej, 1995.

SECONDARY LITERATURE

Paderewski K.: Vademecum of machine tools. WNT, Warszawa, 1979.
Dmochowski J., Uzarowicz A.: Machining operations and machine tools. PWN, Warszawa, 1980.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technological machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W08	C1, C2, C3	Wy1 - Wy10	N1, N2, N4
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U12	C1, C2, C3	La1 - La5	N2, N3
PEK_K01, PEK_U02, PEK_K03	K1ZIP_K04	C1, C2, C3	La1 - La5	N1 - N4

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekonometria**
Name in English: **Econometrics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032030**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of probability theory.
2. Statistical sampling: statistical sample term, statistical experiment design, sample results presentation, statistics calculations from the sample and populations structure.
3. Matrix analysis.

SUBJECT OBJECTIVES

C1. Gaining knowledge, including applicational aspects, from the econometrical modeling.
C2. Gaining ability to interpret quantitative and qualitative results on the basis of conducted calculations.
C3. Gaining skills in the optimal set of explanatory variables for the econometric model selection , econometric model building,model verification on the basis of tests.
C4. Gaining skills in the scope of regression equation assessment.
C5. Gaining skills how to think and act creatively and logically, how to solve given problems, defining priorities in order to execute given task

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows types and application of the econometrical models, explanatory variables classification and explanatory variable selection metohods.
PEK_W02 - Knows assumptions regarding the random component in the LSM method and tests allowing to verify the efficiency of LSM-estimate.
PEK_W03 - Knows the ways of regression equation assessment

II. Relating to skills:
PEK_U01 - Can select explanatory variables do teh econometrical model. on the basis of the variables can biuld the model, and subsequently can verify the model's correctness.
PEK_U02 - Can interpret the parameters, graphs, results - both quantitative and qualitative.
PEK_U03 - Can conduct calculations with the use of computer software enabling indepth data analysis.

III. Relating to social competences:
PEK_K01 - Can think and act in a creative way.
PEK_K02 - Can draw logical conclusions and can properly solve given problem.
PEK_K03 - Can properly define priorities that serve the execution of the given task.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Econometrics and econometrical model - the terms. The subject of the econometrical modeling and econometrical modeling applications. Repetition regarding regression analysis knowledg	2
Lec2	Repetition regarding regression analysis knowledg	2
Lec3	Regression equation assessment - estimated parameters precision, equation fitting to the empirical data	2
Lec4	Autocorrelation, normality and homoscedasticity of the random component- the terms. Randomness and symmetry of the random component - veryfication of the random component.	2
Lec5	Explanatory variable selection metohods: Hellwig's method, graph method, analysis of correlation coefficients	2
Lec6	Information entropy - Shannon's theorem. Information criteria as a basis of model selection (AIC, BIC).	2
Lec7	Software aiding econometrical calculations: Statistica software- - basic commands, results interpretation.	2
Lec8	Software aiding econometrical calculations: R language software - basic commands, results interpretation.	2
Lec9	Econometrics in the production engineering aplication.	2
Lec10	Test	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Organizational issues. Parameters estimation, correlation analysis - tasks.	2

Proj2	Estimated parameters precision assessment. Equation fitting to the empirical data - tasks.	2
Proj3	Autocorrelation of the random component- Durbin-Watson test, normality of the random component - Shapiro-Wilk test. Randomness of the random component verification: series test, symmetry of the random component - symmetry test, homoscedasticity of the random component - Goldfeld-Quandt test.	2
Proj4	Chosen explanatory variable selection metohods.	2
Proj5	R language software - basic commands usage, calculations, tasks. Test.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. computer software
N4. problem exercises
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03;	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02, PEK_U03 ; PEK_K01, PEK_K02, PEK_K03;	entry test, oral answers, written exams, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Dziechciarz J., Ekonometria. Metody, przykłady, zadania, Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu, Wrocław 2002,
Kukuła K., Wprowadzenie do ekonometrii w przykładach i zadaniach, Wydawnictwo Naukowe PWN, Warszawa 1999,
Gajda J., Ekonometria, Wydawnictwo C.H. Beck, Warszawa 2004,
Welfe A., Ekonometria, Polskie wydawnictwo Ekonomiczne, Warszawa 2003,
Gruszczyński M., Podgórska M., Ekonometria, Szkoła Główna Handlowa w Warszawie, Warszawa 2003

SECONDARY LITERATURE
Statystyczna analiza danych z wykorzystaniem programu R /red. nauk. Marek Walesiak, Eugeniusz Gatnar ; [aut. Andrzej Bąk et al.] Warszawa: Wydawnictwo Naukowe PWN, 2009,
Ekonometria i badania operacyjne :podręcznik dla studiów licencjackich /red. nauk. Marek Gruszczyński, Tomasz Kuszewski, Maria Podgórska ; aut. Anna Decewicz [et al.]. Warszawa : Wydawnictwo Naukowe PWN, 2009,
Statystyka dla inżynierów /Witold Klonecki. Warszawa : Wydawnictwo Naukowe PWN, 1999,
Nowak R., Statystyka dla fizyków, Wydawnictwa Naukowe PWN, Warszawa 2002
Shannon E. C., A Mathematical Theory of Communication, The Bell System Technical Journal, Vol. 27, lipiec, październik, 1948,
T. Bednarski, F. Borowicz, On inconsistency of Hellwig's variable choice method in regression models, Discussiones Mathematicae Probability and Statistics 29 (2009),
Arnold T. W., Uninformative Parameters and Model Selection Using Akaike's Information Criterion, Journal of Wildlife Management 74(6):1175–1178; 2010; DOI: 10.2193/2009-367,
Chow G.C., Ekonometria, Wydawnictwo Naukowe PWN, Warszawa 1995
Mercik J., Szmigiel C., Ekonometria, Wyższa Szkoła Zarządzania i Finansów we Wrocławiu, Wrocław 2000,
Peracchi F., Econometrics, Jonh Wiley & Sons Ltd, Chichester, West Sussex 2001,
Hellwig Z., Problem optymalnego wyboru predykant, Przegląd statystyczny, R.XVI, zeszyt 3-4, 1969
Baye M., Managerial economics and business strategy, Boston McGraw Hill, 2009,
Chiang A.C., Podstawy ekonomii matematycznej, Państwowe Wydawnictwo Ekonomiczne, Warszawa 1994,
Theil H., Zasady ekonometrii, Państwowe Wydawnictwo Naukowe, Warszawa 1979

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Econometrics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W01	C1	Wy1 - Wy10	N1, N5
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U01	C2,C3,C4	Pr1 - Pr5	N2, N3, N4, N5
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K05	C5	Pr1 - Pr5	N2, N3, N4, N5

SUBJECT SUPERVISOR
dr inż. Maria Rosienkiewicz tel.: 43 84 email: maria.rosienkiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy logistyki**
Name in English: **Fundamentals of logistics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032031**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	10			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the organization and operation of the production przesiębiorstwa

SUBJECT OBJECTIVES

C1. To familiarize students with the basic tasks of logistics business processes.
C2. Some specific models and methods used in the design and evaluation of logistics systems.
C3. Characterization of core technology and material flow logistics information systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the structure of the logistics system, its components and the relationships between them.
PEK_W02 - He knows the methods and strategies of managing logistics processes in the enterprise

II. Relating to skills:
PEK_U01 - It can be used for selected models and methods for the design, management and evaluation of logistics system.
PEK_U02 - He can choose the material flow technology and information flow

III. Relating to social competences:
PEK_K01 - Able to present opinions on the social and environmental impact of the operation of the supply chain.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts and definitions. System and logistics process. The classification criteria.	2
Lec2	Logistics supply. Inventory management. Just In Time Strategy.	2
Lec3	Logistics of production. Range of computer support: MRP I, MRP II, ERP.	2
Lec4	Logistics distribution. Forecasting demand.	2
Lec5	Reverse logistics. Ekologistyka	2
Lec6	Information technology, automatic identification method, EDI	2
Lec7	Packaging. Basic functions. Logistic label.	2
Lec8	Technologies of handling and storage.	2
Lec9	Transport technologies. Linear infrastructure .	2
Lec10	Logistics centers.Point infrastructure .	2
		Total hours: 20

Form of classes – Classes		Number of hours
Cl1	Introduction to exercise. Overview of the exemplary embodiment of the supply chain	2
Cl2	Inventory management. Classification ABC / XYZ.	2
Cl3	Forecasting demand	2
Cl4	Simulation of a Kanban production system	2
Cl5	Transport management in the context of supply chain	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem exercises
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Written exam - test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01	test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Ballou R.H. Business :ogistics / Supply Chain Management. Pearson Education Inc. 2004.
Logistyka. Red. D. Kisperska_Moroń, S. Krzyżaniak. ILiM, Poznań 2009.
Logistyka. Teoria i praktyka.Tom I i II. Red. S. Krawczyk. Difin, Warszawa 2011.

SECONDARY LITERATURE
Zając P.: CRM - Zarządzanie relacjami z klientem w logistyce dystrybucji. Navigator 17. Oficyna Wydaw. Politechniki Wrocławskiej, Wrocław 2007.
Kwaśniowski S., Nowakowski T., Zając M.: Trasnport intermodalny w sieciach logistycznych. Navigator 18. Oficyna Wydaw. Politechniki Wrocławskiej, Wrocław 2008.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of logistics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ZIP_W17	C1, C3	Lec1, Lec2, Lec8 - Lec15	N1
PEK_W02	K1ZIP_W17	C2	Lec2 - Lec7	N1
PEK_U01	K1ZIP_U17	C2	Cl1 - Cl7	N2, N3
PEK_U02	K1ZIP_U17	C2	Cl1 - Cl7	N2, N3
PEK_K01	K1ZIP_K02	C1	Cl1 - Cl7	N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Tomasz Nowakowski tel.: 71 320-35-11 email: Tomasz.Nowakowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy informatyczne w zarządzaniu przedsiębiorstwem**
Name in English: **Information systems in the enterprise management**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032033**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the operation of the business in terms of materials management.
2. The ability to acquire information from the documents and their interpretation.
3. Computer skills.

SUBJECT OBJECTIVES

C1. Introduction to the problems of integrated management systems
C2. Getting the student from the basic knowledge of the mode of action and implementation of MRP II and ERP
C3. Acquisition of basic umiętności using MRP II and ERP

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of integrated manufacturing systems
PEK_W02 - Knowledge of the concepts used in Integrated Information System - stuktura production, purchasing position, route and schedule of technology
PEK_W03 - Knowledge of Integrated Information System applications in production

II. Relating to skills:
PEK_U01 - Ability to use integrated management system, for example IFS Application
PEK_U02 - Ability to use technology production structure
PEK_U03 - Ability to design a technological route in Integrated Information System

III. Relating to social competences:
PEK_K01 - Able to work in a group, went through various roles in the organization of enterprises
PEK_K02 - Recognizes the importance of data quality in Integrated Information System

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Batch, Characteristics of the production cycle	2
Lec2	Stocks Production, Production Planning	2
Lec3	Management Information Systems, MRP I and MRP II	2
Lec4	Workflow systems	2
Lec5	Methods for identifying the functions of the company, depending on the function diagrams, entity relationship diagrams	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Preliminary information on the operation of IFS Applications. Generating companies in IFS Applications. Defining the structure of production.	2
Proj2	Defining the position of purchase. Defining costs. Sales.	2
Proj3	Entering data storage products. Define the product structure.	2
Proj4	Defining the position of product in different production lines. Routes production.	2
Proj5	Entry of items in shopping. Generate schedule. Generating MRP report.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem exercises
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02	Presentation and defense of the MRP report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Zintegrowany system zarządzania przedsiębiorstwem IFS Applications : ćwiczenia z obsługi : wybrane moduły : praca zbiorowa / pod red. Leszka Kiełtyki ; Politechnika Częstochowska.
2. Oracle : system zarządzania bazą danych : podręcznik użytkownika / Michał Lentner. Warszawa : Akademicka Oficyna Wydawnicza EXIT, 2001.

SECONDARY LITERATURE

SAP - zrozumieć system ERP / Jerzy Auksztol, Piotr Balwierz, Magdalena Chomuszko. Warszawa : Wydawnictwo Naukowe PWN, 2012.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Information systems in the enterprise management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02, PEK_W03	K1ZIP_W10, K1ZIP_W15	C1, C2, C3	Lec1 - Lec5	N1, N2
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U15, K1ZIP_U23	C2, C3	Pr1 - Pr5	N3
PEK_K01, PEK_K02	K1ZIP_K11	C2, C3	Pr1 - Pr5	N3

SUBJECT SUPERVISOR

dr inż. Arkadiusz Kowalski tel.: 37-10 email: arkadiusz.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ergonomia i BHP**
Name in English: **Ergonomics and safety**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **ZPM032102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases. Estimate of professional risk on work positions	2
Lec3	Ergonomics as interdisciplinary science	2
Lec4	Labor biomechanics - science about threats for employee health discovering, being result of executable work	2
Lec5	Dangerous and harmful agents in work environment	2
Lec6	First pre-medical aid	2
Lec7	Fire protection	2
Lec8	Threats and work protection at transport manual labour. Heights work and closed-containers work as especially dangerous works.	2
Lec9	Sitting work geometry, computer work stand. Breaks at work, shift work. Stress at work.	2
Lec10	Work physiology. Work environment microclimate. Ventilation and air conditioning at accomodation.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE
D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ergonomics and safety
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ZIP_W21	C1	Lec1, Lec2, Lec3, Lec6, Lec7, Lec8, Lec9, Lec10	N1, N2, N3, N4
PEK_W02	K1ZIP_W21, K1ZIP_W24, K1ZIP_W25	C2	Lec3, Lec4, Lec9	N1,N2, N3,N4
PEK_W03	K1ZIP_W20, K1ZIP_W21	C3	Lec5, Lec6, Lec7, Lec8, Lec9, Lec10	N1,N2, N3,N4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowe zarządzanie eksploatacją i utrzymaniem ruchu maszyn i urządzeń**
Name in English: **Computer aided operation and maintenance management of machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge of the structure and operation of machine elements and units and the principles of matching and constructing them.
2. The student has basic knowledge of materials science, metrology and information science.
3. The student has sound knowledge relating to the principal manufacturing techniques and the role of technological machines.

SUBJECT OBJECTIVES

C1. The student is to learn the general rules concerning the use, maintenance and repair of machines.
C2. The student is to learn the general methods and tools of the computer support of maintenance processes.
C3. The student is to learn the possibilities of managing machine operation and planning and managing repairs in the enterprise.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the range of maintenance actions, the general principles of selecting a maintenance strategy and the ways of organizing maintenance actions.
PEK_W02 - The student knows the basic problems relating to the management of operation and maintenance in industrial plants.
PEK_W03 - The student knows the basic characteristics and capacities of the computer systems aiding the planning of service-repair tasks, stock management and service-repair personnel management.

II. Relating to skills:
PEK_U01 - The student can exploit the acquired knowledge to formulate technical, organizational and economic actions relating to the operation of manufacturing machines and equipment.
PEK_U02 - The student can develop general assumptions for selected maintenance strategies.
PEK_U03 - The student can use modern IT tools for the computer management of operation processes.

III. Relating to social competences:
PEK_K01 - The student knows how to search for and use the literature recommended for the course and acquire knowledge on her/his own.
PEK_K02 - The student can use modern IT tools.
PEK_K03 - The student understands the necessity of systematic and unassisted work in order to master the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introductory problems relating to operation of technological systems (operation ability, its measures and indicators). Physicochemical basis of machine and equipment operation. The role of technical diagnostics.	2
Lec2	Operational models and principles of operation control. Basic reliability definitions and terms.	2
Lec3	Basic problems relating to maintenance (tasks, strategies and trends). The essence of the Total Productive Maintenance (TPM) system - framework and supporting pillars, ratings.	2
Lec4	Maintenance versus enterprise management (ERP systems). The role and importance of maintenance planning. The role and organization of the Maintenance Department.	2
Lec5	Models and organizational structures of maintenance services. Activities of maintenance services. Cost related problems.	2
Lec6	Introduction to computer-aided maintenance management. Classification and characterization of tools. The information structure and practical properties of CMMS class systems.	2
Lec7	Presentation of selected CMMS systems – the basic modules, the range of application. The selection criteria.	2
Lec8	Computer support of the planning and carrying out of machine and equipment service-repair work. Examples of applications.	2

Lec9	Principles of implementing systems in industrial practice (benefits and problems). Practical examples.	2
Lec10	Course crediting.	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Introduction. The presentation of a selected CMMS system – the user interface, the basic modules, the practical properties.	2
Proj2	Identification of operational objects and resources. Operational structure. Data logging.	2
Proj3	Planning of operational actions and instructions. Keeping records of material and human resources. Planning and carrying out of tasks. Development of instructions for operational actions.	2
Proj4	Planning of employee workloads. Generation of cards with tasks for maintenance objects.	2
Proj5	Stock management. Analyses and reports. Management of engineering documentation. Course crediting.	2
		Total hours: 10

TEACHING TOOLS USED

N1. The traditional lecture with the use of transparencies and slides.
N2. Tutorials.
N3. Self-study.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_K02, PEK_W03	Final test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	The grading of the tasks carried out as part of the particular topics.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Base of operation of machinery and equipment. Wyd. WSiP. Warszawa, 2007.
Słowiński B.: Engineering of machines maintenance. Wyd. Pol. Koszalińskiej. Koszalin, 2011.
Kaźmierczak J.: The operation of technical systems. Wyd. Pol. Śląskiej. Gliwice, 2000.

SECONDARY LITERATURE

Hebda M.: Elements of operation theory of technical systems. Wyd. MCNEMT. Radom, 1990.
Żółtowski B.: The basics of machine diagnostics. Wyd. ATR Bydgoszcz. Bydgoszcz, 1996.
Honczarenko J.: Flexible manufacturing automation. Obrabiarki i systemy obróbkowe. WNT Warszawa, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer aided operation and maintenance management of machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_K02, PEK_W03	K1ZIP_W11	C1, C2, C3	Wy1 - Wy9	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U11	C1, C2, C3	Pr1 - Pr5	N3
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K10	C1, C2, C3	Pr1 - Pr5	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie przedsięwzięciem**
Name in English: **Management of an undertaking**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **ZPM032110**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Familiarizing yourself with today's knowledge of project management.
C2. Learning the proper preparation of the project.
C3. Learning the proper supervision of the execution of the project.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knowledge of the project life cycle
PEK_W02 - Knowledge about management of objectives, integration of tasks, time and cost
PEK_W03 - Knowledge about quality and risk management as well as human resources and expenses management

II. Relating to skills:

PEK_U01 - Knowing how to prepare the project (technical development of the project).
PEK_U02 - Knowing how to supervise the implementation of the project.
PEK_U03 - Ability to manage of a project management in a methodical way.

III. Relating to social competences:

PEK_K01 - Awareness of the role of the engineer in the planning of projects and the need for accountability and involvement in one of the most important links in the enterprise management process.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.
PEK_K03 - Understands the need for lifelong learning in the field of business engineering and professional as well as social skills development.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The life cycle of the project: Initiation, Planning, Commissioning, Control and Monitoring, Closure	3
Lec2	Integration management	3
Lec3	Goals management	3
Lec4	Management of time and costs	4
Lec5	Management of quality and risk	3
Lec6	Management of human ressources and expenses	4
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Split into project groups and selection of project topic	1
Proj2	Presentation of a subject, goal and range of the project	1
Proj3	Communication	1
Proj4	Detailed goals and analysis of project feasibility	2
Proj5	Activities and ressources	1
Proj6	Schedule	1
Proj7	Estimation of costs	2
Proj8	Quality and risk management	1
		Total hours: 10

TEACHING TOOLS USED
N1. case study N2. problem exercises N3. self study - preparation for project class N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Completion of project task
P =		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE 1. „A Guide to the Project Management Body of Knowledge: Third Edition (PMBOK Guide)", Project Management Institute, 2004, ISBN: 193069945X SECONDARY LITERATURE 2. Nancy Mingus „Project management"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management of an undertaking
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W14	C1	Lect1 - Lect6	N4
PEK_U01, PEK_U03	K1ZIP_U19	C2	Pr1 - Pr8	N1, N2, N3
PEK_U02	K1ZIP_U14	C3	Pr1 - Pr8	N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K09	C1, C2, C3	Pr1 - Pr8	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Joanna Gąbka tel.: 41-84 email: joanna.gabka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Operacyjne sterowanie wytwarzaniem**
Name in English: **Operational control of manufacturing**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **ZPM032201**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the operation of the manufacturing enterprise.
2. Knowledge of technological processes in manufacturing.
3. Computer skills (Windows).

SUBJECT OBJECTIVES

C1. Get to know the essence of manufacturing operational control in various industries.
C2. Getting familiar with the methods and problems of scheduling of production orders
C3. Gathering scheduling skills using a dedicated IT tool.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of the principles and methods of construction schedules for production orders.
PEK_W02 - Knowledge of the basic criteria for optimizing schedules.
PEK_W03 - Knowledge of scheduling strategies in companies from various industries.

II. Relating to skills:
PEK_U01 - Ability to prepare a schedule for production orders.
PEK_U02 - Ability to use tools for building schedules.
PEK_U03 - Ability to apply schedule optimization based on selected criteria.

III. Relating to social competences:
PEK_K01 - Awareness of the role of the engineer in the planning of production and demand for accountability and involvement in one of the most important links of the production process in the company.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.
PEK_K03 - Understands the need for lifelong learning in the field of business engineering and professional and social skills development.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Manufacturing operational control in various industrial sectors.	2
Lec2	Methods and techniques of manufacturing operational control.	2
Lec3	Scheduling of production orders on the example of selected information tool.	2
Lec4	An example of operational control of manufacturing in a chosem manufacturing company	2
Lec5	Scheduling algorithms and methods to optimize scheduling	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Establishing a simple schedule.	2
Proj2	Shortening the time of production orders in the prepared schedule.	2
Proj3	Scheduling of assembling processes.	2
Proj4	Self construction of a schedule and the use of known methods of shortening the lead time.	2
Proj5	Construction and comparison of different versions of the schedule.	2
		Total hours: 10

TEACHING TOOLS USED

N1. case study
N2. problem exercises
N3. traditional lecture with the use of transparencies and slides
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Completion of a project task
F2	PEK_K01, PEK_K02, PEK_K03	Defense of a project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Czesław Smutnicki, Algorytmy szeregowania, Akademicka Oficyna Wydawnicza EXIT, ISBN: 83-87674-39-7
2. Muhlemann A., Oakland J., Lockyer K.: Zarządzanie Produkcja i Usługi, Wydawnictwo Naukowe PWN, Warszawa 2001

SECONDARY LITERATURE
1. Brzeziński M.: Organizacja i sterowanie produkcją, Placet, Warszawa 2002
2. Durlik I.: Organizacja i zarządzanie produkcją, Warszawa 2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operational control of manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_ZPW_W02	C1, C2	Lect1 - Lect5	N1, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U15, K1ZIP_ZPW_U02	C3	Pr1 - Pr5	N2, N4
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K07	C1	Pr1 - Pr5	N3

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo, normowanie i ergonomia w organizacji pracy**
Name in English: **Safety, standarization and ergonomics in work organization**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **optional**
Subject code: **ZPM032202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases. Estimate of professional risk on work positions	2
Lec3	Ergonomics as interdisciplinary science	2
Lec4	Labor biomechanics - science about threats for employee health discovering, being result of executable work	2
Lec5	Dangerous and harmful agents in work environment	2
Lec6	First pre-medical aid	2
Lec7	Fire protection	2
Lec8	Threats and work protection at transport manual labour. Heights work and closed-containers work as especially dangerous works.	2
Lec9	Sitting work geometry, computer work stand. Breaks at work, shift work. Stress at work.	2
Lec10	Work physiology. Work environment microclimate. Ventilation and air conditioning at accomodation.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion
N3. tutorials
N4. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE

D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Safety, standarization and ergonomics in work organization
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1ZIP_W21	C1	Lec1, Lec2, Lec3, Lec6, Lec7, Lec8, Lec9, Lec10	1,2,3,4
PEK_W02	K1ZIP_W21, K1ZIP_W24, K1ZIP_W25	C2	Lec3, Lec4, Lec9	1,2,3,4
PEK_W03	K1ZIP_W20, K1ZIP_W21	C3	Lec5, Lec6, Lec7, Lec8, Lec9, Lec10	1,2,3,4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ochrona własności intelektualnej**
Name in English: **Protecting intellectual property**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032204**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				10
Number of hours of total student workload (CNPS)	30				30
Form of crediting	Crediting with grade				Crediting with grade
Group of courses					
Number of ECTS points	1				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge in the field of innovation
2. Basic knowledge in the area of accounting and finance
3. General knowledge of business law and marketing.

SUBJECT OBJECTIVES

C1. To familiarize students with the concept of intellectual property and basic legal standards.
C2. The acquisition of basic skills notification of descriptions of inventions and utility models, and industrial, etc.
C3. Ability to use patent information.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge related to intellectual property
PEK_W02 - Is able to assess the patentability
PEK_W03 - Has knowledge of plagiarism

II. Relating to skills:
PEK_U01 - Knows the procedure for the examination of patent applications and utility models.
PEK_U02 - Knows about the dangers of unlicensed software use
PEK_U03 - Can evaluate engineering work from plagiarism point of view

III. Relating to social competences:
PEK_K01 - Understand the legal aspects and effects of engineering activities.
PEK_K02 - He understands the need and knows the possibility of lifelong learning (studies II and III degree, postgraduate courses) - raising professional competence, personal and social
PEK_K03 - Teamwork ability

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of intellectual property, source of intellectual property rights	2
Lec2	ndustrial property rights - an invention, industrial design, utility model, trademark and legal protection.	2
Lec3	Copyright and related rights	2
Lec4	Patent information: sources and collections of patent documentation and literature, access to information and databases of Patent Office. Copyright Literary and Artistic Works	2
Lec5	Intellectual property protection software. Intellectual property databases and domains	2
		Total hours: 10

Form of classes – Seminar		Number of hours
Sem1	the conclusions of the discussion.	10
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	presentation of the chosen theme
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Autor: Pyr.a R., tytuł: Poradnik wynalazcy , wydawnictwo: Urząd Patentowy RP, rok:2008Autor: Golat A.M., tytuł: Własność intelektualna i przemysłowa, wydawnictwo: C.H. Becke, rok: 2005Autor: Deren A.M., tytuł: Własność intelektualna i przemysłowa, wydawnictwo: Kompendium wiedzy. Ofic. Wyd. PWSzZ Nysa, rok: 2007Autor: Staszko W. (red.), tytuł: Ochrona patentowa, wydawnictwo: Wyd. Uniwersytetu Śląskiego, rok: 1983Autor: Sieniów T., Włodarczyk W., tytuł: Własności intelektualne w społeczeństwie informacyjnym, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2001Autor: Adamczak A., Gedłek M., tytuł: Znaki towarowe w działalności małych i średnich przedsiębiorstw, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2009Autor: Adamczak A., Dobosz E., Gedłek M., tytuł: Wzory przemysłowe w działalności małych i średnich przedsiębiorstw, wydawnictwo: Krajowa Izba Gospodarcza, rok: 2009

SECONDARY LITERATURE
Autor: Gajos M., tytuł: Opis patentowy jako źródło informacji, wydawnictwo: Wyd. Uniwersytetu Śląskiego, rok: 2000Autor: Lowe P., tytuł: Zarzadzanie technologia. Możliwości poznawcze i szanse, wydawnictwo: Wyd. Śląskie, rok: 1999Autor: Jeziorow J., tytuł: Wrocławski "Kodeks dobrych praktyk w zakresie korzystania zwyników pracy intelektualnej., wydawnictwo: Urząd Marszałkowski Województwa Dolnośląskiego, rok: 2010Autor: Golat R., tytuł: Prawo autorskie. Poradnik dla twórców., wydawnictwo: Dom Wydawniczy ABC., rok: 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Protecting intellectual property
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W22	C1, C2, C3	Lec1 - Lec5	N1
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U22	C1, C2, C3	Sem1	N2
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K01, K1ZIP_K09	C1, C2, C3	Sem1	N2

SUBJECT SUPERVISOR

dr inż. Zygmunt Domagała tel.: 71 320-27-85 email: Zygmunt.Domagala@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Eksploatacja systemów produkcyjnych**
Name in English: **Operation of production systems**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Level and form of studies: **I level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM032209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge relating to the structure and operation of machine elements and units and knows the principles of matching and constructing them
2. The student has basic knowledge of materials science, metrology and information science.
3. The student has sound knowledge relating to the principal manufacturing techniques and the role of technological machines.

SUBJECT OBJECTIVES

C1. The student is to learn the general rules concerning the use, maintenance and repair of machines.
C2. The student is to learn the basic diagnostic methods of testing the condition of machines.
C3. The student is to learn the possibilities of managing machine operation and planning and managing repairs in the enterprise.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic rules concerning the use, maintenance and repair of manufacturing machines and equipment.
PEK_W02 - The student knows the range of maintenance actions, the general principles of selecting a maintenance strategy and the ways of organizing maintenance actions.
PEK_W03 - The student knows the basic characteristics and capacities of the computer systems aiding the planning of service-repair tasks, stock management and service-repair personnel management.

II. Relating to skills:
PEK_U01 - The student can exploit the acquired knowledge to formulate technical, organizational and economic actions relating to the operation of manufacturing machines and equipment.
PEK_U02 - The student can develop general assumptions for repair work.
PEK_U03 - The student can use modern IT tools for the computer management of operation processes.

III. Relating to social competences:
PEK_K01 - The student knows how to search for and use the literature recommended for the course and acquire knowledge on her/his own.
PEK_K02 - The student can use modern IT tools.
PEK_K03 - The student understands the necessity of systematic and unassisted work in order to master the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Technological machines and devices - current development trends. Basic operation requirements (flexibility, productivity, capability, accuracy and other). The cause-effect analysis of machine breakdowns.	2
Lec2	Basic problems relating to operation maintenance of machines (operation, operation theory, operational requirements). Reliability definitions and terms.	2
Lec3	Operational models and the principles of operation maintenance control. Operation maintenance strategies. A set of rules governing the operation maintenance of machines.	2
Lec4	Physicochemical basics of machine operation (friction, wear, lubrication). Oil economy.	2
Lec5	Types of repairs (running, average, major). The EU directives concerning machine repairs.	2
Lec6	The role of manufacturing machine acceptance tests. Machine diagnostics. Technical and economic aspects of machines modernization.	2
Lec7	Basic problems related to maintenance (tasks, strategies and trends). The essence of the Total Productive Maintenance (TPM) system - framework and supporting pillars, ratings.	2
Lec8	Role and importance of maintenance organization and planning. The classification and characterization of the tools aiding maintenance management.	2

Lec9	CMMS class operation management aiding information systems (the requirements and functions of selected systems, the system selection criteria). The implementation of the systems in industrial practice.	2
Lec10	Course crediting.	2
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Introduction. The presentation of a selected CMMS system – the user interface, the basic modules.	2
Proj2	The identification of maintenance objects for selected machines and equipment. The building of an operational structure.	2
Proj3	A statement of operation actions, instructions and necessary materials. The definition of inspection (checking and lubricating) routes.	2
Proj4	The planning of employee workloads. The generation of cards with tasks for maintenance objects.	2
Proj5	Stock management for spare parts: the spare parts card, stock levels. Course crediting.	2
		Total hours: 10

TEACHING TOOLS USED

N1. The traditional lecture with the use of transparencies and slides.
N2. Tutorials.
N3. Self-study.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Final test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	The grading of the tasks carried out as part of the particular topics.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Legutko S.: Base of operation of machinery and equipment. Wyd. WSiP. Warszawa, 2007.
Słowiński B.: Engineering of machines maintenance. Wyd. Pol. Koszalińskiej. Koszalin, 2011.
Kaźmierczak J.: The operation of technical systems. Wyd. Pol. Śląskiej. Gliwice, 2000.

SECONDARY LITERATURE
Hebda M.: Elements of operation theory of technical systems. Wyd. MCNEMT. Radom, 1990.
Żółtowski B.: The basics of machine diagnostics. Wyd. ATR Bydgoszcz. Bydgoszcz, 1996.
Honczarenko J.: Flexible manufacturing automation. Obrabiarki i systemy obróbkowe. WNT Warszawa, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation of production systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1ZIP_W11	C1, C2, C3	Wy1 - Wy9	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K1ZIP_U11	C1, C2, C3	Pr1 - Pr5	N3
PEK_K01, PEK_K02, PEK_K03	K1ZIP_K10	C1, C2, C3	Pr1 - Pr5	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Optymalizacja rozmieszczenia stanowisk roboczych**
Name in English: **Optimizing deployment of workstations**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of logistics and enterprise management
2. The ability to build simulation models for discrete manufacturing systems

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about how to deploy workstations
C2. Learn how to build a layout plans
C3. Learn how to optimize the planned deployments of workstations

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge of the mathematical arrangement of workplaces
PEK_W02 - He has knowledge of the technological conditions of the deployment of workstations
PEK_W03 - He knows the basic techniques of simulation deployment of workstations

II. Relating to skills:
PEK_U01 - He can choose a variety of simulation tools to verify the layout plans
PEK_U02 - Can apply various simulation tools to verify and optimize the layout plans
PEK_U03 - The student is able to properly make the deployment plan workstations

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Methodological approaches in the design of the deployment of production cells	4
Lec2	Mathematical methods for designing the deployment of workstations	6
Lec3	Technical considerations taken into account when deploying workstations	6
Lec4	Verification of simulation methods proposed solutions	4
Lec5	Tools for modeling and simulation of manufacturing systems	2
Lec6	Discrete Simulation - Action	2
Lec7	Data collection for the project simulation	2
Lec8	Multi-criteria optimization	2
Lec9	Classification of forms of organization of production for manufacturing cells	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Determination of the coefficient io to match the number of facilities for the production plan and the available production technology	2
Proj2	The selection of machinery from manufacturers' catalogs. Optimizing deployment of workstations by using a mathematical algorithm MST (Modified Spanning Tree Algorithm)	4
Proj3	Optimizing deployment of workstations by using a mathematical algorithm triangles Schmigalli	2
Proj4	Optimizing deployment of workstations by using a mathematical algorithm ROC (Rank Order Clustering)	2
Proj5	Develop deployment of workstations, taking into account technological conditions. A comparison of the above methods based on the calculated cost.	3
Proj6	Assessment of the project	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture
N3. problem exercises
N4. calculation exercises
N5. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Assessment of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. PROJEKTOWANIE ROZMIESZCZENIA STANOWISK ROBOCZYCH / STANISLAW LIS, KRZYSZTOF SANTAREK Warszawa : PWN, 1980.
2. Podstawowa problematyka projektowania stanowisk pracy / Teresa Musioł, Jarosław Grzesiek ; Wyższa Szkoła Ekonomii i Administracji w Bytomiu. Bytom : Wyższa Szkoła Ekonomii i Administracji, 2008.

SECONDARY LITERATURE

PROJEKTOWANIE STANOWISK I PROCESOW PRACY / KAROL RYPULAK. LUBLIN : POLITECHNIKA, 1981.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Optimizing deployment of workstations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W02, K2ZIP_W03, K2ZIP_W07	C1	Lec1 - Lec9	N1, N2
PEK_U01, PEK_U02, PEK_U03	K2ZIP_U02, K2ZIP_U03, K2ZIP_U07	C2, C3	Pr1-Pr6	N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Arkadiusz Kowalski tel.: 37-10 email: arkadiusz.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Symulacja procesów produkcyjnych**
Name in English: **The simulation of manufacturing processes**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of process planning

SUBJECT OBJECTIVES

C1. Introduction to with the problems design methods of simulation models of manufacturing systems
C2. The acquisition of practical skills-building simulation models and analyzing their results
C3. Understanding the issues of multi-criteria optimization of manufacturing systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Using the example simulation tool for manufacturing systems
PEK_U02 - Using a sample tool to optimize production systems
PEK_U03 - Building adequate, discrete simulation models for production systems

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of deliveries	4
Proj2	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of deliveries including hardening operations	2
Proj3	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of delivery including quality control operations	2
Proj4	Budowa symulacyjnego modelu deterministycznego systemu wytwórczego w celu wyznaczenia optymalnej częstotliwości dostaw przy różnorodnym planie produkcji	4
Proj5	Building deterministic simulation model of manufacturing system to determine the optimum frequency of operation of supply assembly including	2
Proj6	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of supply, taking into account the various modes of transport and the cost of	2
Proj7	Performing a test	2
Proj8	Building non-deterministic simulation model of manufacturing system	2
Proj9	Building a simulation model of the manufacturing system niederministycznego uzwględnieniem breaks and the use of macros	2
Proj10	Building non-deterministic simulation model of manufacturing system using variables and attributes	2
Proj11	Perform non-deterministic multi-criteria optimization of manufacturing systems	4
Proj12	Perform a test	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises
N2. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Defence project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Discrete-event system simulation / Jerry Banks [et al.]. Upper Saddle River : Pearson Education cop. 2010.

SECONDARY LITERATURE

System modeling and simulation : an introduction / Frank L. Severance. Chichester : John Wiley & Sons 2001.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The simulation of manufacturing processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2ZIP_U02, K2ZIP_U03	C1, C2, C3	Pr1 - Pr12	N1, N2

SUBJECT SUPERVISOR

dr inż. Arkadiusz Kowalski tel.: 37-10 email: arkadiusz.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Logistyka zaopatrzenia**
Name in English: **Logistics of supply**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management,logistic processes/systems performance design and testing
2. has a basic knowledge in the field of operations research
3. has a basic knowledge in the field of spreadsheet using, e.g. Excel

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the area of supply systems performance.
C2. Acquiring the ability to define the main problems and tasks that occur in the area of supply logistics.
C3. Acquiring the ability to define the processes of cooperation and integration in the supply area.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has an extended knowledge of the research, design, and logistic systems management, especially in the phase of supply performance
PEK_W02 - Can identify the processes of cooperation and integration in the supply chain's downstream (relations in: supply system - system of production) to reference the desired economic results of the enterprise

II. Relating to skills:
PEK_U01 - Can obtain information from literature, databases and other sources
PEK_U02 - Able to integrate the information, make their interpretation and critical evaluation, and to draw conclusions and formulate and fully justify opinions
PEK_U03 - Able to prepare a research study

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Logistics of supply - the main definitions, issues, goals and tasks.	2
Lec2	Organization of procurement processes.	2
Lec3	Cooperation with the supplier and the process of supplier evaluation and selection.	2
Lec4	Strategies in the area of supply in the enterprise.	2
Lec5	Transportation and supply delivery performance.	2
Lec6	Information flows in the area of supply.	2
Lec7	Assessment of the level of supply system performance. Minimizing risk in the area of supply.	3
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction to the course. Simulation of the supply processes organization performance.	2
Proj2	The consolidation / deconsolidation of purchases (own study/case study).	2
Proj3	Problem of supplier analysis and selection process (own study/case study).	2
Proj4	Decision problem "make or buy" (own study/case study)	2
Proj5	Supply inventory management in an enterprise (own study/case study).	2
Proj6	Risk in the area of supply performance (own study/case study)	2
Proj7	Suppy system effectiveness (own task/case study). Completion of the course.	3
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. problem discussion N3. tutorials N4. self study - preparation for project class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_W02	A positive evaluation of the written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_U03,	a positive evaluation of the tasks performed during the project classes
F2	PEK_W01, PEK_W02, PEK_U02,	A positive evaluation of the written test
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Bozarth C., Handfield R.B., „Wprowadzenie do zarządzania operacjami i łańcuchem dostaw", Wyd. Helion S. A., Gliwice, 2007
2. Brzeziński M., „Logistyka w przedsiębiorstwie", Wyd. Bellona, Warszawa, 2006
3. Chaberek M., „Rachunek decyzyjny w logistyce zaopatrzenia", Wyd. GWSH, Gdańsk, 2002
4. Kowalska K., ,,Logistyka Zaopatrzenia", Wydawnictwo Akademii Ekonomicznej, Katowice, 2005
5. Krawczyk S., ,,Zarządzanie procesami logistycznymi", Wyd. PWE,Warszawa, 2001
6. Sarjusz - Wolski Z., ,,Strategia Zarządzania Zaopatrzeniem", Wyd. PLACET, Warszawa, 1998
7. Twaróg J., ,,Mierniki i Wskaźniki Logistyczne", Wyd. Instytut Logistyki i Magazynowania, Poznań, 2003
8. Vollmuth H.J., ,,Controlling. Instrumenty od A do Z", Wyd. Placet, Warszawa, 1995
9. Witkowski J., ,,Zarządzanie Łańcuchem Dostaw", Wyd. PWE, Warszawa, 2010
10. Wojciechowski T., ,,Zarządzanie sprzedażą i zakupem materiałów", Wyd. PWE, Warszawa, 1999
11.Lysons, Kenneth. "Zakupy zaopatrzeniowe", PWE, Warszawa 2004.

SECONDARY LITERATURE

1. Blanchard B. S.: Logistics Engineering and Management (5th Ed). Upper Saddle River: Pearson Prentice Hall, 2004
2. Dąbrowska - Mitek M., ,,Ocena dostawców w przedsiębiorstwach handlowych", - Problemy Jakości, Luty 2007
3. Mańkowski C., ,,Kontroling i logistyka zaopatrzenia jako czynniki synergiczne gospodarowania", Wyd. UW, Gdańsk, 2005
4. Pfohl H.Ch., ,,Systemy Logistyczne", Wyd. Instytut Logistyki i Magazynowania, Poznań, 2001
5. Pfohl H.Ch., ,,Zarządzanie logistyką", Wyd. Instytut Logistyki i Magazynowania, Poznań, 1998
6. Wolniak R., Skotnicka - Zasadzień B., ,,Wybrane metody badania satysfakcji klienta i oceny dostawców w organizacjach", Wydawnictwo Politechniki Śląskiej, Gliwice, 2008
Czasopisma:
1. The International Journal of Logistics Management
2. International Journal of Physical Distribution & Logistics Management
3. Journal of Business Logistics
4. Gospodarka Materiałowa i Logistyka
5. Logistyka

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logistics of supply
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_LS_W01	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7	N1, N2, N5
PEK_U01, PEK_U02, PEK_U03	K2ZIP_LS_U02	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Pr1, Pr2, Pr3, Pr4, Pr5, Pr6, Pr7	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie procesów logistycznych**
Name in English: **Logistics processes modelling**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041103**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of management, designing and testing logistics processes and systems
2. Knowledge of spreadsheet, e.g.Excel

SUBJECT OBJECTIVES

C1. Developing the knowledge of the areas of logistics systems modeling methodology
C2. Mastering the skills of planning and designing of logistics systems with special emphasis on tools to support the work of logistics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has an extended knowledge of modeling random logistics processes

II. Relating to skills:
PEK_U01 - Student can develop a model of logistic processes using methods of system analysis and computer tools

III. Relating to social competences:
PEK_K01 - Student knows how to interact and work in a group
PEK_K02 - The student is able to prioritize appropriately for specific tasks and problems
PEK_K03 - Student can think and act in a creative way

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to modeling. Objectives, possibilities and limitations of modeling. The stages of construction and testing of models.	2
Lec2	Graphical representation methods of logistics processes.	2
Lec3	Critical path with limited resources, the analysis of parallel activities MAC.	2
Lec4	Dynamic programming.	2
Lec5	Dynamic programming in logistic processes modelling - examples	2
Lec6	Decision making under risk: decision tree and playing with nature.	2
Lec7	Introduction to simulation modeling. Generating pseudo-random numbers.	2
Lec8	Designing and development of the algorithm and simulation program.	2
Lec9	Examples of simulation models for simulating the dynamics of transport - storage processes.	2
Lec10	Collection and analysis of input data for modeling.	2
Lec11	The verification and evaluation of the results of simulations. The model testing.	2
Lec12	Introduction to queuing theory: the process of birth and death.	2
Lec13	Discussion of examples of queuing theory: systems of M/M/m type without queue.	2
Lec14	Discussion of examples of queuing theory: systems of M/M/m type with queue.	2
Lec15	Final test.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Discussion of laboratory plan, requirements, terms and conditions of the course completion. Presentation of selected case studies based on newspaper articles.	2
Proj2	The choice of the number of transport-storage equipment - based on a graphical model of the process.	2
Proj3	The problem of storage location in a given distribution network.	2

Proj4	Selecting the option of process of purchase and storage - using dynamic programming methods.	2
Proj5	Construction of the decision tree for a given example.	2
Proj6	The simulation of the (S, Q) inventory control model in random conditions.	2
Proj7	Testing of the simulated inventory control model and searching of its optimal parameters.	3
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for project class
N5. self-study and preparation for the test completion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	evaluation of the written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_K01, PEK_K02, PEK_K03	evaluation of the tasks carried out in the classroom project
F2	PEK_W01, PEK_U01	evaluation of the written test
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Bozarth C., Handfield R.B., Wprowadzenie do zarządzania operacjami i łańcuchem dostaw., Helion, 2007
2. Ciesielski M.(red.), Instrumenty zarządzania łańcuchami dostaw, PWE,2009
3. Chaberek M, Modelowanie procesów i systemów logistycznych.Cz. 1., Wyd. U.G. Gdansk, 2001
4. Krawczyk S., Metody ilosciowe w logistyce (przedsiebiorstwa) t.II, Wydawnictwo C. H. Beck, 2001
5. Pfohl H-Ch., Systemy logistyczne: podstawy organizacji i zarzadzania,Wyd. IliM, Poznan , 2001

SECONDARY LITERATURE

1. Blanchard B. S., Logistics Engineering and Management (5th Ed). Upper Saddle River: Pearson Prentice Hall, 2004
2. Grajewski P., Organizacja procesowa, PWE, 2007
3. Mokrzyszczak H., Logistyka: podstawy procesów logistycznych, WIG, Białystok, 1998
4. Wojciechowski A., Systemy logistyczne, WAT, 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logistics processes modelling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2ZIP_LS_W08	C1	Le.1, Le.2, Le.3, Le.4, Le.5, Le.6, Le.7, Le.8, Le.9, Le.10, Le.11, Le. 12, Le.13, Le.14, Le.15	N1, N2, N5
PEK_U01	K2ZIP_LS_U10	C1, C2	Le.1, Le.2, Le.3, Le.4, Le.5, Le.6, Le.7, Le.8, Le.9, Le.10, Le.11, Le. 12, Le.13, Le.14, Le.15, Pr1, Pr2, Pr3, Pr4, Pr5, Pr 6, Pr7	N1, N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2ZIP_LS_K01, K2ZIP_LS_K02, K2ZIP_LS_K03	C2	Pr1, Pr2, Pr3, Pr4, Pr5, Pr 6, Pr7	N4

SUBJECT SUPERVISOR

dr inż. Anna Jodejko-Pietruczuk tel.: 71 320-28-17 email: Anna.Jodejko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie systemów transportowo-magazynowych**
Name in English: **Systems design of transportation and warehousing**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge of management and design processes and logistics systems
2. Has knowledge in the field of logistics

SUBJECT OBJECTIVES

C1. Understanding the issues concerning planownaia and projektownaia transport and storage systems.
C2. Acquiring the ability to plan and organize material and information flows in warehouses.
C3. Acquiring the ability to optimize logistics systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the concept of transport system - storage, explain its construction, calling its individual components.
PEK_W02 - Can describe for selected cases to propose their own solutions for transport and storage, discussing their choices, to indicate the most appropriate having regard to the strategy.
PEK_W03 - Able to calculate the sample solution and transport system magayznowego at the operational level.

II. Relating to skills:
PEK_U01 - He can decide and choose the elements of the design process and transport and storage.
PEK_U02 - Has the ability to develop a system of documentation for transportation and storage.
PEK_U03 - Has the ability to estimate the cost of transport and storage system and exploit them.

III. Relating to social competences:
PEK_K01 - Works independently and interact as a team
PEK_K02 - Respects the findings doing the job.
PEK_K03 - Discussed, maintaining openness to other sentence.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introductory lecture: - The content of the lecture. - Assessment and timing tests. - Basic and further reading. - Organization of the course.	1
Lec2	Identification of logistic processes in conveying and storage. -definition Warehouse. Identify the basic processes of transport and storage. Identify the functional-process storage areas. -definition Unit load. -Fronty Handling. -Work Cargo.	2
Lec3	Methods of presentation of flow record cargo logistics storage system. -Scenografia Organizatorska. -Synoptyczne Charts. -Wykresy Sankey. -Credit Material flow process.	2
Lec4	The allocation of the objects in the planning of cargo flows. Metoda Schimigalli. computer Metody Trucking - optimization of cargo flows Problem transport route planning. Podstawowe structural solutions. Przykłady computing	2

Lec5	Designing storage structure. Magazyny: high and low storage. Magazyn the "regime" temperature. Magazyn cross-dock. Magazyn bulk materials. Magazyn liquid materials.	2
Lec6	Colloquium 1z 2. The test covers material from classes 1-5	1
Lec7	Selection of equipment for storage. Składowanie static without racking (short repetition). Składowanie static. Składowanie dynamic.	2
Lec8	Forklift trucks. Charakterystyka universal forklift. Charakterystyka specialized forklifts.	2
Lec9	Rack Charakterystyka stacking machines. Harmonogramowanie time stacker cranes. Optymalizacja stacker cranes work.	2
Lec10	Scheduling time of mobile devices in the transport logistics warehouse systems Harmonogramowanie time forklifts. Harmonogramowanie time stacker cranes.	2
Lec11	Conveyors in logistics warehouse systems. Rodzaje conveyors. Rozwiązania construction. Zasady selection of conveyors	2
Lec12	The selection means of the flow of information. Oznaczanie pallets in the warehouse. Oznaczanie loading units in stock. Wybór of information technology in logistics storage system. Dobór reading devices 1D, 2D and RFID. (stationary scanners, radio with docking station, camera) Dobór printing devices / programming: 1D, 2D and RFID.	2
Lec13	The choice of computer-aided systems work logistic storage system Systemy WMS, MRP, ERP. Szczegółowe WMS system performance. Bazy logistic data storage systems	2
Lec14	Logistics optimization methods of storage systems. Energy consumption of storage systems Metody expert. Sposoby assess and reduce the energy consumption of selected processes magayznowych	2
Lec15	Colloquium 2z2. colloquium overall	1
Lec16	Educational trip to the store or office dealing with the structural design magazines.	2
Lec17	Discussion of the trip. Exposure to credit ratings lecture.	1
		Total hours: 30
Form of classes – Project		Number of hours

Proj1	Discussion of the organization of classes and examination of project activities. Providing basic and supplementary literature. Development of unit load forming algorithm EURO subjects piece of various dimensions, weight, size and resistance to physical exposure.	2
Proj2	Project deposition distribution of palletised goods in the warehouse, taking into account the classification: areas, zones and places.	2
Proj3	Scheduling transport cycles of selection and evaluation of technical means used in the design magazine - for example a forklift.	2
Proj4	Scheduling transport cycles of selection and evaluation of technical means used in the design magazine - for example rack stacker crane.	2
Proj5	Project completion storage subsystem piece units on the main line and picking bays.	2
Proj6	Analysis and identification of logistics for the storage system adopted in the project storage solutions for process automation.	2
Proj7	Choice concept store, technologies and processes - with diversity dimensions of goods and the size of the line of orders (from single pieces to full pallets on the same SKU).	2
Proj8	Overview of completed projects, a summary of the project activities. Credits.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. case study
N4. self study - preparation for project class
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	evaluation of the computational part of the project
F2	PEK_K01, PEK_K02, PEK_K03	participation in discussions of problem, the report - in the form of presentation of the group their projetów, defense project
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Korzeń Z.: „Logistyczne systemy transportu bliskiego i magazynowania" T. I; Instytut Logistyki i Magazynowania, Poznań, 1998.
2.Korzeń Z.: „Logistyczne systemy transportu bliskiego i magazynowania" T. II, Instytut Logistyki i Magazynowania, Poznań, 1999.
3.Krawczyk S. (red.): „Logistyka. Teoria i Praktyka", T.1, DIFIN, Warszawa, 2012.
4.Krawczyk S. (red.): „Logistyka. Teoria i Praktyka", T.2, DIFIN, Warszawa, 2012.
5.Zając P.: „Systemy magazynowe", Oficyna Wydawnicza NDiO, Wrocław, 2010.
6.Fijałkowski J.: „Transport wewnętrzny w systemach logistycznych"; Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001.

Czasopisma specjalistyczne:
1.Logistyka
2.Nowoczesny Magazyn
3.Eurologistics

SECONDARY LITERATURE

[1]. Gudehus T.: „Logistik" T. I; Grundlagen, Verfahren und Strategien; Springer, Hamburg; 1999;
[2]. Gudehus T.: „Logistik" T. I; Netzwerke, Systeme und Lieferketteen; Springer, Hamburg; 1999;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Systems design of transportation and warehousing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03, PEK_U01, PEK_U02, PEK_U03	K2ZIP_LS_W03	C1, C2, C3	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7, Wy8	N1, N2, N3,

PEK_U02, PEK_U03	K2ZIP_K02, K2ZIP_K03, K2ZIP_K04, K2ZIP_K05, K2ZIP_LS_U04, K2ZIP_LS_U05, K2ZIP_LS_U06, K2ZIP_LS_U07, K2ZIP_LS_U09	C2, C3,	Pr1, Pr2, Pr3, Pr4, Pr5, Pr5, Pr6, Pr7, Pr8	N4, N5

SUBJECT SUPERVISOR
dr inż. Paweł Zając tel.: 71 320-27-19 email: pawel.zajac@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie eksploatacją systemów logistycznych**
Name in English: **Management of logistic systems exploitation performance**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management,logistic processes/systems performance design and testing
2. has a basic knowledge in the field of operations research
3. has a basic knowledge in the field of spreadsheet using, e.g. Excel

SUBJECT OBJECTIVES

C1. The acquisition of the basic knowledge in the areas of theory of exploitation and reliability of technical systems and their supporting systems.
C2. Acquiring the ability to use the main maintenance methods.
C3. Acquiring the ability to solve the real-life problems, which may affect the effective performance of logistics processes being performed in exploitation systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a basic knowledge in the field of exploitation, dependability and durability of technical systems (including logistic systems).
PEK_W02 - Aquiring the knowledge necessary to plan exploitation processes for a specified type of systems and ability to their design and modification.
PEK_W03 - Aquiring the knowledge in the field of renewal processes management.

II. Relating to skills:
PEK_U01 - Aquiring the ability to use the statistical tools (e.g. RAMS tools) for the assessment of technical systems in the field of their exploitation processes performance
PEK_U02 - Aquiring the ability to define the main reliability characteristics of technical objects, including logistic objects

III. Relating to social competences:
PEK_K01 - Can think and act in a creative and enterprising way
PEK_K02 - Able to prioritize appropriately for specific tasks and problems

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the technical object exploitation problems - the main terms and definitions. Technical system logistics.	2
Lec2	System of operation and maintenance and its models. Maintenance and operation conditions.	2
Lec3	Equipment exploitation process. Exploitation state and the set of exploitation states of equipment.	2
Lec4	Exploitation time and distribution of equipment exploitation time. Indicators, assessment characteristics.	2
Lec5	Maintenance and operation process of machines and equipment used in logistics.	2
Lec6	Tools and methods of technical object failure analysis.	2
Lec7	Cause and types of failures.	2
Lec8	Elements of theory of reliability - the main terms, object failure, reliability structure, dependability assessment.	2
Lec9	Technical system renewal. Scope and objectives of technical systems maintenance.	2
Lec10	Maintenance strategies and operating and maintenance prevention. Potential for the operation and maintenance.	2
Lec11	Elements of operational activities in the logistics of technical systems supporting.	2
Lec12	Maintenance of spare parts inventory.	2
Lec13	Costs in maintenance and operation process performance.	2
Lec14	Withdrawal from the use of the object. Disposal and recycling.	2
Lec15	Management tools used in maintenance and operation process performance.	2

		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction to the project course. Reliability analysis of technical objects (e.g. evaluation of reliability/unreliability functions, failure intensity)	3
Proj2	The use of conformance tests to assess the reliability of technical objects	2
Proj3	Analysis of technical objects reliability structure, definition of optimal warranty period for the specified assumptions	2
Proj4	Maintenance strategy selection with taking into account economic and reliability criteria	2
Proj5	Problem of technical maintenance scheduling with taking into account forecasting number of failures and assessment of maintenance costs of technical object	2
Proj6	Repairman problem	2
Proj7	Technical object reliability analysis with the use of FTA method	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for project class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	A positive evaluation of the written test with possible oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement

F1	PEK_W01, PEK_U01, PEK_U02	written test
F2	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	a positive evaluation of the tasks performed during the project classes
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Borkowski S., Selejdak J., Salamon Sz., Efektywność eksploatacji maszyn i urządzeń, Sekcja Wydawnicza Wydziału Zarządzania Politechniki Częstochowskiej, Częstochowa, 2006
2. Dwiliński L., Wstęp do teorii eksploatacji obiektu technicznego, Wyd. Politechniki Warszawskiej, Warszawa 1991
3. Figurski J., Podstawy eksploatacji obiektów technicznych, Międzyresortowe Centrum Naukowe Eksploatacji Majątku Trwałego, Radom 1990
4. Gołąbek A., Eksploatacja i niezawodność maszyn, Politechnika Wrocławska skrypt, Wrocław 1988
5. Kazimierczak J., Eksploatacja systemów technicznych. Wyd. Politechniki Śląskiej, Gliwice 2000
6. Legutko S., Eksploatacja maszyn. Wyd. PP, Poznań 2007
7. Niziński S., Elementy eksploatacji obiektów technicznych. Wyd. Uniwersytetu Warmińsko-Mazurskiego, Olsztyn 2000
8. Nowakowski T. Niezawodność systemów logistycznych. Wyd. PWr. Wrocław 2011
9. Oziemski S., Efektywność eksploatacji maszyn. BPE, Radom ITE, Warszawa 1999
10. Ważyńska-Fiok K., Niezawodność systemów technicznych , PWN, Warszawa 1990

SECONDARY LITERATURE

1. Bobrowski D., Modele i metody matematyczne teorii niezawodności w przykładach i zadaniach, WNT, Warszawa 1985
2. Chaberek M.: Makro i mikroekonomiczne aspekty wsparcia logistycznego. Wydawnictwo Uniw. Gdańskiego, Gdańsk 2002
3. Grabski F., Jaźwiński J., Funkcje o losowych argumentach w zagadnieniach niezawodności, bezpieczeństwa i logistyki, WKŁ, Warszawa 2009
4. Nowakowski T., Metodyka prognozowania niezawodności obiektów mechanicznych, Wyd. PWr., Wrocław 1999
5. Szopa T., Niezawodność i bezpieczeństwo, Wyd. Politechniki Warszawskiej, Warszawa 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management of logistic systems exploitation performance
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_LS_W06	C1, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15	N1, N2, N5

PEK_U01, PEK_U02	K2ZIP_LS_U08	C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15, Pr1, Pr2, Pr3, Pr4, Pr5, Pr6, Pr7	N2, N3, N4
PEK_K01, PEK_K02	K2ZIP_LS_K02, K2ZIP_LS_K03	C3	Pr1, Pr2, Pr3, Pr4, Pr5, Pr6, Pr7	N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Logistyka łańcuchów dostaw**
Name in English: **Supply chain logistics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				15
Number of hours of total student workload (CNPS)	60				30
Form of crediting	Examination				Crediting with grade
Group of courses					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management, logistic processes/systems performance design and testing
2. has a basic knowledge in the area of logistic processes performance modelling

SUBJECT OBJECTIVES

C1. Understanding the issues of making strategic and operational decisions in the development of logistics and operation of external supply chains operating in a competitive market environment.
C2. Acquiring the ability to plan and organize the flow of material and information in procurement and distribution processes.
C3. Acquiring the ability to obtain information from the literature, databases, and other sources in order to prepare research paper on a selected topic

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has an extended knowledge of the research, design, and supply chain management, especially in the phases of the supply and distribution
PEK_W02 - Can identify cooperation and integration processes in supply chains for reference desired economic results of the enterprise

II. Relating to skills:
PEK_U01 - Can use a properly chosen information and communication technologies in order to analyze and assess the supply chains performance level
PEK_U02 - Has the ability to use methods of improving the efficiency of the logistics system

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group
PEK_K02 - Can think and act in a creative way

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Supply chains. Supply chain management.	2
Lec2	Logistic cooperation in the area of supply chain management.	2
Lec3	Supply chain management. The basic methods, tools and management concepts.	2
Lec4	Supply chain strategy	2
Lec5	Creation of models of strategy and business location.	2
Lec6	The role of information and information systems in supply chain management	2
Lec7	The assessment of the integrated logistics chain performance level.	2
Lec8	Effectiveness of integrated logistic chain performance.	2
Lec9	Integrated logistics chain performance design.	2
Lec10	Risk management in supply chains.	2
Lec11	Directions and concepts of improvement of supply chain management.	2
Lec12	Network organization and wirtual organization.	2
Lec13	The costs and their reduction in supply chain management	2
Lec14	Directions and concepts of improvement of supply chain management.	2
Lec15	Benchmarking and reeingeneering in logistics.	2
		Total hours: 30
Form of classes – Seminar		Number of hours
Sem1	Discussion of basic concepts and premises development of logistics chains. Distribution of seminar topics for group preparation by students.	2
Sem2	The integration and coordination of activities in the supply chain. The cooperation in an integrated supply chain (integration levels, cooperations rules, CPFR, needs identification, demand planning, etc.)	2

Sem3	Time management, customer relations management and quality management in supply chains	2
Sem4	Information systems supporting supply chain management.	2
Sem5	Methods for assessing the level of an integrated supply chain performance.	2
Sem6	Logistics network design. Suppliers evaluation and selection process.	2
Sem7	Directions and concepts of improvement of supply chain management. Development trends of supply chains. Summary of semminar activities.	3
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for seminar
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	written exam, with the possibility of additional oral answer
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01, PEK_K02	preparation of a study on a selected topic
F2	PEK_K01, PEK_K02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	preparation of seminar presentation on a selected topic
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Bozarth C.C., Handfield R.B., Wprowadzenie do zarządzania operacjami i łańcuchem dostaw: kompletny podręcznik logistyk i zarządzania dostawami, Helion, Gliwice 2007
2. Christopher M., Logistyka i zarządzanie łańcuchem podaży. Jak obniżyć koszty i poprawić jakość obsługi, Wydawnictwo Profesjonalnej Szkoły Biznesu, Kraków 1998.
3. Christopher M., Strategia zarządzania dystrybucją. Praktyka logistyki biznesu, Agencja Wydawnicza "Placet", Warszawa 1996.
4. Coyle J.J., Bardi E.J., Langley Jr C.J., Zarządzanie logistyczne, PWE, Warszawa 2002.
5. Kisperska-Moroń D. (red.), Pomiar funkcjonowania łańcuchów dostaw, Wydawnictwo AE w Katowicach, Katowice 2006.
6. Logistyka on-line. Zarządzanie łańcuchem dostaw w dobie gospodarki elektronicznej, praca zbiorowa pod red. K. Rutkowskiego, PWE Warszawa 2002.
7. Rutkowski K. (red.), Logistyka dystrybucji. Specyfika, tendencje rozwojowe, dobre praktyki, Oficyna Wydawnicza SGH, Warszawa 2005.
8. Rutkowski K. (red.), Zintegrowany łańcuch dostaw. Doświadczenia globalne i polskie, praca zbiorowa pod red. K. Rutkowskiego, SGH, Warszawa 1999.
9. Witkowski J., Zarządzanie łańcuchem dostaw. Koncepcje, procedury, doświadczenia, PWE Warszawa 2003.

SECONDARY LITERATURE

1. Chopra S., Meindl P., Supply Chain Management. Strategy, Planning and Operation, Prentice-Hall, Inc., Upper Saddle River, New Jersey 2001.
2. Handfield R.B., Nichols E.L. Jr, Introduction to Supply Chain Management, Prentice Hall, New Jersey 1999.
3. Knolmayer G., Mertens P., Zeier A., Supply Chain Management Based on SAP Systems. Order Management in Manufacturing Companies, Springer-Verlag Berlin Heidelberg 2002.
4. Simchi-Levi D., Kaminsky P., Simchi-Levi E., Designing and Managing the Supply Chain. Concepts, Strategies and Case Studies, The McGraw-Hill Companies, Inc. 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Supply chain logistics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_LS_W01	C1, C2	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7, Wy8, Wy9, Wy10, Wy11, Wy12, Wy13, Wy14, Wy15, Se1, Se2, Se3, Se4, Se5, Se6, Se7	N1, N2, N5
PEK_U01, PEK_U02	K2ZIP_LS_U01, K2ZIP_LS_U02	C1, C2, C3	Se1, Se2, Se3, Se4, Se5, Se6, Se7	N1, N2, N3, N4
PEK_K01, PEK_K02	K2ZIP_K03, K2ZIP_LS_K01	C3	Se1, Se2, Se3, Se4, Se5, Se6, Se7	N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Logistyka łańcuchów dostaw**
Name in English: **Supply chain logistics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				15
Number of hours of total student workload (CNPS)	60				30
Form of crediting	Examination				Crediting with grade
Group of courses					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management, logistic processes/systems performance design and testing

SUBJECT OBJECTIVES

C1. Understanding the issues of making strategic and operational decisions in the development of logistics and operation of external supply chains operating in a competitive market environment.
C2. Acquiring the ability to plan and organize the flow of material and information in procurement and distribution processes.
C3. Acquiring the ability to obtain information from the literature, databases, and other sources in order to prepare research paper on a selected topic

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has an extended knowledge of the research, design, and supply chain management, especially in the phases of the supply and distribution
PEK_W02 - Can identify cooperation and integration processes in supply chains for reference desired economic results of the enterprise

II. Relating to skills:
PEK_U01 - Can use a properly chosen information and communication technologies in order to analyze and assess the supply chains performance level
PEK_U02 - Has the ability to use methods of improving the efficiency of the logistics system

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group
PEK_K02 - Can think and act in a creative way

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Supply chains. Supply chain management.	2
Lec2	Logistic cooperation in the area of supply chain management	2
Lec3	Supply chain management. The basic methods, tools and management concepts. The quality of logistics processes	4
Lec4	The role of information and information systems in supply chain management	2
Lec5	The assessment of the integrated logistics chain performance level.	4
Lec6	Integrated logistics chain performance design	4
Lec7	Network organization and wirtual organization.	2
Lec8	The costs and their reduction in supply chain management	2
Lec9	Directions and concepts of improvement of supply chain management.	4
Lec10	Development trends of supply chains.	4
		Total hours: 30
Form of classes – Seminar		Number of hours
Sem1	Discussion of basic concepts and premises development of logistics chains. Distribution of seminar topics for group preparation by students.	2
Sem2	The integration and coordination of activities in the supply chain. The cooperation in an integrated supply chain.	2
Sem3	Time management, customer relations management and quality management in supply chains	2
Sem4	Information systems supporting supply chain management.	2
Sem5	Methods for assessing the level of an integrated supply chain performance.	2
Sem6	Logistics network design. Suppliers evaluation and selection process.	2

Sem7	Directions and concepts of improvement of supply chain management. Development trends of supply chains. Summary of semminar activities.	3
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. problem discussion N3. tutorials N4. self study - preparation for seminar N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	written exam, with the possibility of additional oral answer
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01, PEK_K02	preparation of a study on a selected topic
F2	PEK_K01, PEK_K02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	preparation of seminar presentation on a selected topic
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Bozarth C.C., Handfield R.B., Wprowadzenie do zarządzania operacjami
i łańcuchem dostaw: kompletny podręcznik logistyk i zarządzania dostawami, Helion, Gliwice 2007
2. Christopher M., Logistyka i zarządzanie łańcuchem podaży. Jak obniżyć koszty
i poprawić jakość obsługi, Wydawnictwo Profesjonalnej Szkoły Biznesu, Kraków 1998.
3. Christopher M., Strategia zarządzania dystrybucją. Praktyka logistyki biznesu,
Agencja Wydawnicza "Placet", Warszawa 1996.
4. Coyle J.J., Bardi E.J., Langley Jr C.J., Zarządzanie logistyczne, PWE, Warszawa 2002.
5. Kisperska-Moroń D. (red.), Pomiar funkcjonowania łańcuchów dostaw, Wydawnictwo AE w Katowicach, Katowice 2006.
6. Logistyka on-line. Zarządzanie łańcuchem dostaw w dobie gospodarki elektronicznej, praca zbiorowa pod red. K. Rutkowskiego, PWE Warszawa 2002.
7. Rutkowski K. (red.), Logistyka dystrybucji. Specyfika, tendencje rozwojowe, dobre praktyki, Oficyna Wydawnicza SGH, Warszawa 2005.
8. Rutkowski K. (red.), Zintegrowany łańcuch dostaw. Doświadczenia globalne
i polskie, praca zbiorowa pod red. K. Rutkowskiego, SGH, Warszawa 1999.
9. Witkowski J., Zarządzanie łańcuchem dostaw. Koncepcje, procedury, doświadczenia, PWE Warszawa 2003.

SECONDARY LITERATURE
1. Chopra S., Meindl P., Supply Chain Management. Strategy, Planning and Operation, Prentice-Hall, Inc., Upper Saddle River, New Jersey 2001.
2. Handfield R.B., Nichols E.L. Jr, Introduction to Supply Chain Management, Prentice Hall, New Jersey 1999.
3. Knolmayer G., Mertens P., Zeier A., Supply Chain Management Based on SAP Systems. Order Management in Manufacturing Companies, Springer-Verlag Berlin Heidelberg 2002.
4. Simchi-Levi D., Kaminsky P., Simchi-Levi E., Designing and Managing
the Supply Chain. Concepts, Strategies and Case Studies, The McGraw-Hill Companies, Inc. 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Supply chain logistics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_ZJ_W10	C1, C2	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7, Wy8, Wy9, Wy10, Se1, Se2, Se3, Se4, Se5, Se6, Se7	N1, N2, N5
PEK_U01, PEK_U02	K2ZIP_ZJ_U15, K2ZIP_ZJ_U16	C1, C2, C3	Se1, Se2, Se3, Se4, Se5, Se6, Se7	N1, N2, N3, N4
PEK_K01, PEK_K02	K2ZIP_K03, K2ZIP_ZJ_K08	C3	Se1, Se2, Se3, Se4, Se5, Se6, Se7	N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Logistyka dystrybucji**
Name in English: **Logistics of distribution**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041113**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management,logistic processes/systems performance design and testing
2. has a basic knowledge in the field of operations research
3. has a basic knowledge in the field of spreadsheet using, e.g. Excel

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the area of systems performance and distribution.
C2. Acquiring the ability to define the main problems and tasks that occur in the area of distribution logistics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has an extended knowledge of the research, design, and supply chain management, especially in the phase of distribution
PEK_W02 - Can identify the processes of cooperation and integration in the supply chain's downstream (relations in: system of production - distribution channel participants - client) to reference the desired economic results of the enterprise

II. Relating to skills:
PEK_U01 - Can obtain information from literature, databases and other sources
PEK_U02 - Able to integrate the information, make their interpretation and critical evaluation, and to draw conclusions and formulate and fully justify opinions
PEK_U03 - Able to prepare a research study

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group
PEK_K02 - Able to prioritize appropriately for specific tasks and problems

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course. The terms of distribution logistics and distribution system. The essence of logistics distribution. Basic tasks and capabilities in the field of distribution logistics.	2
Lec2	Distribution logistics in the system approach. Distribution strategies. The relationship between the distribution logistics and marketing.	2
Lec3	Planning the distribution network. Distribution channels (direct, indirect). Variants of the organization of distribution processes.	2
Lec4	Distribution requirements planning. Demand forecasting methods. Demand forecasting errors. Demand planning DRP.	2
Lec5	Logistics customer service. Measuring the level of customer service - an indicator of the reliability of supply OTIF (on time, in-full, error free). Cycle of customer orders and the associated information flows.	2
Lec6	The main problems occurring in logistics of distribution.	2
Lec7	Effects and costs in the logistics of distribution (logistics costs, distribution costs). level of supply service. The effectiveness of the distribution system, methodology, criteria and evaluation tools.	2
Lec8	Tools of modern distribution: cross docking, vendor management inventory, effective customer service.	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction to the course. Simulation of the "beer game".	2
Proj2	Managing the flow of finished goods from producer to final consumer - the choice of distribution channels (own task / case study)	2
Proj3	Distrubution requirements planning (own task/case study)	2

Proj4	Manufacturer warehouse network as a support for distribution processes performance (own task/case study)	2
Proj5	Location of warehouses - justification for process selection (own task/case study)	2
Proj6	Determination of service regions - intuitive rules and quantitative methods (own task/case study)	2
Proj7	Distribution system effectiveness (own task/case study). Completion of the course.	3
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for project class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	A positive evaluation of the written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	a positive evaluation of the tasks performed during the project classes
F2	PEK_W01, PEK_W02, PEK_U02, PEK_U03	A positive evaluation of the written test
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Barcik R.: Logistyka dystrybucji. Wydawnictwo ATH, Bielsko-Biała 2005
2. Bozarth C., Handfield R.B.: Wprowadzenie do zarządzania operacjami i łańcuchem dostaw. Wyd. Helion, Gliwice 2007
3. Christopher M.L: Strategia zarządzania dystrybucją. Agencja Wydawnicza Placet, Warszawa 1999
4. J.Coyle, E. Bardi: The Management of Business Logistics. West Publishing Company, 1980
5. Czubała A: Dystrybucja produktów. PWE, 1996
6. Handbook of Logistics & Distribution Management. Pod red. J. Gattorna. Gower, 1994
7. D. Kempny, Logistyczna obsługa klienta, PWE, Warszawa 2001.
8. Krawczyk S.: Metody ilościowe w logistyce (przedsiębiorstwa) t.II, Wydawnictwo C. H. Beck, Warszawa 2001
9. Krawczyk S.: Zarządzanie procesami logistycznymi. PWE, Warszawa 2001
10. Rushton, J. Oxley: Handbook of Logistics and Distribution Management. Kogan Page, 1995
11. Sarjusz-Wolski Z.: Sterowanie zapasami w przedsiębiorstwie. Wyd. PWE, Warszawa 2000
12. Sarjusz-Wolski Z.: Strategia zarządzania zaopatrzeniem: Praktyka logistyki biznesu. Wyd. "Placet", Warszawa 1998
13. Stern L.W., El-Ansary A.I., Coughlan A.T.: Kanały marketingowe. Wydawnictwo Naukowe PWN, Warszawa 2002.

SECONDARY LITERATURE
1. Blanchard B. S.: Logistics Engineering and Management (5th Ed). Upper Saddle River: Pearson Prentice Hall, 2004
2. M. Christopher: The Customer Service Planner. Butterworth-Heinemann, 1992
3. Grajewski P.: Organizacja procesowa. PWE, Warszawa 2007
4. McKinnon A: Physical Distribution Systems. Routledge, 1989
5. Mokrzyszczak H.: Logistyka: podstawy procesów logistycznych. WIG, Białystok 1998
•Czasopisma:
1. The International Journal of Logistics Management
2. International Journal of Physical Distribution & Logistics Management
3. Journal of Business Logistics
4. Gospodarka Materiałowa i Logistyka
5. Logistyka

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logistics of distribution
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_LS_W01	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8	N1, N2, N5
PEK_U01, PEK_U02, PEK_U03	K2ZIP_LS_U02	C1, C2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Pr1, Pr2, Pr3, Pr4, Pr5, Pr6, Pr7	N1, N2, N3, N4
PEK_K01, PEK_K02	K2ZIP_LS_K01, K2ZIP_LS_K02	C2	Pr1, Pr2, Pr3, Pr4, Pr5, Pr6, Pr7	N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody i techniki eksperymentu**
Name in English: **Methods and techniques of experiments**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of statistics, mathematical analysis and linear algebra

SUBJECT OBJECTIVES

C1. Explain the purpose of carrying out experiments
C2. Explain the methods and techniques to carry out the experiment
C3. Explain the types and purposes of tools to carry out the experiment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the purpose and effect of the proposed experiment
PEK_W02 - Able to propose and define a plan of the experiment
PEK_W03 - Knows the concept and objectives of the experiment

II. Relating to skills:
PEK_U01 - Can collect data for the experiment
PEK_U02 - Can process the data of the experiment
PEK_U03 - Able to design an experiment

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, concept experiment	2
Lec2	The differences between the method and technique	2
Lec3	Basic experiment Part 1	2
Lec4	Basic experiment Part 2	2
Lec5	Measurement	2
Lec6	Statistical tools	2
Lec7	Quality Tools	2
Lec8	Optimization Tools	2
Lec9	Factorial / multifactorial experiment	2
Lec10	DoE	2
Lec11	Methods for optimization of technological processes Part 1	2
Lec12	Methods for optimization of technological processes Part 2	2
Lec13	Case Study Part 1	2
Lec14	Case Study Part 2	2
Lec15	Summary, examination	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction, health and safety regulations	2
Proj2	Discussion of proposed projects	2
Proj3	Choice otf the experiment	2
Proj4	Data processing Part 1	2
Proj5	Data processing Part 2	2
Proj6	Verification and Optimization	2
Proj7	Summary, projects checking	2

Proj8	Examination	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. informative lecture N3. case study N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U02	project / test
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE Ewaryst Rafajłowicz "Optimization of the experiment with applications in monitoring the quality of production" Publishing Wroclaw University of Technology Mieczyslaw Korzyński "Methodology of the experiment" WNT SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods and techniques of experiments
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_ZJ_W08	C1, C2, C3	Lec1-Lec15	N1, N2
PEK_U01, PEK_U02, PEK_U02	K2ZIP_ZJ_U13	C1, C2, C3	Proj1-Proj7	N3, N4

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody i techniki eksperymentu**
Name in English: **Methods and techniques of experiments**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of statistics, mathematical analysis and linear algebra

SUBJECT OBJECTIVES

C1. Explain the purpose of carrying out experiments
C2. Explain the methods and techniques to carry out the experiment
C3. Explain the types and purposes of tools to carry out the experiment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the purpose and effect of the proposed experiment
PEK_W02 - Able to propose and define a plan of the experiment
PEK_W03 - Knows the concept and objectives of the experiment

II. Relating to skills:
PEK_U01 - Can collect data for the experiment
PEK_U02 - Can process the data of the experiment
PEK_U03 - Able to design an experiment

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, concept experiment	2
Lec2	The differences between the method and technique	2
Lec3	Basic experiment Part 1	2
Lec4	Basic experiment Part 2	2
Lec5	Measurement	2
Lec6	Statistical tools	2
Lec7	Quality Tools	2
Lec8	Optimization Tools	2
Lec9	Factorial / multifactorial experiment	2
Lec10	DoE	2
Lec11	Methods for optimization of technological processes Part 1	2
Lec12	Methods for optimization of technological processes Part 2	2
Lec13	Case Study Part 1	2
Lec14	Case Study Part 2	2
Lec15	Summary, examination	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction, health and safety regulations	2
Proj2	Discussion of proposed projects	2
Proj3	Choice otf the experiment	2
Proj4	Data processing Part 1	2
Proj5	Data processing Part 2	2
Proj6	Verification and Optimization	2
Proj7	Summary, projects checking	2

Proj8	Examination	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture
N3. case study
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project / test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Ewaryst Rafajłowicz "Optimization of the experiment with applications in monitoring the quality of production" Publishing Wroclaw University of Technology
Mieczyslaw Korzyński "Methodology of the experiment" WNT

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods and techniques of experiments
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W08	C1, C2, C3	Lec1-Lec15	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K2ZIP_OP_U11	C1, C2, C3	Proj1-Proj7	N4

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody kształtowania wybranych cech produktów**
Name in English: **Methods for forming of the selected products features**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041203**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of manufacturing technologies, machining methods, the basic properties of the materials
2. Student has basic skills in the selection of materials and manufacturing processes
3. Student has abilities of analyzing and synthesis of information

SUBJECT OBJECTIVES

C1. Acquiring knowledge about phenomena affecting the using wear of products. Learning about the surface engineering methods shaping functional, technological and operational properties of products.
C2. Acquisition of skills of understanding the links between the characteristics of the material and geometric properties of the surface layers and consumables products. Acquisition of skills for choosing surface engineering methods for forming selected features of the products.
C3. The acquisition and consolidation of social skills include: team working abilities, responsible, accountable use of engineering knowledge.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Enumerates and briefly characterises the basic phenomena that affect the using wear of products. Explains the basic terms of surface engineering.
PEK_W02 - Characterises basic properties of surface layers and explains their effect on the usable characteristics of the products.
PEK_W03 - Explains the implementation mechanisms of surface treatment processes. Enumerates and characterises the basic groups of the processes forming of usable characteristics of the surface layers.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course topics. Rules of the course.	2
Lec2	Preview of the external factors (work conditions) influences on the products.	2
Lec3	Introduction to the surface engineering methods.	2
Lec4	Features of the products formed by surface engineering methods.	2
Lec5	Manufacturing processes for modifying of the properties superficial layers of the Fe alloys.	2
Lec6	Manufacturing processes for modifying of the properties superficial layers of the non-ferrous alloys.	2
Lec7	Laser processing methods of the superficial layers.	2
Lec8	Chemical and electro – chemical coating methods.	2
Lec9	Thermal spray coating processes.	2
Lec10	CVD & PVD coating processes.	2
Lec11	Surface engineering methods in the new product development.	2
Lec12	Economical issues of the implementation surface engineering methods.	2
Lec13	Surface engineering methods in manufacturing: case study.	2
Lec14	Surface engineering methods in manufacturing: case study.	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
N3. tutorials
N4. case study
N5. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
T.Burakowski, T.Wierzchoń: Inżynieria powierzchni metali, WNT 1995
L.A. Dobrzański: Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006
A.Kimpel: Napawanie i natryskiwanie cieplne. Technologie, WNT, Warszawa, 2000
M.Blicharski, Inżynieria powierzchni, WNT 2009

SECONDARY LITERATURE
F.W.Bach, K.Mohwld, A.Laarmann, T.Wenz: Modern Surface Technology, Willey, 2006
L.A. Dobrzański: Podstawy kształtowania struktury i własności materiałów metalowych, Wydawnictwo Politechniki Śląskiej, 2007
P.Kula Inżynieria warstwy wierzchniej, Wyd. Pol. Łódz. 2000
L.A. Dobrzański: Kształtowanie struktury oraz własności materiałów inżynierskich i biomedycznych
E.Kannatey-Asibu: Principles of laser material processing, Willey, 2009
R.B. Heinmann: Plasma spray coating, Willey 2008
M. Cartier: Handbook of surface treatment and coatings, Professional Engineering Publishing 2003
Surface engineering for corrosion and wear resistance, Materials Park, OH : ASM International: Institute of Materials, 2001.
A guide to surface engineering terminology London : Institute of Materials in association with the IFHT, 1995.
Inżynieria Powierzchni, Instytut Mechaniki Precyzyjnej, Warszawa 1996-
Surface and Coatings Technology, Elsevier, 2000-
Surface Engineering, Maney Publishing, 2003 -

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods for forming of the selected products features
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W10, K2ZIP_W04	C1, C2, C3	Lec1 - Lec14	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Mariusz Frankiewicz tel.: 713202083 email: mariusz.frankiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń**
Name in English: **Operartion maintenance of machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041205**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of the structure and operation of components and assemblies as well as the principles of selection and construction.
2. It has a well-established knowledge of basic techniques.
3. It has a well-established expertise in construction and machine control rules.

SUBJECT OBJECTIVES

C1. Understanding the basic principles of the concept of Total Productive maintenance (TPM).
C2. Understanding the basic tools of TPM and methods to increase the efficiency of maintenance of the machinery. Understanding the principles of determining indicators of progress in the implementation of TPM methodology.
C3. Getting to know principles of determination of factors describing progres in introduction of the TMP method.
C4. Learning capabilities of computer systems of the CMMS class supporting scheduling service and repair tasks, inventory management and servicing and repair personnel management.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the range of activities and principles of choice of strategy of maintenance of manufacturing machinery and equipment.
PEK_W02 - Knows the basic tools and indicators TPM.
PEK_W03 - Knows the basic features and capabilities of computer systems of the CMMS class supporting scheduling service and repair tasks, inventory management and servicing and repair personnel management.

II. Relating to skills:
PEK_U01 - Can use the acquired knowledge to formulate tasks to improve the system of maintenance of manufacturing machinery and equipment.
PEK_U02 - Is able to determine the indicators covering the progress in the implementation of TPM methodology.
PEK_U03 - Can use modern IT tools for computerized management of maintenance processes.

III. Relating to social competences:
PEK_K01 - Can search and use the recommended literature for the course and independently acquire knowledge.
PEK_K02 - He can take advantage of modern IT tools.
PEK_K03 - Understands the need for regular and independent work on the mastery of the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The main issues related to maintenance of manufacturing machinery and equipment: performance requirements, the analysis of cause-and-effect machine failure, the role and importance (benefits) of the organization and planning of maintenance	4
Lec2	History and development of the concept of TPM, characteristics of basic pillars of TPM	2
Lec3	Characteristics of the main tools in the field of TPM - examples of their use	4
Lec4	Maintenance strategies - the idea of a systematic and systemic approach to the problem of maintenance	2
Lec5	Measures and indicators determining the effectiveness of the implementation of the TPM methodology	2
Lec6	IT systems of CMMS class, maintenance management support (requirements and functions of selected systems, the selection criteria of the system)	4
Lec7	Implementation of TPM methodology into industrial practice (role of Maintenance and its organization)	2
Lec8	Examples of solutions for the implementation of the TPM	8
Lec9	Test	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of selected modules of the CMMS	3
Proj2	Spare Parts Management. The part card. Warehouse Management. The structure of the module and generated documents	2

Proj3	Fulfilling orders for maintenance. Generating demand for materials and spare parts	2
Proj4	Management of personell that fulfills maintenance activities. Reports from the workload. Planning service orders. The stages and the necessary data. Building schedules for maintenance execution	4
Proj5	Reporting of orders completion. Cost analysis: planned and actual costs. Reports for maintenance indicators	2
Proj6	Project acknowledge	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Project defense
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Legutko S.: Podstawy eksploatacji maszyn i urządzeń. Wyd. WSiP. Warszawa, 2007.
2. Słowiński B.: Inżynieria eksploatacji maszyn. Wyd. Pol. Koszalińskiej. Koszalin, 2011.
3. Kaźmierczak J.: Eksploatacja systemów technicznych. Wyd. Pol. Śląskiej. Gliwice, 2000.

SECONDARY LITERATURE
1. Hebda M.: Elementy teorii eksploatacji systemów technicznych. Wyd. MCNEMT. Radom, 1990.
2. Żółtowski B.: Podstawy diagnostyki maszyn. Wyd. ATR Bydgoszcz. Bydgoszcz, 1996.
3. Honczarenko J.: Elastyczna automatyzacja wytwarzania. Obrabiarki i systemy obróbkowe. WNT Warszawa, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operartion maintenance of machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_ZJ_W09	C1 - C3	Lec1 - Lec8	N1, N2
PEK_U01, PEK_U02, PEK_U03	K2ZIP_ZJ_U14	C1 - C3	Pr1 - Pr5	N2
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K02	C1 - C3	Lec1 - Lec8, Pr1 - Pr5	N1, N2

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń**
Name in English: **Operation maintenance of machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041205**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of the structure and operation of components and assemblies as well as the principles of selection and construction.
2. It has a basic knowledge of basic techniques regarding machnes exploitation, reliability and safety.
3. It has a well-established expertise in construction and machine control rules.

SUBJECT OBJECTIVES

C1. Getting to now the basic principles of the concept of Total Productive maintenance (TPM).
C2. Understanding the basic tools of TPM and methods to increase the efficiency of maintenance of the machinery. Understanding the principles of determining indicators of progress in the implementation of TPM methodology.
C3. Getting to know the basic features and capabilities of computer systems of the CMMS class supporting scheduling service and repair tasks, inventory management and servicing and repair personnel management.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the range of activities and principles of choice of strategy of maintenance of manufacturing machinery and equipment.
PEK_W02 - Knows the basic tools and indicators TPM.
PEK_W03 - Knows the basic features and capabilities of computer systems of the CMMS class supporting scheduling service and repair tasks, inventory management and servicing and repair personnel management.

II. Relating to skills:
PEK_U01 - Can use the acquired knowledge to formulate tasks to improve the system of maintenance of manufacturing machinery and equipment.
PEK_U02 - Is able to determine the indicators covering the progress in the implementation of TPM methodology.
PEK_U03 - Can use modern IT tools for computerized management of maintenance processes.

III. Relating to social competences:
PEK_K01 - Can search and use the recommended literature for the course and independently acquire knowledge.
PEK_K02 - He can take advantage of modern IT tools.
PEK_K03 - Understands the need for regular and independent work on the mastery of the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basic issues related to maintenance of manufacturing machinery and equipment: performance requirements, the analysis of cause-and-effect machine failure, the role and importance (benefits) of the organization and planning of maintenance	4
Lec2	History and development of the concept of TPM, characteristics of basic pillars of TPM	2
Lec3	Characteristics of the main tools in the field of TPM - examples of their use	4
Lec4	Maintenance strategies - the idea of a systematic and systemic approach to the problem of maintenance	2
Lec5	Measures and indicators determining the effectiveness of the implementation of the TPM methodology	2
Lec6	IT systems of CMMS class, maintenance management support (requirements and functions of selected systems, the selection criteria of the system)	4
Lec7	Implementation of TPM methodology into industrial practice (role of Maintenance and its organization)	2
Lec8	Examples of solutions for the implementation of the TPM	8
Lec9	Test	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of selected modules of the CMMS	3
Proj2	Spare Parts Management. The part card. Warehouse Management. The structure of the module and generated documents	2

Proj3	Fulfilling orders for maintenance. Generating demand for materials and spare parts	2
Proj4	Management of personell that fulfills maintenance activities. Reports from the workload. Planning service orders. The stages and the necessary data. Building schedules for maintenance execution	4
Proj5	Reporting of orders completion. Cost analysis: planned and actual costs. Reports for maintenance indicators	2
Proj6	Credit	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Project defense
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Podstawy eksploatacji maszyn i urządzeń. Wyd. WSiP. Warszawa, 2007.
Słowiński B.: Inżynieria eksploatacji maszyn. Wyd. Pol. Koszalińskiej. Koszalin, 2011.
Kaźmierczak J.: Eksploatacja systemów technicznych. Wyd. Pol. Śląskiej. Gliwice, 2000.

SECONDARY LITERATURE

Hebda M.: Elementy teorii eksploatacji systemów technicznych. Wyd. MCNEMT. Radom, 1990.
Żółtowski B.: Podstawy diagnostyki maszyn. Wyd. ATR Bydgoszcz. Bydgoszcz, 1996.
Honczarenko J.: Elastyczna automatyzacja wytwarzania. Obrabiarki i systemy obróbkowe. WNT Warszawa, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W09	C1 - C3	Lec1 - Lec8	N1, N2
PEK_U01, PEK_U02, PEK_U03	K2ZIP_OP_U12	C1 - C3	Pr1 - Pr5	N2
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K02	C1 - C3	Lec1 - Lec8, Pr1 - Pr5	N1, N2

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria odwrotna**
Name in English: **Reverse Engineering**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041207**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of machine design and manufacturing technologies.
2. Student has a knowledge of Computer Aided Design (CAD).
3. Student has a knowledge of geometrical metrology.

SUBJECT OBJECTIVES

C1. Providing students with knowledge of application areas of reverse engineering.
C2. Providing students with knowledge of methods of 3D scanning and reconstructions of 3D CAD models of physical objects.
C3. Producing in students the ability of applying data from 3D scanning in the evaluation of the geometrical accuracy of products and in designing new products.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define reverse engineering and describe its basic applications.
PEK_W02 - Student is able to characterize the process of reconstruction of the CAD model.
PEK_W03 - Student is able to choose a 3D scanning method depending on the type of the object to be digitized.

II. Relating to skills:
PEK_U01 - Students can evaluate the data from 3D scanning and perform basic editing operations.
PEK_U02 - Student can perform the process of comparison a model from 3D scanning with CAD data.
PEK_U03 - Student is able to use data from a 3D scanner to design a new product.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Application areas of reverse engineering.	2
Lec2	Contact methods of data acquisition . Technical and medical tomography.	2
Lec3	Optical methods of data acquisition.	2
Lec4	Basic methods of reconstructing of CAD models in reverse engineering.	2
Lec5	Advanced reconstruction methods. Assessment of accuracy in reverse engineering.	2
Lec6	Non-commercial 3D scanning systems - application areas, assessment of accuracy. Presentation of a selected device.	2
Lec7	Case study.	2
Lec8	Final test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Presentation of 3D scanners. 3D scanning of a selected object.	2
Lab2	Learning the program interface. Import and basic editing operations on3D scanning data.	2
Lab3	Orientation of models in space, best-fit function. Comparison of two models, and generating deviation maps.	2
Lab4	Advanced inspection functions.	2
Lab5	NURBS surface modeling - the basics.	4
Lab6	Integrating the CAD model with data from 3D scanning.	2
Lab7	Assessment	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. case study
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	laboratory report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Raja V., Fernandes K.J.: Reverse engineering: an industrial perspective, Springer, 2008, 242s.
[2] Chlebus E.: Techniki komputerowe CAx w inżynierii produkcji, WNT, Warszawa 2000

SECONDARY LITERATURE
[1] Chlebus E., Dybała E.: Reverse engineering in technical and medical applications, Virtual design and automation. 1st VIDA International Conference, Poznań, 3-4 June 2004, 2005, Str. 213-218
[2] Oczoś K., Cena I.: Rapid Inspection - metody pomiarowo-kontrolne adekwatne do rapid-technologii, Mechanik, 2008, No. 3, Str. 165-176
[3] Gawlik J., Karbowski K.: Metody odwzorowywania powierzchni w systemach inżynierii odwrotnej, Zeszyty Naukowe Politechniki Poznańskiej, Budowa Maszyn i Zarządzanie Produkcją, 2004, No. 1, Str. 187-194

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Reverse Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W04	C1-C2	Lec1-Lec8	N1-N3, N5
PEK_U01, PEK_U02, PEK_U03	K2ZIP_OP_U03	C3	Lab1-Lab7	N4-N5

SUBJECT SUPERVISOR

dr inż. Tomasz Będza tel.: 71 320 42 08 email: tomasz.bedza@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mapowanie procesów w przedsiębiorstwie**
Name in English: **Enterprise processes mapping**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041208**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Enhanced knowledge of the enterprise operation in terms of management and production.
2. The ability to obtain information from documents, databases and other sources, the ability to interpret information.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about analyzis methods and business processes documentation.
C2. Acquisition of skills how to use the basic tools used in the process mapping in production enterprises.
C3. Acquisition of skills how to recognize the resources and information flow of across the enterprise.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge about analyzis methods and business processes documentation.
PEK_W02 - Student can characterize resources and information flow in enterprise. He can describe their flow.
PEK_W03 - Student can choose different tools and methods to analyze enterprise processes.

II. Relating to skills:
PEK_U01 - Student has the ability to use different tools of process mapping.
PEK_U02 - Student can use computer aided tools in process modeling.
PEK_U03 - Student can analyze models within compliance with the notation, accuracy and efficiency of modeling techniques.

III. Relating to social competences:
PEK_K01 - Student thinks and acts in a creative and enterprising way.
PEK_K02 - Student is able to interact and work in a group, taking the different roles as a different functions in manufacturing and service enterprises.
PEK_K03 - Student understands the need for continuous improvement of the organization, its processes and products.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Presentation of basics of business processes mapping. Presentation of process definitions and basic information about process modeling. Presentation of basic ways of describing processess in enterprise.	2
Lec2	Presentaion of process modeling using BPMN, discussion of basic concepts. Presentaion of the scope of BPMN and its notation elements. Presentation how to create maps in BPMN. Presentation of the practical use of BPMN in enterprises.	4
Lec3	Presentaion of process modeling using Value Stream Mapping (VSM), discussion of basic concepts. Presentaion of the scope of VSM and its notation elements. Presentation how to create current state maps in VSM. Waste identification. Presentaion how to create future state maps in VSM. Presentation of the practical use of VSM in enterprises.	4
Lec4	Presentaion of process modeling using functional maps, discussion of basic concepts. Presentaion of the scope of functional maps and its notation elements. Presentation how to create functional maps. Presentation of the practical use of functional maps in enterprises.	4
Lec5	Test	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Business processes mapping with BPMN notation.	4
Proj2	Production processes mapping with VSM notation. Current and future state maps.	6
Proj3	Enterprise processes mapping with functional maps notation.	4

Proj4	Presentaion of project results in chosen company - project defensis.	1
		Total hours: 15

TEACHING TOOLS USED
N1. case study N2. self study - preparation for project class N3. project presentation N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	project presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Drejewicz S., „Zrozumieć BPMN modelowanie procesów biznesowych", Helion, Gliwice 2012
2. Rother M., Shook J. „Naucz się widzieć. Eliminacja marnotrawstwa poprzez Mapowanie Strumienia Wartości", WCTT Wrocław 2003 r.,
3. Rummler A. P., Brache A. P., „Podnoszenie efektywności organizacji", PWE, Warszawa 2000 r.,

SECONDARY LITERATURE
1. Skrzypek E., Hofman M., "Zarządzanie procesami w przedsiębiorstwie : identyfikowanie, pomiar, usprawnianie", Wolters Kluwer Polska, Warszawa 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Enterprise processes mapping
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W02, K2ZIP_W02, K2ZIP_W07	C1, C2, C3	Lec 1 - Lec 4	N4
PEK_U01, PEK_U02, PEK_U03,	K2ZIP_OP_U03, K2ZIP_OP_U04, K2ZIP_U09	C1, C2, C3	Proj 1 - Proj 4	N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K2ZIP_OP_K01	C1, C2, C3	Proj 1 - Proj 4	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Joanna Helman tel.: 43-84 email: joanna.helman@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Recykling materiałów**
Name in English: **Recycling of materials**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of the properties of materials.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the life cycle of the product and the disposal methods of the product. Acquisition of basic knowledge about recycling methods.
C2. Understanding the need for waste management policy. Understanding the design and manufacture of the product in the context of environmental impact.
C3. The acquisition and consolidation of social skills like responsibility, honesty, fairness in the procedure observance force in academia.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Defining and understanding the issues of product life cycle.
PEK_W02 - Identifying recycling methods.
PEK_W03 - The presentation and characterization of waste management methods.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. The life cycle of the product. The problem of waste. European scale of the problem. The situation in Poland. Legislative considerations.	2
Lec2	General information about recycling. Balance of environmental burdens. Ekobilansu importance in the economy. Methods of waste disposal and waste products.	2
Lec3	Technical possibilities of identification and separation of materials.	2
Lec4	The problems of recycling polymeric materials. Classification of methods for recycling of polymeric materials. Methods for managing selected polymers as an example of recycling.	4
Lec5	Feedstock recycling for selected examples.	4
Lec6	Thermal recycling for selected examples.	4
Lec7	Recycling and characterization of materials in various industries. Recycling of packaging materials. Recycling of materials in the automotive industry. Recycling of waste electrical.	4
Lec8	Degradable materials as an alternative to recycling.	4
Lec9	Designing. Trends and prospects of recycling materials.	2
Lec10	Summary knowledge of recycling.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. tutorials
N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written and oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Plastics recycling in Europe, Marek Kozłowski 2006;

SECONDARY LITERATURE
Recycling of plastics, Andrzej Błędzki; Recovery and recycling of plastics, Jacek Kijeński, Andrzej Błędzki, Regina Jeziórska; Selected aspects of car recycling, Jerzy Osiński, Piotr Żach

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Recycling of materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W01	C1, C2, C3	Lec1-Lec10	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Joanna Pach tel.: 71-320-42-78 email: joanna.pach@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Planowanie przedsięwzięć produkcyjnych**
Name in English: **Planning of production projects**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041211**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the functioning of the production company.
2. Ability to solve problems of linear mathematics decision problems.
3. Computer skills (Windows) and spreadsheet handling skills.

SUBJECT OBJECTIVES

C1. Introduction to the issue of feasibility study of the project.
C2. Introduction to the methodology of solving decision problems using linear programming with use of the solver tool.
C3. Getting to know the problems of calculating the number of kanban cards in the production system based on "pull" approach.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of the aspects of the project feasibility study.
PEK_W02 - Knowledge of mathematical methods for solving decision problems.
PEK_W03 - Knowledge of the methodology for calculating the number of kanban cards in the system of production based on "pull" approach.

II. Relating to skills:
PEK_U01 - Ability to solve decision-making problems by using linear programming with use of the solver tool.
PEK_U02 - The ability to calculate the number of kanban cards in the production system based on "pull" approach.

III. Relating to social competences:
PEK_K01 - Awareness of the role of the engineer in the planning of production and demand for accountability and involvement in one of the most important links of the production process in the company.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.
PEK_K03 - Ability to think and act in a creative and enterprising way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Feasibility study - basics and development procedure	6
Lec2	Feasibility study - example	6
Lec3	Linear programming - basics	4
Lec4	Linear programming - examples with application of slover tool	6
Lec5	The production system based on "pull" approach and control of the flow of material using kanban cards - basics and an example from industry	2
Lec6	The methodology for calculating the number of kanban cards in the system of production based on "pull" approach	4
Lec7	The methodology for calculating the number of kanban cards in the system of production based on "pull" approach - discussion of an example project	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Solving the decision-making production problem	1
Proj2	Solving the decision-making transportation problem	2
Proj3	Solving the decision-making "make or buy" problem	2
Proj4	Solving the decision-making mix problem	2
Proj5	Solving the decision-making production and warehouse management problem	2
Proj6	Calculation of numer o kanban cards	6
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. problem exercises
N3. self study - preparation for project class
N4. project presentation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02 PEK_K01, PEK_K02, PEK_K03	Asessment of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Alan Thompson: Enterpreneurship and Business Innovation. The Art of Successfull Business Start-Ups and Business Planning. Appendix I: Business Feasibility Study, 2005
2. W. Heath Hoagland, Lionel Williamson: Feasibility Studies, Cooperative Extension Service, University of Kentucky, 2000
3. W. Behrens, P.M. Hawranek, Manual for the preparation of Industrial Feasibility Studies, Newly revised and expanded edition, United Nations Industrial Development Organisation, 1991
4. Steve Easterbook: Lecture 7: The Feasibility Study, University of Toronto, Department of Computer Science, 2004-2005

SECONDARY LITERATURE

1. Muhlemann A., Oakland J., Lockyer K.: Zarządzanie Produkcja i Usługi, Wydawnictwo Naukowe PWN, Warszawa 2001
2. Brzeziński M.: Organizacja i sterowanie produkcją, Placet, Warszawa 2002
3. Durlik I.: Organizacja i zarządzanie produkcją, Warszawa 2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Planning of production projects
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W03, K2ZIP_W07	C1	Lect1 - Lect7	N1, N5
PEK_U01, PEK_U02	K2ZIP_OP_U04	C2, C3	Pr1 - Pr6	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K02	C2, C3	Pr1 - Pr6	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Studium przypadku**
Name in English: **Case study**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041212**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of scientific projects - research and industrial
2. Can prepare an offer in the form of research project proposal and research offer for the company

SUBJECT OBJECTIVES

C1. Explain the principle of scientific - research projects
C2. Explain methods of scheduling and budgeting in research projects
C3. Explain the principles of substantive implementation of research projects

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the purpose and effect of the proposed research topics
PEK_W02 - Can suggest the mode of applying for project
PEK_W03 - Can distinguish between basic research and applied research and development

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Able to work in a team

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction	2
Lec2	Types of projects	2
Lec3	Application Form	2
Lec4	Basic Research Projects	2
Lec5	Research and Development Projects	2
Lec6	Industrial Research Projects	2
Lec7	Funding agencies	2
Lec8	Structural Funds	2
Lec9	Preparation of the draft	2
Lec10	Summary of the preliminarily - application part	2
Lec11	Research project (one executor) - a case study	2
Lec12	Research project (consortium) - a case study	2
Lec13	Research project - Structural Funds - a case study	2
Lec14	Summary	2
Lec15	Examination	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. tutorials
N3. multimedia presentation
N4. project presentation
N5. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Project Management - Case Studies - Harold Kerzner, HELION publishing house

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Case study
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W11, K2ZIP_W01	C1, C2, C3	Lec1-Lec15	N1, N2, N3, N4, N5
PEK_K01	K2ZIP_K03, K2ZIP_K05	C1, C2, C3	Lec1-Lec15	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przedsiębiorczość innowacyjna**
Name in English: **Innovative Entrepreneurship**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041213**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge about the free market economy.
2. Ability to discuss and present one's opinion in terms of dealing with problems connected with the business idea implementation and assessment of its innovation potential.
3. Bachelor's degree and basic knowledge of finance (profit, loss, income, expenses, liquidity, balance, taxes).

SUBJECT OBJECTIVES

C1. To familiarize students with the phenomenon of entrepreneurship from the business process point of view that relates entrepreneurship and business.
C2. To familiarize students with the phenomenon of entrepreneurship from the business process point of view that relates entrepreneurship and business.
C3. To familiarize students with the phenomenon of entrepreneurship from the business process point of view that relates entrepreneurship and business.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of ways and methods of project management, organization, planning and evaluation work in the project, knows methods of technical and economical evaluation of the innovative enterprises.
PEK_W02 - Knows methods and ways of how to assess opportunities and risks in the scope of innovative activity.
PEK_W03 - Knows how to assess and verify entrepreneurial activities that are a way of entrepreneurship realization.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Can search for information and analyze them critically.
PEK_K02 - Acting in a creative and enterprising way can work in a team in the scope of the selection of strategies and tools to
solve problems related to entrepreneurship and innovation.
PEK_K03 - Can objectively evaluate the arguments, rationally explain and justify their point of view in terms of entrepreneurial activities with the use of knowledge in the fields of innovation and business practices.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. The core of innovative entrepreneurship. The development of entrepreneurship in Poland and abroad.	2
Lec2	The entrepreneur. His qualities and competences. Personality approach. Characteristics of entrepreneurs; entrepreneurial orientation, sources of the entrepreneurial motivation. Methods of the entrepreneurship completion.	2
Lec3	Sources of inspiration for business ideas. The concept of realization - a system approach.	2
Lec4	The innovativeness imperative. Definitions of key terms of innovations management. Innovation as the basis for entrepreneurial activities.	2
Lec5	The innovation process. Types of innovation and risk. Sources of innovation.	2
Lec6	The selection of methods of searching for innovative solutions.	2
Lec7	Evaluation and selection of optimal variants of solutions.	2
Lec8	Methods for designing innovative products and processes. Intellectual property.	2
Lec9	Determinants and ways of development of innovative enterprises. Development methods, critical moments, learning, the social networks.	2
Lec10	Building the founding team.	2
Lec11	Market segmentation, targeting, user profiles, defining the model user.	2
Lec12	External conditions for entrepreneurship: legal forms, commitment to the environment. Financing projects.	2
Lec13	Building a business plan.	2
Lec14	Corporate entrepreneurship.	2
Lec15	Test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B. Glinka, S. Gudkova, Przedsiębiorczość, Wolters Kluwer Business, Warszawa 2011
[2] J. Targalski, A. Francik, Przedsiębiorczość i zarządzanie firmą. Teoria i praktyka, C.H. Beck, Warszawa 2009
[3] R. Knosala, A. Boratyńska-Sala, M. Jurczyk-Bunkowska, A. Moczała, Zarządzanie innowacjami, PWE, Warszawa 2014
[4] P. Drucker, Innowacja i przedsiębiorczość. Praktyka i zasady, PWE, Warszawa 1992
[5] J. Bessant, J. Tidd, Innovation and Enterpreneurship, Wiley and Sons, Chichester 2013
[6] W. Bygrave, A. Zacharakis, Entrepreneurship, 2nd Edition, Wiley, 2011
[7] P. Westhead, M. Wright, G. McElwee, Entrepreneurship. Perspectives and Cases, Pearson, Essex 2011

SECONDARY LITERATURE
[1] Harvard Business Review Polska, Sztuka przedsiębiorczości, ICAN Institute, Warszawa 2013
[2] B. Aulet, Przedsiębiorczość zdyscyplinowana. Od startupu do sukcesu w 24 krokach, Helion, Gliwice 2014
[3] J. Cieślik, Przedsiębiorczość dla ambitnych. Jak uruchomić własny biznes, Wydawnictwa Akademickie i Profesjonalne, Warszawa 2010
[4] M. E. Gordon, Uniwersytet Donalda Trumpa. Przedsiębiorczość, Helion, Gliwice 2009
[5] M. Jankowski, Mała wielka firma. 7 sekretów efektywnego zarządzania, Studio EMKA, Warszawa 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Innovative Entrepreneurship
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W01	C1, C2, C3	Wy1 - Wy15	N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K03, K2ZIP_K05	C1, C2, C3	Wy1 - Wy15	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przedsiębiorczość innowacyjna**
Name in English: **Innovative Entrepreneurship**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041213**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge about the free market economy.
2. Ability to discuss and present one's opinion in terms of dealing with problems connected with the business idea implementation and assessment of its innovation potential.
3. Bachelor's degree and basic knowledge of finance (profit, loss, income, expenses, liquidity, balance, taxes).

SUBJECT OBJECTIVES

C1. To familiarize students with the phenomenon of entrepreneurship from the business process point of view that relates entrepreneurship and business.
C2. To familiarize students with the modern understanding of innovative enterpreneurship, innovation sources and innovation organization management (integrating technological, market and organizational changes).
C3. To familiarize students with the factors of success or factors of failure of the company, their measures and sources, finding funding sources innovative enterprises.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of ways and methods of project management, organization, planning and evaluation work in the project, knows methods of technical and economical evaluation of the innovative enterprises.
PEK_W02 - Knows methods and ways of how to assess opportunities and risks in the scope of innovative activity.
PEK_W03 - Knows how to assess and verify entrepreneurial activities that are a way of entrepreneurship realization.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Can search for information and analyze them critically.
PEK_K02 - Acting in a creative and enterprising way can work in a team in the scope of the selection of strategies and tools to
solve problems related to entrepreneurship and innovation.
PEK_K03 - Can objectively evaluate the arguments, rationally explain and justify their point of view in terms of entrepreneurial activities with the use of knowledge in the fields of innovation and business practices.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. The core of innovative entrepreneurship. The development of entrepreneurship in Poland and abroad.	2
Lec2	The entrepreneur. His qualities and competences. Personality approach. Characteristics of entrepreneurs; entrepreneurial orientation, sources of the entrepreneurial motivation. Methods of the entrepreneurship completion.	2
Lec3	Sources of inspiration for business ideas. The concept of realization - a system approach.	2
Lec4	The innovativeness imperative. Definitions of key terms of innovations management. Innovation as the basis for entrepreneurial activities.	2
Lec5	The innovation process. Types of innovation and risk. Sources of innovation.	2
Lec6	The selection of methods of searching for innovative solutions.	2
Lec7	Evaluation and selection of optimal variants of solutions.	2
Lec8	Methods for designing innovative products and processes. Intellectual property.	2
Lec9	Determinants and ways of development of innovative enterprises. Development methods, critical moments, learning, the social networks.	2
Lec10	Building the founding team.	2
Lec11	Market segmentation, targeting, user profiles, defining the model user.	2
Lec12	External conditions for entrepreneurship: legal forms, commitment to the environment. Financing projects.	2
Lec13	Building a business plan.	2
Lec14	Corporate entrepreneurship.	2
Lec15	Test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B. Glinka, S. Gudkova, Przedsiębiorczość, Wolters Kluwer Business, Warszawa 2011
[2] J. Targalski, A. Francik, Przedsiębiorczość i zarządzanie firmą. Teoria i praktyka, C.H. Beck, Warszawa 2009
[3] R. Knosala, A. Boratyńska-Sala, M. Jurczyk-Bunkowska, A. Moczała, Zarządzanie innowacjami, PWE, Warszawa 2014
[4] P. Drucker, Innowacja i przedsiębiorczość. Praktyka i zasady, PWE, Warszawa 1992
[5] J. Bessant, J. Tidd, Innovation and Enterpreneurship, Wiley and Sons, Chichester 2013
[6] W. Bygrave, A. Zacharakis, Entrepreneurship, 2nd Edition, Wiley, 2011
[7] P. Westhead, M. Wright, G. McElwee, Entrepreneurship. Perspectives and Cases, Pearson, Essex 2011

SECONDARY LITERATURE
[1] Harvard Business Review Polska, Sztuka przedsiębiorczości, ICAN Institute, Warszawa 2013
[2] B. Aulet, Przedsiębiorczość zdyscyplinowana. Od startupu do sukcesu w 24 krokach, Helion, Gliwice 2014
[3] J. Cieślik, Przedsiębiorczość dla ambitnych. Jak uruchomić własny biznes, Wydawnictwa Akademickie i Profesjonalne, Warszawa 2010
[4] M. E. Gordon, Uniwersytet Donalda Trumpa. Przedsiębiorczość, Helion, Gliwice 2009
[5] M. Jankowski, Mała wielka firma. 7 sekretów efektywnego zarządzania, Studio EMKA, Warszawa 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Innovative Entrepreneurship
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W01	C1, C2, C3	Wy1 - Wy15	N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K03, K2ZIP_K05	C1, C2, C3	Wy1 - Wy15	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania operacyjne**
Name in English: **Operations research**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041401**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the issues presented in the courses "Mathematical Analysis", "Algebra and Analytic Geometry" and "Engineering Statistics".

SUBJECT OBJECTIVES

C1. Students should obtain basic knowledge from the linear programming and the game theory, taking into account the aspects of their application.
C2. Participants learn to formulate optimization problems in the field of management, transport services market, location of distribution and construction, technology, and systems designing. They also acquire the ability to formulate optimization problems from queuing theory.
C3. Participants obtain and consolidate social skills including emotional intelligence involving the ability to work in a group of students to solve problems effectively with regard to accountability, integrity and fairness in the proceedings

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has a basic knowledge of linear programming methods and methods supporting optimal decision taking. He knows the basics of linear programming, the simplex algorithm, can construct the dual model, knows methods of sensitivity analysis of the optimal solution. He has knowledge of basic programming and discrete algorithms, knows the basic algorithms for solving balanced transportation problem, the basics of formulating and solving problems related to minimizing empty runs, knows the basics of graph theory and can apply them to solve the issues related to project management. He knows the basic concepts of the game theory.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Operations research as a tool to support decision-making processes - classification decision-making processes. Methods of decision making under conditions of certainty. Linear programming (PL) - linear model of decision-making, decisions acceptable and optimal. Graphical methods of PL problem solving. Training the discussed material.	2
Lec2	Linear programming models. Formulation and solution of problems PL - interpretation of the results. Simplex algorithm. Training the discussed material.	2
Lec3	Duality in linear programming. Matrix calculus in solving tasks of PL. The dual problem, its measurement and interpretation. Sensitivity analysis of the optimum solution. Changes in the parameters of the objective function and the free terms of constraints. Addition or removing decision variables. Comprehensive analysis of the optimal solution.	2
Lec4	Integer Linear Programming (discrete). The method of shutoff surfaces.	2
Lec5	Classical transportation models and algorithms. Transportation model with the criterion of time. Transportation model (unbalanced, with limited bandwidth routes). The problem of localization of production.	2
Lec6	Examples of problems, which may be reduced to the transportation problem (issue of optimal allocation). The tasks of transport, production and transport and warehousing. Minimizing empty runs. Blocking the route. The multi-stage transportation problem.	2
Lec7	Introduction to graph theory. Project management (network programming). The maximum flow in a network. Ford-Fulkerson algorithm. Decision trees. Minimum spanning tree. The shortest routes in the graph.	2
Lec8	Network Models - deterministic (CPM, PERT) and stochastic (GERT). Time and cost analysis. Gantt charts. Resource optimization in network. Salesman Problem. Little's algorithm. The knapsack problem. The production and inventory models.	2
Lec9	Multi-criteria optimization. Selection of nonlinear decision models solvable with PL methods.	2

Lec10	Introduction and examples of games (multiplayer, double zero-sum, multi-stage, random). Basic concepts (pure strategy, mixed, payment, the value of the game).	2
Lec11	Matrix games - mixed strategies, expected value criterion, graphical method for solving games 2 × n. John von Neumann's theorem on the existence of solutions for each game matrix. Training the discussed material.	2
Lec12	Examples of the use of mixed strategies: fishing in Jamaica, playing "the guerrillas and the police." Tree - a character-developed game. Solving game with method "pruning the tree" (backwards induction).	2
Lec13	Games against nature. Criteria for finding the optimal decision: Laplace, the Bayesian Hurwitcza and Savage'a.	2
Lec14	Double games with non-zero sum: Nash equilibrium, Pareto optimality, safe and contsafe strategies. Nash arbitration scheme and cooperative solutions. Employer-employee negotiations.	2
Lec15	Final test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Ignasiak E. (red.): Badania operacyjne. Warszawa 2001, PWE[2] Kukuła K. (red.): Badania operacyjne w przykładach i zadaniach. Warszawa 2002, PWN[3] Trzaskalik T.: Wprowadzenie do badań operacyjnych z komputerem. Warszawa 2008, PWE[4] Straffin P.: Teoria gier, 2001, Scholar[5] Malawski M., Wieczorek A., Sosnowska H. (2004): Konkurencjai kooperacja. Teoria gier w ekonomii i naukach społecznych, 2004, PWN.

SECONDARY LITERATURE

[1] Stadnicki J.: Teoria i praktyka rozwiązywania zadań optymalizacji z przykładami zastosowań technicznych. Warszawa 2006, WNT[2] Szapiro T. (red.): Decyzje menadżerskie z Excelem. Warszawa 2000, PWE[3] Guzik B.: Ekonometria i badania operacyjne. Wydawnictwo AE Poznań, Poznań 1999[4] Krawczyk S.: Badania operacyjne dla menadżerów. Wydawnictwo AE Wrocław 1996[5] Lipiec-Zajchowska M. (red.): Wspomaganie procesów decyzyjnych. Tom III. Badania operacyjne. Wydawnictwo C.H. Beck, Warszawa 2003[6] Anholcer M., Gaspras H., Owczarkowski A.: Przykłady i zadania z badań operacyjnych i ekonometrii. Wydawnictwo AE Poznań, Poznań 2003[7]. Watson J.: Strategia: Wprowadzenie do teorii gier,2005, Norton, New York.[8] Gibbons R.: Game Theory for Applied Economists, 1992 Princeton U.P.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operations research
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2ZIP_W01, K2ZIP_W02	C1, C2, C3	Le.1-Le.15	N1, N2

SUBJECT SUPERVISOR

dr inż. Anna Jodejko-Pietruczuk tel.: 71 320-28-17 email: Anna.Jodejko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody kształtowania wybranych cech produktów**
Name in English: **Methods for forming of the selected products features**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041402**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of manufacturing technologies, machining methods, the basic properties of the materials
2. Student has basic skills in the selection of materials and manufacturing processes
3. student has abilities of analyzing and synthesis of information

SUBJECT OBJECTIVES

C1. Acquiring knowledge about phenomena affecting the using wear of products. Learning about the surface engineering methods shaping functional, technological and operational properties of products.
C2. Acquisition of skills of understanding the links between the characteristics of the material and geometric properties of the surface layers and consumables products. Acquisition of skills for choosing surface engineering methods for forming selected features of the products
C3. The acquisition and consolidation of social skills include: team working abilities, responsible, accountable use of engineering knowledge

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Enumerates and briefly characterises the basic phenomena that affect the using wear of products. Explains the basic terms of surface engineering.
PEK_W02 - Characterises basic properties of surface layers and explains their effect on the usable characteristics of the products.
PEK_W03 - Explains the implementation mechanisms of surface treatment processes. Enumerates and characterises the basic groups of the processes forming of usable characteristics of the surface layers.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course topics. Rules of the course.	2
Lec2	Preview of the external factors (work conditions) influences on the products	2
Lec3	Introduction to the surface engineering methods	2
Lec4	Features of the products formed by surface engineering methods	2
Lec5	Manufacturing processes for modifying of the properties superficial layers of the Fe alloys	2
Lec6	Manufacturing processes for modifying of the properties superficial layers of the non-ferrous alloys	2
Lec7	Laser processing methods of the superficial layers	2
Lec8	Chemical and electro – chemical coating methods	2
Lec9	Thermal spray coating processes	2
Lec10	CVD & PVD coating processes	2
Lec11	Surface engineering methods in the new product development	2
Lec12	Economical issues of the implementation surface engineering methods	2
Lec13	Surface engineering methods in manufacturing: case study	2
Lec14	Surface engineering methods in manufacturing: case study	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
N3. tutorials
N4. case study
N5. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
F.W.Bach, K.Mohwld, A.Laarmann, T.Wenz: Modern Surface Technology, Willey, 2006
M. Cartier: Handbook of surface treatment and coatings, Professional Engineering Publishing, 2003
A guide to surface engineering terminology, Institute of Materials in association with the IFHT, 1995.

SECONDARY LITERATURE
E.Kannatey-Asibu: Principles of laser material processing, Willey, 2009
R.B. Heinmann: Plasma spray coating, Willey 2008
Surface engineering for corrosion and wear resistance, Materials Park, OH: ASM International: Institute of Materials, 2001.
Surface and Coatings Technology, Elsevier, 2000
Surface Engineering, Maney Publishing, 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods for forming of the selected products features
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W10, K2ZIP_W04	C1, C2, C3	Lec1 - Lec15	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR
dr inż. Mariusz Frankiewicz tel.: 713202083 email: mariusz.frankiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń**
Name in English: **Operation maintenance of machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041403**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of the structure and operation of components and assemblies as well as the principles of selection and construction.
2. It has a well-established knowledge of basic techniques.
3. It has a well-established expertise in construction and machine control rules.

SUBJECT OBJECTIVES

C1. Understanding the basic principles of the concept of Total Productive maintenance (TPM).
C2. Understanding the basic tools of TPM and methods to increase the efficiency of maintenance of the machinery. Understanding the principles of determining indicators of progress in the implementation of TPM methodology.
C3. Learning capabilities of computer systems of the CMMS class supporting scheduling service and repair tasks, inventory management and servicing and repair personnel management.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the range of activities and principles of choice of strategy of maintenance of manufacturing machinery and equipment.
PEK_W02 - Knows the basic tools and indicators TPM.
PEK_W03 - He knows the basic features and capabilities of computer systems of the CMMS class supporting scheduling service and repair tasks, inventory management and servicing and repair personnel management.

II. Relating to skills:
PEK_U01 - He can use the acquired knowledge to formulate tasks to improve the system of maintenance of manufacturing machinery and equipment.
PEK_U02 - Is able to determine the indicators covering the progress in the implementation of TPM methodology.
PEK_U03 - Can use modern IT tools for computerized management of maintenance processes.

III. Relating to social competences:
PEK_K01 - Can search and use the recommended literature for the course and independently acquire knowledge.
PEK_K02 - He can take advantage of modern IT tools.
PEK_K03 - Understands the need for regular and independent work on the mastery of the course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The main issues related to maintenance of manufacturing machinery and equipment: performance requirements, the analysis of cause-and-effect machine failure, the role and importance (benefits) of the organization and planning of maintenance	4
Lec2	History and development of the concept of TPM, characteristics of basic pillars of TPM	2
Lec3	Characteristics of the main tools in the field of TPM - examples of their use	4
Lec4	Maintenance strategies - the idea of a systematic and systemic approach to the problem of maintenance	2
Lec5	Measures and indicators determining the effectiveness of the implementation of the TPM methodology	2
Lec6	IT systems of CMMS class, maintenance management support (requirements and functions of selected systems, the selection criteria of the system)	4
Lec7	Implementation of TPM methodology into industrial practice (role of Maintenance and its organization)	2
Lec8	Examples of solutions for the implementation of the TPM	8
Lec9	Test	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of selected modules of the CMMS	3
Proj2	Spare Parts Management. The part card. Warehouse Management. The structure of the module and generated documents	2

Proj3	Fulfilling orders for maintenance. Generating demand for materials and spare parts	2
Proj4	Management of personell that fulfills maintenance activities. Reports from the workload. Planning service orders. The stages and the necessary data. Building schedules for maintenance execution	4
Proj5	Reporting of orders completion. Cost analysis: planned and actual costs. Reports for maintenance indicators	2
Proj6	Test	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Project defense
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Legutko S.: Podstawy eksploatacji maszyn i urządzeń. Wyd. WSiP. Warszawa, 2007.
2. Słowiński B.: Inżynieria eksploatacji maszyn. Wyd. Pol. Koszalińskiej. Koszalin, 2011.
3. Kaźmierczak J.: Eksploatacja systemów technicznych. Wyd. Pol. Śląskiej. Gliwice, 2000.

SECONDARY LITERATURE

1. Hebda M.: Elementy teorii eksploatacji systemów technicznych. Wyd. MCNEMT. Radom, 1990.
2. Żółtowski B.: Podstawy diagnostyki maszyn. Wyd. ATR Bydgoszcz. Bydgoszcz, 1996.
3. Honczarenko J.: Elastyczna automatyzacja wytwarzania. Obrabiarki i systemy obróbkowe. WNT Warszawa, 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W09	C1 - C3	Lect1 - Lect8	N1, N2
PEK_U01, PEK_U02, PEK_U03	K2ZIP_PM_U13	C1 - C3	Pr1 - Pr5	N2
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K02	C1 - C3	Lect1 - Lect8, Pr1 - Pr5	N1, N2

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody i techniki eksperymentu**
Name in English: **Methods and techniques of experiments**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041404**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of statistics, mathematical analysis and linear algebra

SUBJECT OBJECTIVES

C1. Explain the purpose of carrying out experiments
C2. Explain the methods and techniques to carry out the experiment
C3. Explain the types and purposes of tools to carry out the experiment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the purpose and effect of the proposed experiment
PEK_W02 - Able to propose and define a plan of the experiment
PEK_W03 - Knows the concept and objectives of the experiment

II. Relating to skills:
PEK_U01 - Can collect data for the experiment
PEK_U02 - Can process the data of the experiment
PEK_U03 - Able to design an experiment

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, concept experiment	2
Lec2	The differences between the method and technique	2
Lec3	Basic experiment Part 1	2
Lec4	Basic experiment Part 2	2
Lec5	Measurement	2
Lec6	Statistical tools	2
Lec7	Quality Tools	2
Lec8	Optimization Tools	2
Lec9	Factorial / multifactorial experiment	2
Lec10	DoE	2
Lec11	Methods for optimization of technological processes Part 1	2
Lec12	Methods for optimization of technological processes Part 2	2
Lec13	Case Study Part 1	2
Lec14	Case Study Part 2	2
Lec15	Summary, examination	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction, health and safety regulations	2
Proj2	Discussion of proposed projects	2
Proj3	Choice otf the experiment	2
Proj4	Data processing Part 1	2
Proj5	Data processing Part 2	2
Proj6	Verification and Optimization	2
Proj7	Summary, projects checking	2

Proj8	Examination	2
		Total hours: 16

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture
N3. case study
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project / test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Ewaryst Rafajłowicz "Optimization of the experiment with applications in monitoring the quality of production" Publishing Wroclaw University of Technology
Mieczyslaw Korzyński "Methodology of the experiment" WNT

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods and techniques of experiments
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W08	C1, C2, C3	Lec1-Lec15	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K2ZIP_PM_U12	C1, C2, C3	Proj1-Proj7	N4

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Planowanie technologiczne CAD/CAM**
Name in English: **Technology planning CAD/CAM**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041405**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of geometric modeling and CAD systems.
2. Fundamentals on technology designing.
3. Basic knowledge about numerically controlled machine tools.

SUBJECT OBJECTIVES

C1. Gaining knowledge in the field of technology design for CNC machine tools using CAD/CAM systems.
C2. Presentation of modern tools supporting manufacturing.
C3. Discussion of issues related to project management in the field of structural design and technology.
C4. Discussion of issues of selection, implementation and integration of CAD/CAM systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge about existing solutions supporting structural design and technology.
PEK_W02 - Ordered knowledge of technological design in CAM systems.
PEK_W03 - Knowledge regarding the selection, integration and implementation of CAD/CAM systems in enterprises.

II. Relating to skills:
PEK_U01 - Student should be able to analyze parts taking into account that will be manufactured on CNC machine tools. Analysis of the structure manufacturability.
PEK_U02 - Students should be able to prepare geometric data necessary to carry out project work.
PEK_U03 - Students should be able to prepare a technological process for CNC machine tools using selected CAD/CAM systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to CAD/CAM.	2
Lec2	Integration of CAD/CAM systems. The exchange of data. A review of available solutions.	2
Lec3	Project management in an environment of CAD/CAM system. Relationship between documents. Generating the documentation.	2
Lec4	Technological design in CAM systems. The steps and tasks performed.	2
Lec5	Technological design in CAM systems. Functions of CAM.	2
Lec6	Processes verification through computer simulation. Simulation methods.	2
Lec7	The issue of selection and implementation of CAD/CAM systems.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Presentation of the selected environment of CAD/CAM system.	2
Proj2	Preparation of geometric data. Developing a plan of treatment for the sample.	4
Proj3	Generating tool paths for machining. Machining simulation. Management of the project.	4
Proj4	Generating technical documentation. NC code generation.	2
Proj5	Applying the FBM method to technology design for milled parts.	2
Proj6	Receive and evaluation of projects.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. problem discussion
N4. self study - preparation for project class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	grade for poroject
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Kief, Hans B.: FFS-Handbuch : Einfuhrung in flexible Fertigungssysteme und deren Komponenten : CNC, DNC, CAD, CAM, FFS, FMS, CAQ, CIM. 1998 r.
2.Kief, Hans B.: NC/CNC handbuch 2007/08 : CNC, DNC, CAD, CAM, CIM, FFS, SPS, RPD, LAN, NC-Maschinen, NC-Roboter, Antriebe, Simulation, Fach- und Stichwortverzeichnis . 2007r.
3.Singh, D. K.: Fundamentals of manufacturing engineering. 2008r.

SECONDARY LITERATURE

1.Kief, Hans B.: FFS-Handbuch : Einfuhrung in flexible Fertigungssysteme und deren Komponenten : CNC, DNC, CAD, CAM, FFS, FMS, CAQ, CIM. 1998 r.
2.Kief, Hans B.: NC/CNC handbuch 2007/08 : CNC, DNC, CAD, CAM, CIM, FFS, SPS, RPD, LAN, NC-Maschinen, NC-Roboter, Antriebe, Simulation, Fach- und Stichwortverzeichnis . 2007r.
3.Singh, D. K.: Fundamentals of manufacturing engineering. 2008r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technology planning CAD/CAM
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W04	C1, C3, C4	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7	N1, N2, N5
PEK_U01, PEK_U02, PEK_U03	K2ZIP_PM_U04, K2ZIP_PM_U05	C2, C3	Pr1, Pr2, Pr3, Pr4, Pr5	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Jacek Czajka tel.: 31-37 email: jacek.czajka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie procesów produkcyjnych**
Name in English: **Modelling of the production processes**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041408**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about the organization (production company) and it's management principles.

SUBJECT OBJECTIVES

C1. The acquisition of knowledge and skills in the area of modeling of production systems using methods IDEF0 and UML.
C2. The acquisition of knowledge and skills in the area of modeling of production systems using method BPMN.
C3. The acquisition of knowledge and skills in the area of modeling of production systems using method VSM.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has a basic knowledge in the area of modeling of manufacturing systems.
PEK_W02 - The student has an extended knowledge in the area of modeling of manufacturing systems using methods IDEF0, UML, BPMN and VSM.

II. Relating to skills:
PEK_U02 - Student is able to independently develop a model of the production system using the BPMN method (Business Process Model & Notation)
PEK_U03 - Student is able to independently develop a model of the production system using the VSM method (Value Stream Mapping).

III. Relating to social competences:
PEK_K01 - Student is able to prepare and present the analysis of the results of the project

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts. System - Process - Model	2
Lec2	IDEF0 method - part 1 - Description of the method	2
Lec3	IDEF0 method - part 2 - Tutorial	2
Lec4	UML method - part 1 - Use case diagram, Class diagram	2
Lec5	UML method - part 2 - Activity diagram, State Machine diagram, Time diagram	2
Lec6	UML method - part 3 - Tutorial	2
Lec7	BPMN method - part 1 - Description, Activities, Users - Business roles	2
Lec8	BPMN method - part 2 - Events, Gates	2
Lec9	BPMN method - part 3 - Tutorial	2
Lec10	VSM method - part 1 - Current state diagram	2
Lec11	VSM method - part 2 - Future state diagram	2
Lec12	VSM method - part 3 - Tutorial	2
Lec13	Other methods (Flowchart, Aris, Corporate Modeler etc.)	2
Lec14	Case studies	2
Lec15	End test	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	- The organization of classes, - Discussion of the course, the presentation of the scoring system designs and conditions for end mark. - Presentation of schedules for each project, and an introduction to the topics	2
Proj2	Projekt 1a. Model of the system using IDEF0 method	6
Proj3	Projekt 1b. Model of the system using UML method	6

Proj4	Projekt 1c. Model of the system using BPMN method	6
Proj5	Projekt 1d. Model of the system using VSM method	6
Proj6	Summary. Presentation of the project results	4
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. report preparation
N3. informative lecture
N4. problem lecture
N5. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 + PEK_W02	End test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Points for project 1a
F2	PEK_U01	Points for project 1b
F3	PEK_U02	Points for project 1c
F4	PEK_U03	Points for project 1d
F5	PEK_U01 + PEK_U02 + PEK_U03	Points for attendance
P = F1 + F2 + F3 + F4 + F5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]„Integration definition for function modelling (IDEF0)”. Federal Information Processing Standards Publications, 21-grudz-1993.
[2] G. Booch, J. Rumbaugh, i I. Jacobson, UML - przewodnik użytkownika, Wyd. 2. Warszawa: Wydawnictwa Naukowo-Techniczne, 2002.
[3] S. Drejewicz, Zrozumieć BPMN modelowanie procesów biznesowych. Gliwice: Wydawnictwo Helion, 2012.
[4] M. Rother i J. Shook, Naucz się widzieć: Eliminacja marnotrawstwa poprzez mapowanie strumieni wartości, Wyd. 2, popr. Wrocław: Lean Enterprise Institute Polska, 2009.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modelling of the production processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_W02, K2ZIP_W03	C1	Lec1-14	N3 - N5
PEK_U01	K2ZIP_U02, K2ZIP_U07, K2ZIP_U09	C1	pr1-6	N1 - N2
PEK_K01	K2ZIP_K05	C1	pr1-6	N1 - N2

SUBJECT SUPERVISOR

dr inż. Sławomir Susz tel.: +48 71 3202066 email: slawomir.susz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Optymalizacja rozmieszczenia stanowisk roboczych**
Name in English: **Optimizing deployment of workstations**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041409**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of logistics and enterprise management
2. The ability to build simulation models for discrete manufacturing systems

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about how to deploy workstations
C2. Learn how to build a layout plans
C3. Learn how to optimize the planned deployments of workstations

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge of the mathematical arrangement of workplaces
PEK_W02 - He has knowledge of the technological conditions of the deployment of workstations
PEK_W03 - He knows the basic techniques of simulation deployment of workstations

II. Relating to skills:
PEK_U01 - He can choose a variety of simulation tools to verify the layout plans
PEK_U02 - Can apply various simulation tools to verify and optimize the layout plans
PEK_U03 - The student is able to properly make the deployment plan workstations

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Methodological approaches in the design of the deployment of production cells	4
Lec2	Mathematical methods for designing the deployment of workstations	6
Lec3	Technical considerations taken into account when deploying workstations	6
Lec4	Verification of simulation methods proposed solutions	4
Lec5	Tools for modeling and simulation of manufacturing systems	2
Lec6	Discrete Simulation - Action	2
Lec7	Data collection for the project simulation	2
Lec8	Multi-criteria optimization	2
Lec9	Classification of forms of organization of production for manufacturing cells	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Determination of the coefficient io to match the number of facilities for the production plan and the available production technology	2
Proj2	The selection of machinery from manufacturers' catalogs. Optimizing deployment of workstations by using a mathematical algorithm MST (Modified Spanning Tree Algorithm)	4
Proj3	Optimizing deployment of workstations by using a mathematical algorithm triangles Schmigalli	2
Proj4	Optimizing deployment of workstations by using a mathematical algorithm ROC (Rank Order Clustering)	2
Proj5	Develop deployment of workstations, taking into account technological conditions. A comparison of the above methods based on the calculated cost.	3
Proj6	Assessment of the project	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture
N3. problem exercises
N4. calculation exercises
N5. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Assessment of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. PROJEKTOWANIE ROZMIESZCZENIA STANOWISK ROBOCZYCH / STANISLAW LIS, KRZYSZTOF SANTAREK Warszawa : PWN, 1980.
2. Podstawowa problematyka projektowania stanowisk pracy / Teresa Musioł, Jarosław Grzesiek ; Wyższa Szkoła Ekonomii i Administracji w Bytomiu. Bytom : Wyższa Szkoła Ekonomii i Administracji, 2008.

SECONDARY LITERATURE
PROJEKTOWANIE STANOWISK I PROCESOW PRACY / KAROL RYPULAK. LUBLIN : POLITECHNIKA, 1981.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Optimizing deployment of workstations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W02, K2ZIP_W03, K2ZIP_W07	C1	Lec1 - Lec9	N1, N2
PEK_U01, PEK_U02, PEK_U03	K2ZIP_PM_U02, K2ZIP_U02, K2ZIP_U03, K2ZIP_U07	C2, C3	Pr1 - Pr6	N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Arkadiusz Kowalski tel.: 37-10 email: arkadiusz.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Recykling materiałów**
Name in English: **Recycling of materials**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041412**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of the properties of materials.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the life cycle of the product and the disposal methods of the product. Acquisition of basic knowledge about recycling methods.
C2. Understanding the need for waste management policy. Understanding the design and manufacture of the product in the context of environmental impact.
C3. The acquisition and consolidation of social skills like responsibility, honesty, fairness in the procedure observance force in academia.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Defining and understanding the issues of product life cycle.
PEK_W02 - Identifying recycling methods.
PEK_W03 - The presentation and characterization of waste management methods.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. The life cycle of the product. The problem of waste. European scale of the problem. The situation in Poland. Legislative considerations.	2
Lec2	General information about recycling. Balance of environmental burdens. Ekobilansu importance in the economy. Methods of waste disposal and waste products.	2
Lec3	Technical possibilities of identification and separation of materials.	2
Lec4	The problems of recycling polymeric materials. Classification of methods for recycling of polymeric materials. Methods for managing selected polymers as an example of recycling.	4
Lec5	Feedstock recycling for selected examples.	4
Lec6	Thermal recycling for selected examples.	4
Lec7	Recycling and characterization of materials in various industries. Recycling of packaging materials. Recycling of materials in the automotive industry. Recycling of waste electrical.	4
Lec8	Degradable materials as an alternative to recycling.	4
Lec9	Designing. Trends and prospects of recycling materials.	2
Lec10	Summary knowledge of recycling.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. tutorials
N3. traditional lecture with the use of transparencies and slides
N4. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written and oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Plastics recycling in Europe, M. Kozłowski

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Recycling of materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W01	C1, C2, C3	Lec1-Lec10	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Joanna Pach tel.: 71-320-42-78 email: joanna.pach@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mapowanie procesów w przedsiębiorstwie**
Name in English: **Enterprise processes mapping**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041413**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Enhanced knowledge of the enterprise operation in terms of management and production.
2. The ability to obtain information from documents, databases and other sources, the ability to interpret information.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about analyzis methods and business processes documentation.
C2. Acquisition of skills how to use the basic tools used in the process mapping in production enterprises.
C3. Acquisition of skills how to recognize the resources and information flow of across the enterprise.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge about analyzis methods and business processes documentation.
PEK_W02 - Student can characterize resources and information flow in enterprise. He can describe their flow.
PEK_W03 - Student can choose different tools and methods to analyze enterprise processes.

II. Relating to skills:
PEK_U01 - Student has the ability to use different tools of process mapping.
PEK_U02 - Student can use computer aided tools in process modeling.
PEK_U03 - Student can analyze models within compliance with the notation, accuracy and efficiency of modeling techniques.

III. Relating to social competences:
PEK_K01 - Student thinks and acts in a creative and enterprising way.
PEK_K02 - Student is able to interact and work in a group, taking the different roles as a different functions in manufacturing and service enterprises.
PEK_K03 - Student understands the need for continuous improvement of the organization, its processes and products.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Presentation of basics of business processes mapping. Presentation of process definitions and basic information about process modeling. Presentation of basic ways of describing processess in enterprise.	2
Lec2	Presentaion of process modeling using BPMN, discussion of basic concepts. Presentaion of the scope of BPMN and its notation elements. Presentation how to create maps in BPMN. Presentation of the practical use of BPMN in enterprises.	4
Lec3	Presentaion of process modeling using Value Stream Mapping (VSM), discussion of basic concepts. Presentaion of the scope of VSM and its notation elements. Presentation how to create current state maps in VSM. Waste identification. Presentaion how to create future state maps in VSM. Presentation of the practical use of VSM in enterprises.	4
Lec4	Presentaion of process modeling using functional maps, discussion of basic concepts. Presentaion of the scope of functional maps and its notation elements. Presentation how to create functional maps. Presentation of the practical use of functional maps in enterprises.	4
Lec5	Test	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Business processes mapping with BPMN notation	4
Proj2	Production processes mapping with VSM notation. Current and future state maps.	6
Proj3	Enterprise processes mapping with functional maps notation.	4

Proj4	Presentaion of project results in chosen company - project defensis.	1
		Total hours: 15

TEACHING TOOLS USED
N1. case study N2. self study - preparation for project class N3. project presentation N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	project presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Drejewicz S., „Zrozumieć BPMN modelowanie procesów biznesowych”, Helion, Gliwice 2012
2. Rother M., Shook J. „Naucz się widzieć. Eliminacja marnotrawstwa poprzez Mapowanie Strumienia Wartości”, WCTT Wrocław 2003 r.,
3. Rummler A. P., Brache A. P., „Podnoszenie efektywności organizacji”, PWE, Warszawa 2000 r.,

SECONDARY LITERATURE

1. Skrzypek E., Hofman M., "Zarządzanie procesami w przedsiębiorstwie : identyfikowanie, pomiar, usprawnianie", Wolters Kluwer Polska, Warszawa 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Enterprise processes mapping
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W02, K2ZIP_W02, K2ZIP_W07	C1, C2, C3	Lec1, LEc2, Lec3, LEc4	N4
PEK_U01, PEK_U02, PEK_U03,	K2ZIP_PM_U03, K2ZIP_PM_U04, K2ZIP_U09	C1, C2, C3	Proj 1 - Proj 4	N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K2ZIP_PM_K01	C1, C2, C3	Proj 1 - Proj 4	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Joanna Helman tel.: 43-84 email: joanna.helman@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria odwrotna**
Name in English: **Reverse engineering**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041414**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of machine design and manufacturing technologies.
2. Student has a knowledge of Computer Aided Design (CAD).
3. Student has a knowledge of geometrical metrology.

SUBJECT OBJECTIVES

C1. Providing students with knowledge of application areas of reverse engineering.
C2. Providing students with knowledge of methods of 3D scanning and reconstructions of 3D CAD models of physical objects.
C3. Producing in students the ability of applying data from 3D scanning in the evaluation of the geometrical accuracy of products and in designing new products.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define reverse engineering and describe its basic applications.
PEK_W02 - Student is able to characterize the process of reconstruction of the CAD model.
PEK_W03 - Student is able to choose a 3D scanning method depending on the type of the object to be digitized.

II. Relating to skills:
PEK_U01 - Students can evaluate the data from 3D scanning and perform basic editing operations.
PEK_U02 - Student can perform the process of comparison a model from 3D scanning with CAD data.
PEK_U03 - Student is able to use data from a 3D scanner to design a new product.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Application areas of reverse engineering.	2
Lec2	Contact methods of data acquisition . Technical and medical tomography.	2
Lec3	Optical methods of data acquisition.	2
Lec4	Basic methods of reconstructing of CAD models in reverse engineering.	2
Lec5	Advanced reconstruction methods. Assessment of accuracy in reverse engineering.	2
Lec6	Non-commercial 3D scanning systems - application areas, assessment of accuracy. Presentation of a selected device.	2
Lec7	Case study.	2
Lec8	Final test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Presentation of 3D scanners. 3D scanning of a selected object.	2
Lab2	Learningh the program interface. Import and basic editing operations on3D scanning data.	2
Lab3	Orientation of models in space, best-fit function. Comparison of two models, and generating deviation maps.	2
Lab4	Advanced inspection functions.	2
Lab5	NURBS surface modeling - the basics.	4
Lab6	Integrating the CAD model with data from 3D scanning.	2
Lab7	Assessment	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. case study
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	laboratory report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Raja V., Fernandes K.J.: Reverse engineering: an industrial perspective, Springer, 2008, 242s.
[2] Chlebus E.: Techniki komputerowe CAx w inżynierii produkcji, WNT, Warszawa 2000

SECONDARY LITERATURE
1. E. Chlebus, B. Dybała, ""Reverse engineering in technical and medical applications"", Virtual design and automation - 1st VIDA International Conference, Poznań, 3-4 June 2004, 2005, str. 213-218
2. K. Oczoś, I. Cena, ""Rapid Inspection - metody pomiarowo-kontrolne adekwatne do rapid-technologii"", Mechanik, 2008, No. 3, str. 165-176
3. J. Gawlik, K. Karbowski, ""Metody odwzorowywania powierzchni w systemach inżynierii odwrotnej"", Zeszyty Naukowe Politechniki Poznańskiej, Budowa Maszyn i Zarządzanie Produkcją, 2004, No. 1, str. 187-194

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Reverse engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W04	C1-C2	Lec1-Lec8	N1-N3, N5
PEK_U01, PEK_U02, PEK_U03	K2ZIP_PM_U03	C3	Lab1-Lab7	N4-N5

SUBJECT SUPERVISOR

dr inż. Tomasz Będza tel.: 71 320 42 08 email: tomasz.bedza@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie cyklem życia produktu**
Name in English: **Product Lifecycle Management**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041415**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of IT systems in the manufacturing
2. knowledge of the new product development process
3. knowledge, including practical CAD systems

SUBJECT OBJECTIVES

C1. The aim of the course is to provide knowledge about the principles and importance of product lifecycle management, ie from its inception until its disposal in manufacturing systems.
C2. The aim of the course is to provide basic information about the methods and techniques of managed of the product life stages.
C3. Will be presented and used the latest solutions that support the work of the product lifecycle management, including tools of the PLM family (Product Lifecycle Management).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - knowledge of the role and function of PLM in the manufacturing
PEK_W02 - knowledge of the role and functions of a PDM system in the manufacturing
PEK_W03 - understanding of the importance of integration and process approach in the organization of the production system

II. Relating to skills:
PEK_U01 - ability to model a new product - design and technological documentation
PEK_U02 - team management skills development
PEK_U03 - ability of modeling workflows

III. Relating to social competences:
PEK_K01 - Think and act in a logical manner
PEK_K02 - Can draw logical conclusions and resolve problem.
PEK_K03 - Able to prioritize appropriately for implementation specified by you or other tasks.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to subject	2
Lec2	Managing product development - design	2
Lec3	IT systems in Product Development	2
Lec4	Product data management - project, BOM	2
Lec5	Product Lifecycle Management	2
Lec6	The importance of product lifecycle management	2
Lec7	Trends in Product Lifecycle Management	2
Lec8	Workflow management	2
Lec9	Managing product development - process planning	2
Lec10	Product Data Management - documents, classification	2
Lec11	Zarządzanie danymi produktu - integracja	2
Lec12	Product data management - changes	2
Lec13	Product Lifecycle Management - stages of life	2
Lec14	Standards in PDM / PLM	2
Lec15	PLM Market	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Students will develop a project using the PLM tool. They make modeling of the product, its structure and its manufacturing process. Selected business processes needed to produce the product will be modeled too. Process simulation will be conducted using tools for managing workflow.	15

	Total hours: 15

TEACHING TOOLS USED

N1. tutorials
N2. self study - preparation for project class
N3. traditional lecture with the use of transparencies and slides
N4. multimedia presentation
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	project, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
script: Production Management, Mariusz Cholewa, PhD(Eng.)

SECONDARY LITERATURE
PDMA Handbook of New Product Development (2nd Edition); Edited by: Kahn, Kenneth B. © 2005 John Wiley & Sons

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Product Lifecycle Management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W01	C1, C2	Lec1-Lec15	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K2ZIP_PM_U01, K2ZIP_PM_U03, K2ZIP_PM_U04, K2ZIP_PM_U07	C3	Proj1	N1, N2, N5
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K03, K2ZIP_PM_K01, K2ZIP_PM_K02	C1, C3	Proj1	N1, N2

SUBJECT SUPERVISOR

dr inż. Mariusz Cholewa tel.: 31-37 email: mariusz.cholewa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Innowacyjne technologie mechaniczne**
Name in English: **Innovative mechanical technologies**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041416**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15	15	
Number of hours of total student workload (CNPS)	60		60	30	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	2		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student will be acquainted with modern methods of computer aided technologies supporting product development - those were the main subject of the course of Product Development Technologies during earlier studies
2. Issues of concept design, construction in 2D and 3D, especially computer modeling directed at different manufacturing technologies
3. Basic information on technologies of rapid prototyping as a verifying tool in virtual prototyping

SUBJECT OBJECTIVES

C1. Methods of manufacturing prototypes and prototype series. Additive Manufacturing Technologies. Rapid Prototyping
C2. Rapid Prototyping of products made of polymers, metals and ceramics
C3. Rapid Tooling
C4. Rapid Manufacturing
C5. Medical applications of additive manufacturing technologies

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student should recognize machines for rapid prototyping and characterize their basic usability features
PEK_W02 - Student should know how to optimally select and propose appropriate rapid prototyping technology based on requirements for new products which are to be verified physically

II. Relating to skills:
PEK_U01 - Student should perform a product development process optimized for its physical verification and evaluation for function and quality
PEK_U02 - Student should be able to propose construction assumptions for a new product and design using proper engineering tools, based on a chosen manufacturing technology

III. Relating to social competences:
PEK_K01 - Awareness of the role of a product engineer in the process of production planning and the need for responsibility and engagement in new product development in a company
PEK_K02 - Awareness of legal and business aspects and effects of engineering activities in the area of new product development

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Types and applications of physical prototypes. Manufacturing methods.	2
Lec2	Technologies of Rapid Prototyping - concept models	2
Lec3	Technologies of Rapid Prototyping - functional models made of polymers	4
Lec4	Technologies of Rapid Prototyping - functional models made of metals	4
Lec5	Technologies of Rapid Tooling - classification	2
Lec6	Technologies of Rapid Tooling - manufacturing prototype series of polymers	2
Lec7	Technologies of Rapid Tooling - manufacturing prototype series of metals	2
Lec8	Practical examples of Rapid Prototyping and Tooling in the industry	2
Lec9	Rapid Manufacturing - applications	4
Lec10	Innovative mechanical technologies in medical applications	4
Lec11	Final test	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Technologies of Rapid Prototyping - concept models	2
Lab2	Technologies of Rapid Prototyping - functional models made of polymers	3
Lab3	Technologies of Rapid Prototyping - functional models made of metals	2
Lab4	Technologies of Rapid Tooling - manufacturing prototype series of polymers	2
Lab5	Technologies of Rapid Tooling - manufacturing prototype series of metals	2
Lab6	Technologies of Rapid Manufacturing	2

Lab7	Innovative mechanical technologies in medical applications	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Development of design assumptions for example new products	3
Proj2	Analysis and functional evaluation of design concepts for new products	2
Proj3	Design and visualization of 3D concepts of new products	2
Proj4	Design and visualization of 3D constructions of new products	2
Proj5	Analysis and virtual verification of CAD design models of new products	2
Proj6	Manufacturing (example) physical models of prototypes of new products	2
Proj7	Physical verification, functional and quality evaluation of manufactured prototypes of new products	2
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. self study - preparation for laboratory class
N4. self study - preparation for project class
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	short test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02 PEK_K01, PEK_K02	Evaluation and defense of a developed project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. E. Chlebus, "Techniki komputerowe CAx w inżynierii produkcji", WNT, Warszawa 2000
2. Z. Kacprzyk, "Komputerowe wspomaganie projektowania: podstawy i przykłady", Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2012

SECONDARY LITERATURE
E. Chlebus, T. Boratyński, B. Dybała, M. Frankiewicz, P. Kolinka, "Innowacyjne technologie Rapid Prototyping - Rapid Tooling w rozwoju produktu", Oficyna Wydawnicza PWr, Wrocław 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Innovative mechanical technologies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_W04	C1-C5	Lec1-Lec11	N1-N5
PEK_U01, PEK_U02	K2ZIP_U04	C1-C5	Proj1-Proj7	N1-N5
PEK_K01, PEK_K02	K2ZIP_K02	C1-C5	Lab1-Lab7	N1-N5

SUBJECT SUPERVISOR

dr hab. inż. Bogdan Dybała tel.: 40 61 email: bogdan.dybala@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Symulacja procesów produkcyjnych**
Name in English: **The simulation of manufacturing processes**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041417**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of process planning

SUBJECT OBJECTIVES

C1. Introduction to with the problems design methods of simulation models of manufacturing systems
C2. The acquisition of practical skills-building simulation models and analyzing their results
C3. Understanding the issues of multi-criteria optimization of manufacturing systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Using the example simulation tool for manufacturing systems
PEK_U02 - Using a sample tool to optimize production systems
PEK_U03 - Building adequate, discrete simulation models for production systems

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of deliveries	4
Proj2	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of deliveries including hardening operations	2
Proj3	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of delivery including quality control operations	2
Proj4	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of deliveries at various production plan	4
Proj5	Building deterministic simulation model of manufacturing system to determine the optimum frequency of operation of supply assembly including	2
Proj6	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of supply, taking into account the various modes of transport and the cost of	2
Proj7	Performing a test	2
Proj8	Building non-deterministic simulation model of manufacturing system	2
Proj9	Building a simulation model of the manufacturing system niederministycznego uzwględnieniem breaks and the use of macros	2
Proj10	Building non-deterministic simulation model of manufacturing system using variables and attributes	2
Proj11	Perform non-deterministic multi-criteria optimization of manufacturing systems	4
Proj12	Perform a test	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises
N2. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Defence project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Zdanowicz R.: Modelowanie i symulacja procesów wytwarzania, WPŚ, Gliwice 2002.
2. Chlebus E.: Techniki komputerowe CAx w inżynierii produkcji. PWT, Warszawa 2000

SECONDARY LITERATURE
1. A. Muhlemann, „Zarządzanie Produkcją. Usługi", PWN 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The simulation of manufacturing processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2ZIP_U02, K2ZIP_U03	C1, C2, C3	Pr1-Pr12	N1, N2

SUBJECT SUPERVISOR

dr inż. Arkadiusz Kowalski tel.: 37-10 email: arkadiusz.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Studium przypadku**
Name in English: **Case study**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041419**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of scientific projects - research and industrial
2. Can prepare an offer in the form of research project proposal and research offer for the company

SUBJECT OBJECTIVES

C1. Explain the principle of scientific - research projects
C2. Explain methods of scheduling and budgeting in research projects
C3. Explain the principles of substantive implementation of research projects

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the purpose and effect of the proposed research topics
PEK_W02 - Can suggest the mode of applying for project
PEK_W03 - Can distinguish between basic research and applied research and development

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Able to work in a team

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction	2
Lec2	Types of projects	2
Lec3	Application Form	2
Lec4	Basic Research Projects	2
Lec5	Research and Development Projects	2
Lec6	Industrial Research Projects	2
Lec7	Funding agencies	2
Lec8	Structural Funds	2
Lec9	Preparation of the draft	2
Lec10	Summary of the preliminarily - application part	2
Lec11	Research project (one executor) - a case study	2
Lec12	Research project (consortium) - a case study	2
Lec13	Research project - Structural Funds - a case study	2
Lec14	Summary	2
Lec15	Examination	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. tutorials
N3. multimedia presentation
N4. project presentation
N5. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, K01	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Project Management - Case Studies - Harold Kerzner, HELION publishing house

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Case study
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W11, K2ZIP_W01	C1, C2, C3	Lec1-Lec15	N1, N2, N3, N4, N5
PEK_K01	K2ZIP_K03, K2ZIP_K05	C1, C2, C3	Lec1-Lec15	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Planowanie przedsięwzięć produkcyjnych**
Name in English: **Planning of production projects**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041420**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the functioning of the production company.
2. Ability to solve problems of linear mathematics decision problems.
3. Computer skills (Windows) and spreadsheet handling skills.

SUBJECT OBJECTIVES

C1. Introduction to the issue of feasibility study of the project.
C2. Introduction to the methodology of solving decision problems using linear programming with use of the solver tool.
C3. Getting to know the problems of calculating the number of kanban cards in the production system based on "pull" approach.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of the aspects of the project feasibility study.
PEK_W02 - Knowledge of mathematical methods for solving decision problems.
PEK_W03 - Knowledge of the methodology for calculating the number of kanban cards in the system of production based on "pull" approach.

II. Relating to skills:
PEK_U01 - Ability to solve decision-making problems by using linear programming with use of the solver tool.
PEK_U02 - The ability to calculate the number of kanban cards in the production system based on "pull" approach.

III. Relating to social competences:
PEK_K01 - Awareness of the role of the engineer in the planning of production and demand for accountability and involvement in one of the most important links of the production process in the company.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Feasibility study - basics and development procedure	4
Lec2	Feasibility study - example	6
Lec3	Linear programming - basics	2
Lec4	Linear programming - examples with application of slover tool	4
Lec5	Linear programming - examples with application of slover tool (continued)	4
Lec6	The production system based on "pull" approach and control of the flow of material using kanban cards - basics and an example from industry	4
Lec7	The methodology for calculating the number of kanban cards in the system of production based on "pull" approach	4
Lec8	The methodology for calculating the number of kanban cards in the system of production based on "pull" approach - discussion of an example project	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Solving the decision-making production problem	1
Proj2	Solving the decision-making transportation problem	2
Proj3	Solving the decision-making "make or buy" problem	2
Proj4	Solving the decision-making mix problem	2
Proj5	Solving the decision-making production and warehouse mamagement problem	2
Proj6	Calculation of kanban cards number	6
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. problem exercises
N3. self study - preparation for project class
N4. project presentation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02 PEK_K01, PEK_K02, PEK_K03	Completion of a project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Alan Thompson: Enterpreneurship and Business Innovation. The Art of Successfull Business Start-Ups and Business Planning. Appendix I: Business Feasibility Study, 2005
2. W. Heath Hoagland, Lionel Williamson: Feasibility Studies, Cooperative Extension Service, University of Kentucky, 2000
3. W. Behrens, P.M. Hawranek, Manual for the preparation of Industrial Feasibility Studies, Newly revised and expanded edition, United Nations Industrial Development Organisation, 1991
4. Steve Easterbook: Lecture 7: The Feasibility Study, University of Toronto, Department of Computer Science, 2004-2005

SECONDARY LITERATURE
1. Muhlemann A., Oakland J., Lockyer K.: Zarządzanie Produkcja i Usługi, Wydawnictwo Naukowe PWN, Warszawa 2001
2. Brzeziński M.: Organizacja i sterowanie produkcją, Placet, Warszawa 2002
3. Durlik I.: Organizacja i zarządzanie produkcją, Warszawa 2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Planning of production projects
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_PM_W03, K2ZIP_W07	C1	Lec1 - Lecc8	N1, N5
PEK_U01, PEK_U02	K2ZIP_PM_U04	C2, C3	Pr1 - Pr6	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K02	C2, C3	Lec1 - Lec8	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przedsiębiorczość innowacyjna**
Name in English: **Innovative Entrepreneurship**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041421**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge about the free market economy.
2. Ability to discuss and present one's opinion in terms of dealing with problems connected with the business idea implementation and assessment of its innovation potential.
3. Bachelor's degree and basic knowledge of finance (profit, loss, income, expenses, liquidity, balance, taxes).

SUBJECT OBJECTIVES

C1. To familiarize students with the phenomenon of entrepreneurship from the business process point of view that relates entrepreneurship and business.
C2. To familiarize students with the modern understanding of innovative enterpreneurship, innovation sources and innovation organization management (integrating technological, market and organizational changes).
C3. To familiarize students with the factors of success or factors of failure of the company, their measures and sources, finding funding sources innovative enterprises.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of ways and methods of project management, organization, planning and evaluation work in the project, knows methods of technical and economical evaluation of the innovative enterprises.
PEK_W02 - Knows methods and ways of how to assess opportunities and risks in the scope of innovative activity.
PEK_W03 - Knows how to assess and verify entrepreneurial activities that are a way of entrepreneurship realization.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Can search for information and analyze them critically.
PEK_K02 - Acting in a creative and enterprising way can work in a team in the scope of the selection of strategies and tools to
solve problems related to entrepreneurship and innovation.
PEK_K03 - Can objectively evaluate the arguments, rationally explain and justify their point of view in terms of entrepreneurial activities with the use of knowledge in the fields of innovation and business practices.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. The core of innovative entrepreneurship. The development of entrepreneurship in Poland and abroad.	2
Lec2	The entrepreneur. His qualities and competences. Personality approach. Characteristics of entrepreneurs; entrepreneurial orientation, sources of the entrepreneurial motivation. Methods of the entrepreneurship completion.	2
Lec3	The entrepreneurial process. Opportunity recognition.	2
Lec4	Entrepreneurial strategy for innovations. The business model.	2
Lec5	Entrepreneurial marketing.	2
Lec6	Building the founding team.	2
Lec7	Managing for innovations. Innovation as a core business process.	2
Lec8	Innovation process model. Enabling effective search for innovations.	2
Lec9	Creating the innovative organization. Organizing business processes in order to focus them on innovations.	2
Lec10	Technological trajectories and new innovative firms. Benefits from innovations.	2
Lec11	Building a business plan.	2
Lec12	Legal & tax issues. Intellectual property and financing entrepreneurial ventures	2
Lec13	Entrepreneurial growth. Leadership.	2
Lec14	Corporate entrepreneurship.	2
Lec15	Test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. traditional lecture with the use of transparencies and slides
N3. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Bessant J., Tidd J., Managing Innovation, 5th Edition, Wiley, 2013
[2] Bessant J., Tidd J., Innovation And Entrepreneurship, Wiley, 2011
[3] Bygrave W., Zacharakis A., Entrepreneurship, 2nd Edition, Wiley, 2011
[4] Drucker P.F., Innovation And Entrepreneurship, HarperBusiness, 1993
[5] Westhead P., Wright M., McElwee G., Entrepreneurship. Perspectives And Cases, Pearson Education Limited, 2011

SECONDARY LITERATURE
[1] Aulet B., Disciplined Entrepreneurship: 24 Steps to a Successful Startup, Wiley, 2013
[2] Gordon M.E., Trump University Entrepreneurship 101: How To Turn Your Idea Into a Money Machine, Wiley, 2009
[3] Johnson K.D., The Entrepreneur Mind: 100 Essential Beliefs, Characteristics, and Habits of Elite Entrepreneurs, Johnson Media Inc., 2013
[4] Bridge R., You Can Do It Too: The 20 Essential Things Every Budding Entrepreneur Should Know, Kogan Page, 2010
[5] Gerber M.E., Awakening the Entrepreneur Within: How Ordinary People Can Create Extraordinary Companies, HarperBusiness, 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Innovative Entrepreneurship
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W01	C1, C2, C3	Wy1 - Wy15	N1, N2, N3
PEK_K01, PEK_K02, PEK_k03	K2ZIP_K03, K2ZIP_K05	C1, C2, C3	Wy1 - Wy15	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie wiedzą**
Name in English: **Knowledge management**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041423**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has an established knowledge in the usage and communication in engineers' language.
2. Has a basic knowledge of manufacturing systems.

SUBJECT OBJECTIVES

C1. Familiarization of basic methods and techniques of knowledge management.
C2. Familiarization of the practical implementation of the chosen strategies of knowledge management systems to industrial practice.
C3. Familiarization of construction and possibilities of selected knowledge management tools.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the definition of the concept of knowledge and knowledge management, knows the goals of knowledge management. Can define knowledge management systems in the field of locating, acquiring, developing, transferring and using of knowledge, knowledge protection. Is able to identify the flows of knowledge between employees, organizational structure and environment of the organization.
PEK_W02 - Is able to recognize the need to manage knowledge and identify solutions.
PEK_W03 - Knows the technical capabilities of knowledge management systems and can offer different solutions in applications.

II. Relating to skills:
PEK_U01 - Is able to identify the elements and areas of knowledge management in the enterprise.
PEK_U02 - Is able to analyze the technical or organizational problem and design appropriate configuration of knowledge management system.
PEK_U03 - Can choose knowledge management tool, depending on the needs of a knowledge management system in the enterprise.

III. Relating to social competences:
PEK_K01 - Understands the need of lifelong learning in the field of activity of an engineer specializing in "Management and production engineering" and improve professional and social competence.
PEK_K02 - Can think and critically analyze the functioning of systems to improve its effectiveness.
PEK_K03 - Is aware of the responsibility for their own work and its impact on the functioning of the enterprise.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational Issues. Definitions and dimensions of knowledge. Conceptual progression from data to knowledge. History of knowledge.	2
Lec2	Evolution of economy systems. Knowledge based economy.	2
Lec3	Intellectual capital. The learning organization.	2
Lec4	Knowledge management foundations: infrastructure, mechanism and technologies.	2
Lec5	Processes and systems of knowledge management.	2
Lec6	Organizational impacts of knowledge management. Impact on people, processes, products and organizational performance.	2
Lec7	Technologies for applying knowledge. Developing knowledge application systems.	2
Lec8	Knowledge capture systems.	2
Lec9	Knowledge sharing systems. Systems that distribution of knowledge.	2
Lec10	Knowledge creating systems.	2
Lec11	Knowledge management tools.	2
Lec12	Web 2.0 as a part of knowledge management system.	2
Lec13	Shaping knowledge sharing culture. Leadership in knowledge management.	2
Lec14	Assessment of knowledge in enterprise. Assessment of knowledge management solutions.	2

Lec15	Test.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Organizational issues: discussion on topics and rules for the project. Selecting an enterprise to study the knowledge management.	2
Proj2	Knowledge management audit in chosen enterprise: uncovering gaps and improving knowledge management performance in various areas of organization.	4
Proj3	Strategies for sourcing and deploying knowledge needed for organziation.	4
Proj4	Selection and development of knowledge management tools in the enterprise.	3
Proj5	Presentation of completed projects	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for project class
N3. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Report
F2	PEK_K01, PEK_K02, PEK_K03	Presentation of the project
P = F		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Jashapara A., Knowledge Management: an Integrated Approach, Financial Times Prentice Hall, Harlow 2011
[2] Becerra-Fernandez I., Sabherwal R., Knowledge Management. Systems and Processes, M.E. Sharpe, New York 2010

SECONDARY LITERATURE

[1] Iżykowski S., Sierżan D., Knowledge Management, Wrocław University Of Technology, 2011
[2] Bergeon B., Essentials of Knowledge Management, John Wiley & Sons, New Jersey 2003
[3] Byrne D., Essential Knowledge Management for Those Working with Infomation, Facet Publishing 2009
[4] Uriarte A. F. Jr, Introduction to Knowledge Management, ASEAN, Japan 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Knowledge management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W05, K2ZIP_W10	C1		N1
PEK_U01, PEK_U02, PEK_U03	K2ZIP_U05	C2, C3		N2, N3
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K01	C2, C3		N2, N3

SUBJECT SUPERVISOR

dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie projektami i innowacjami**
Name in English: **Project and innovation management**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041425**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2			1	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics knowledge of management and marketing
2. Knowledge of the techniques and methods in the area of production management and services
3. Skills in information technology

SUBJECT OBJECTIVES

C1. To familiarize students with the objectives and concepts of project management and innovation
C2. Way of presenting problems and procedures to be followed in the implementation of project tasks
C3. Implementation to the appropriate software (eg MS Project)
C4. Teamwork skills
C5. Way of presentation of project tasks

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the procedures and techniques of project management
PEK_W02 - Understands the relationships and dependencies between the general objectives and sub-objectives of the project and the risks of the project

II. Relating to skills:
PEK_U01 - Has the ability to carry out simple and complex operations using the procedures and techniques of project management
PEK_U02 - It has the ability to use the resources for the implementation of information technology and project management

III. Relating to social competences:
PEK_K01 - Is aware of the increasing importance of project management and innovation in solving technical problems, economic and social
PEK_K02 - The gradual acquisition of competence to work under the direction of a team leader, in terms of competitiveness

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, assessment and literature. Introduction.	2
Lec2	Factors causing the change and the need for the organization by the project. Definitions and objectives of characterizing the type of project tasks. Components (elements) of the project.	2
Lec3	Basic types of projects (internal and external). Measures of success of the project. Measures of success of the project. The structure of the project. The management and nine areas of project management competence	2
Lec4	Initiating the project. Determining the actual requirements for the design and purpose of the project. List the needs of the project, limitations of the feasibility, cost analysis and recommendations for the project. Outline of the project	2
Lec5	Planning for the project. The main and sub objectives of the project. Decomposition-pyramid du Pont. The scope, impact and limitations of the project. Definition of the approach and identify of required resources. Inventory and Evaluation of the people involved in the project. Critical success factors.	2
Lec6	Project control plans and creation of a structure analysis of the work. The communication plan. The control plan design changes. Quality management plan and a plan of supply. Plan completion. The approach to the structure analysis of the work. Determination of levels of supervision	2
Lec7	Development of the project plan details. The selection of the project team:. Estimating the cost and duration of the project. Gantt Chart. Network diagrams CPM and PERT. Determining the project schedule. The risk of the project. Alternative plans	2
Lec8	Software description eg: MS Project. Closing the project: project evaluation and report on the implementation of the project, conclusions and experience.	2

Lec9	Basic concepts related to the development of technology: knowledge, research, scientific discoveries, inventions, innovations, patents, utility and industrial models, deployment and transfer	2
Lec10	Methods to stimulate creativity and innovation. Methods and techniques for generating, collecting, analyzing and selecting solutions. Measures of Technical Strategy: the intensity of R & D, sales of new products. Lean Manufacturing	2
Lec11	Software R & D and innovation strategy company a) the evolution of the management of R & D, b) development of products and processes, c) the dynamics of the market and the R & D, d) R & D programs .	2
Lec12	Technology transfer and innovation: - Types of licenses, - Forms of transfer and acquisition of technology, - Marketing of innovative technologies and attitudes, - Managing the implementation and improvement, - Technology transfer as a matter of national	2
Lec13	Institutional and organizational forms of innovation: - Innovation Relay Centres IRC FEMIRC, - Incubators, - Technology transfer centers, - etc	2
Lec14	The standards and specifications. Product certification and accreditation of institutions. Requirements of the EU Directive	2
Lec15	Final exam	2
		Total hours: 30
	Form of classes – Project	Number of hours
Proj1	Scope of the project, assessment. Create teams. Generating project topics	2
Proj2	Presentation topics by leaders (or other members of the group), including project initiation phase	2
Proj3	Discussion about the merits of the presented projects, corrections and additions	2
Proj4	The planning phase of the project. Main and sub-objectives, the impact of the project	2
Proj5	The organizational structure of the project- presentation and discussion. Project control plan.	2
Proj6	Cost analysis, end of project	2
Proj7	Presentation in front of students and teacher. Assessment of the project	3
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
N3. self study - preparation for project class
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	Colloquium
P = F1+F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Presentation and of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Mingus N.: Zarządzanie projektami, Wyd. Helion, Gliwice 2002 ,
Kerzner H.: Advanced Project Management, edycja polska, Wyd. ONE PRESS, 2005,
Lowe P.: Zarządzanie technologią. Możliwości poznawcze i szanse. Wyd. Śląsk, Katowice 1999,
Dworczyk M. Szlasa R.: Zarządzanie innowacjami. Wpływ innowacji na wzrost konkurencyjności przedsiębiorstw. Oficyna Wyd. Politechniki Warszawskiej, 2001.

SECONDARY LITERATURE
Wilczewski S.: MS Project 2003 Zarządzanie projektami,
Burton c., Michael N.: Zarządzanie projektami, Wyd. ASTRUN, Wrocław 1999,
Kasprzak W. Pelc K.: Wyzwania technologiczne- prognozy i strategie. Wyd. Profesjonalnej Szkoły Biznesu, Kraków 1999,
Mazurkiewicz A.: Modelowanie transformacji wiedzy do praktyki w budowie i eksploatacji maszyn. Wyd. Inst. Technologii Eksploatacji, Radom- Poznań 1999.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Project and innovation management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_PM_W11	C1, C2	lec1-lec13	N1, N2
PEK_U01, PEK_U02	K2ZIP_U01	C2, C3	Pr1-Pr6	N2, N3
PEK_K01, PEK_K02	K2ZIP_PM_K01, K2ZIP_PM_K02	C4, C5	Pr1-Pr7	N3, N4

SUBJECT SUPERVISOR

dr inż. Krzysztof Kędzia tel.: 71 320-26-67 email: krzysztof.kedzia@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English: **MASTER THESIS**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Production Management**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ZPM041450**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				90	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge in the management and production engineering field documented positive marks in all subjects including Production Management specialization courses
2. Can obtain information from the literature. Analyze and apply on the basis of observations and analyzes.

SUBJECT OBJECTIVES

C1. Individual preparation of Master thesis, including the examination of the problem in order to work, the selection of relevant methods and techniques, and propose a method for its solution and defend the results of the work
C2. Strengthen the skills to obtain information from various sources and to prepare and present an oral and multimedia presentation on the issues resolved in the framework of the thesis
C3. Acquisition of and preserve individual work ability, identify goals and objectives for implementation, selection of appropriate methods and techniques, and document their work

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can diagnose analyze problems related to the management of manufacturing companies, selected the appropriate methods and techniques, and plan their implementation
PEK_U02 - Can obtain information from literature, databases and other carefully selected sources, also in foreign languages is also able to integrate the information, make their interpretation and critical evaluation
PEK_U03 - Can analyze and evaluate existing manufacturing processes and manufacturing systems and propose ways of reorganization and optimization due to certain criteria optimization

III. Relating to social competences:

PEK_K01 - Have sense of responsibility for their own work and in implementing their tasks
PEK_K02 - Can define priorities appropriately to fulfill the given task
PEK_K03 - Understands the need for learning throughout life, and knows the possibility of continuous training and professional skills development, personal and social

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. case study
N2. tutorials
N3. self study - self studies and preparation for examination

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

1. Majchrzak J.:Metodyka pisania prac magisterskich i dyplomowych, Wydawnictwo Uniwersytetu Ekonomicznego, Poznań 2009 2. Brycz B.: Przewodnik dla piszących prace magisterskie w zakresie zarządzania, Polskie Wydawnictwo Ekonomiczne, Warszawa 2011

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MASTER THESIS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2ZIP_U12, K2ZIP_U14			
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K04			

SUBJECT SUPERVISOR

dr hab. inż. Anna Burduk tel.: 37-10 email: anna.burduk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Optymalizacja rozmieszczenia stanowisk roboczych**
Name in English: **Optimizing deployment of workstations**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042004**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of logistics and enterprise management
2. The ability to build simulation models for discrete manufacturing systems

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about how to deploy workstations
C2. Learn how to build a layout plans
C3. Learn how to optimize the planned deployments of workstations

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge of the mathematical arrangement of workplaces
PEK_W02 - He has knowledge of the technological conditions of the deployment of workstations
PEK_W03 - He knows the basic techniques of simulation deployment of workstations

II. Relating to skills:
PEK_U01 - He can choose a variety of simulation tools to verify the layout plans
PEK_U02 - Can apply various simulation tools to verify and optimize the layout plans
PEK_U03 - The student is able to properly make the deployment plan workstations

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Methodological approaches in the design of the deployment of production cells	2
Lec2	Mathematical methods for designing the deployment of workstations	4
Lec3	Technical considerations taken into account when deploying workstations	2
Lec4	Verification of simulation methods proposed solutions	2
Lec5	Tools for modeling and simulation of manufacturing systems	2
Lec6	Discrete Simulation - Action	2
Lec7	Data collection for the project simulation	2
Lec8	Multi-criteria optimization	2
Lec9	Classification of forms of organization of production for manufacturing cells	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Determination of the coefficient io to match the number of facilities for the production plan and the available production technology	1
Proj2	The selection of machinery from manufacturers' catalogs. Optimizing deployment of workstations by using a mathematical algorithm MST (Modified Spanning Tree Algorithm)	2
Proj3	Optimizing deployment of workstations by using a mathematical algorithm triangles Schmigalli	2
Proj4	Optimizing deployment of workstations by using a mathematical algorithm ROC (Rank Order Clustering)	2
Proj5	Develop deployment of workstations, taking into account technological conditions. A comparison of the above methods based on the calculated cost.	2
Proj6	Assessment of the project	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture
N3. problem exercises
N4. calculation exercises
N5. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = f1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Assessment of the project
P = f1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. PROJEKTOWANIE ROZMIESZCZENIA STANOWISK ROBOCZYCH / STANISLAW LIS, KRZYSZTOF SANTAREK Warszawa : PWN, 1980.
2. Podstawowa problematyka projektowania stanowisk pracy / Teresa Musioł, Jarosław Grzesiek ; Wyższa Szkoła Ekonomii i Administracji w Bytomiu. Bytom : Wyższa Szkoła Ekonomii i Administracji, 2008.

SECONDARY LITERATURE
PROJEKTOWANIE STANOWISK I PROCESOW PRACY / KAROL RYPULAK. LUBLIN : POLITECHNIKA, 1981.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Optimizing deployment of workstations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W02, K2ZIP_W03, K2ZIP_W07	C1	Lec1 - Lec9	N1, N2
PEK_U01, PEK_U02, PEK_U03	K2ZIP_U02, K2ZIP_U03, K2ZIP_U07	C2, C3	Pr1 - Pr6	N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Arkadiusz Kowalski tel.: 37-10 email: arkadiusz.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Symulacja procesów produkcyjnych**
Name in English: **The simulation of manufacturing processes**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042006**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of process planning

SUBJECT OBJECTIVES

C1. Introduction to with the problems design methods of simulation models of manufacturing systems
C2. The acquisition of practical skills-building simulation models and analyzing their results
C3. Understanding the issues of multi-criteria optimization of manufacturing systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Using the example simulation tool for manufacturing systems
PEK_U02 - Using a sample tool to optimize production systems
PEK_U03 - Building adequate, discrete simulation models for production systems

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of deliveries	2
Proj2	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of deliveries including hardening operations	1
Proj3	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of delivery including quality control operations	1
Proj4	Budowa symulacyjnego modelu deterministycznego systemu wytwórczego w celu wyznaczenia optymalnej częstotliwości dostaw przy różnorodnym planie produkcji	2
Proj5	Building deterministic simulation model of manufacturing system to determine the optimum frequency of operation of supply assembly including	2
Proj6	Building a deterministic simulation model of manufacturing system in order to determine the optimal frequency of supply, taking into account the various modes of transport and the cost of	2
Proj7	Performing a test	1
Proj8	Building non-deterministic simulation model of manufacturing system	2
Proj9	Building a simulation model of the manufacturing system niederministycznego uzwględnieniem breaks and the use of macros	2
Proj10	Building non-deterministic simulation model of manufacturing system using variables and attributes	2
Proj11	Perform non-deterministic multi-criteria optimization of manufacturing systems	2
Proj12	Perform a test	1
		Total hours: 20

TEACHING TOOLS USED

N1. problem exercises
N2. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Defence project
P = f1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Zdanowicz R.: Modelowanie i symulacja procesów wytwarzania, WPŚ, Gliwice 2002.
2. Chlebus E.: Techniki komputerowe CAx w inżynierii produkcji. PWT, Warszawa 2000

SECONDARY LITERATURE
1. A. Muhlemann, „Zarządzanie Produkcją. Usługi", PWN 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The simulation of manufacturing processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2ZIP_U02, K2ZIP_U03	C1, C2, C3	Pr1 - Pr12	N1, N2

SUBJECT SUPERVISOR

dr inż. Arkadiusz Kowalski tel.: 37-10 email: arkadiusz.kowalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Logistyka zaopatrzenia**
Name in English: **Logistics of supply**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management,logistic processes/systems performance design and testing
2. has a basic knowledge in the field of operations research
3. has a basic knowledge in the field of spreadsheet using, e.g. Excel

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the area of supply systems performance.
C2. Acquiring the ability to define the main problems and tasks that occur in the area of supply logistics.
C3. Acquiring the ability to define the processes of cooperation and integration in the supply area.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has an extended knowledge of the research, design, and logistic systems management, especially in the phase of supply performance
PEK_W02 - Can identify the processes of cooperation and integration in the supply chain's downstream (relations in: supply system - system of production) to reference the desired economic results of the enterprise

II. Relating to skills:
PEK_U01 - Can obtain information from literature, databases and other sources
PEK_U02 - Able to integrate the information, make their interpretation and critical evaluation, and to draw conclusions and formulate and fully justify opinions
PEK_U03 - Able to prepare a research study

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Logistics of supply - the main definitions, issues, goals and tasks.	2
Lec2	Organization of procurement processes. Information flows in the area of supply.	2
Lec3	Cooperation with the supplier and the process of supplier evaluation and selection.	2
Lec4	trategies in the area of supply in the enterprise.	2
Lec5	Assessment of the level of supply system performance. Minimizing risk in the area of supply.	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Introduction to the course. Simulation of the supply processes organization performance.	2
Proj2	The consolidation / deconsolidation of purchases (own study/case study).	2
Proj3	Problem of supplier analysis and selection process (own study/case study).	2
Proj4	Supply inventory management in an enterprise (own study/case study).	2
Proj5	Suppy system effectiveness, supply risk (own task/case study). Completion of the course.	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for project class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_W02	A positive evaluation of the written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_U03	a positive evaluation of the tasks performed during the project classes
F2	PEK_W01, PEK_W02, PEK_U02	A positive evaluation of the written test
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Bozarth C., Handfield R.B., „Wprowadzenie do zarządzania operacjami i łańcuchem dostaw", Wyd.Helion S.A., Gliwice, 2007
2. Brzeziński M., „Logistyka w przedsiębiorstwie", Wyd. Bellona, Warszawa,2006
3. Chaberek M., „Rachunek decyzyjny w logistyce zaopatrzenia", Wyd. GWSH, Gdańsk, 2002
4. Kowalska K., ,,Logistyka Zaopatrzenia", Wydawnictwo Akademii Ekonomicznej, Katowice, 2005
5. Krawczyk S., ,,Zarządzanie procesami logistycznymi", Wyd. PWE,Warszawa, 2001
6. Sarjusz - Wolski Z., ,,Strategia Zarządzania Zaopatrzeniem", Wyd. PLACET, Warszawa, 1998
7. Twaróg J., ,,Mierniki i Wskaźniki Logistyczne", Wyd. Instytut Logistyki i Magazynowania, Poznań, 2003
8. Vollmuth H.J., ,,Controlling. Instrumenty od A do Z", Wyd. Placet, Warszawa, 1995
9. Witkowski J., ,,Zarządzanie Łańcuchem Dostaw", Wyd. PWE, Warszawa, 2010
10. Wojciechowski T., ,,Zarządzanie sprzedażą i zakupem materiałów", Wyd. PWE, Warszawa, 1999
11.Lysons, Kenneth. "Zakupy zaopatrzeniowe", PWE, Warszawa 2004.

SECONDARY LITERATURE

1. Blanchard B. S.: Logistics Engineering and Management (5th Ed). Upper Saddle River: Pearson Prentice Hall, 2004
2. Dąbrowska - Mitek M., ,,Ocena dostawców w przedsiębiorstwach handlowych", - ProblemyJakości, Luty 2007
3. Mańkowski C., ,,Kontroling i logistyka zaopatrzenia jako czynniki synergiczne gospodarowania", Wyd. UW, Gdańsk, 2005
4. Pfohl H.Ch., ,,Systemy Logistyczne", Wyd. Instytut Logistyki i Magazynowania, Poznań, 2001
5. Pfohl H.Ch., ,,Zarządzanie logistyką", Wyd. Instytut Logistyki i Magazynowania, Poznań, 1998
6. Wolniak R., Skotnicka - Zasadzień B., ,,Wybrane metody badania satysfakcji klienta i oceny dostawców w organizacjach", Wydawnictwo Politechniki Śląskiej, Gliwice, 2008
Czasopisma:
1. The International Journal of Logistics Management
2. International Journal of Physical Distribution & Logistics Management
3. Journal of Business Logistics
4. Gospodarka Materiałowa i Logistyka
5. Logistyka

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logistics of supply
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_LS_W01	C1	Lec1, Lec2, Lec3, Lec4, Lec5	N1, N2, N5
PEK_U01, PEK_U02, PEK_U03	K2ZIP_LS_U02	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5,Pr1, Pr2, Pr3, Pr4,Pr5	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie procesów logistycznych**
Name in English: **Logistics processes modelling**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042103**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of management, designing and testing logistics processes and systems
2. Knowledge of spreadsheet, e.g.Excel

SUBJECT OBJECTIVES

C1. Developing the knowledge of the areas of logistics systems modeling methodology
C2. Mastering the skills of planning and designing of logistics systems with special emphasis on tools to support the work of logistics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has an extended knowledge of modeling random logistics processes

II. Relating to skills:
PEK_U01 - Student can develop a model of logistic processes using methods of system analysis and computer tools

III. Relating to social competences:
PEK_K01 - Student knows how to interact and work in a group
PEK_K02 - The student able to prioritize appropriately for specific tasks and problems
PEK_K03 - Student can think and act in a creative way

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to modeling. Objectives, possibilities and limitations of modeling. The stages of construction and testing of models.	2
Lec2	Graphical representation methods of logistics processes.	2
Lec3	Critical path with limited resources, the analysis of parallel activities MAC.	2
Lec4	Dynamic programming.	2
Lec5	Introduction to simulation modeling. Generating pseudo-random numbers.	2
Lec6	Designing and development of the algorithm and simulation program.	2
Lec7	Examples of simulation models for simulating the dynamics of transport - storage processes.	2
Lec8	Collection and analysis of input data for modeling.	2
Lec9	The verification and evaluation of the results of simulations. The model testing.	2
Lec10	Final test.	2
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Discussion of laboratory plan, requirements, terms and conditions of the course completion. Presentation of selected case studies based on newspaper articles.	2
Proj2	The choice of the number of transport-storage equipment - based on a graphical model of the process.	2
Proj3	Selecting the option of process of purchase and storage - using dynamic programming methods.	2
Proj4	Construction of the decision tree for a given example.	2
Proj5	The simulation of the (S, Q) inventory control model in random conditions.	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for project class
N5. self-study and preparation for the test completion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	evaluation of the written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_K01, PEK_K02, PEK_K03	evaluation of the tasks carried out in the classroom project
F2	PEK_W01, PEK_U01	evaluation of the written test
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Bozarth C., Handfield R.B., Wprowadzenie do zarządzania operacjami i łańcuchem dostaw., Helion, 2007
2. Ciesielski M.(red.), Instrumenty zarządzania łańcuchami dostaw, PWE,2009
3. Chaberek M, Modelowanie procesów i systemów logistycznych.Cz. 1., Wyd. U.G. Gdansk, 2001
4. Krawczyk S., Metody ilosciowe w logistyce (przedsiebiorstwa) t.II, Wydawnictwo C. H. Beck, 2001
5. Pfohl H-Ch., Systemy logistyczne: podstawy organizacji i zarzadzania,Wyd. IliM, Poznan , 2001

SECONDARY LITERATURE
1. Blanchard B. S., Logistics Engineering and Management (5th Ed). Upper Saddle River: Pearson Prentice Hall, 2004
2. Grajewski P., Organizacja procesowa, PWE, 2007
3. Mokrzyszczak H., Logistyka: podstawy procesów logistycznych, WIG, Białystok, 1998
4. Wojciechowski A., Systemy logistyczne, WAT, 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logistics processes modelling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2ZIP_LS_W08	C1	Le.1, Le.2, Le.3, Le.4, Le. 5, Le.6, Le.7, Le.8, Le.9, Le.10	N1, N2, N5
PEK_U01	K2ZIP_LS_U10	C1, C2	Le.1, Le.2, Le.3, Le.4, Le. 5, Le.6, Le.7, Le.8, Le.9, Le.10, Pr1, Pr2, Pr3, Pr4, Pr5	N1, N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2ZIP_LS_K01, K2ZIP_LS_K02, K2ZIP_LS_K03	C2	Pr1, Pr2, Pr3, Pr4, Pr5	N4

SUBJECT SUPERVISOR

dr inż. Anna Jodejko-Pietruczuk tel.: 71 320-28-17 email: Anna.Jodejko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie systemów transportowo-magazynowych**
Name in English: **Systems design of transportation and warehousing**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge of management and design processes and logistics systems
2. Has knowledge in the field of logistics

SUBJECT OBJECTIVES

C1. Understanding the issues concerning planownaia and projektownaia transport and storage systems
C2. Acquiring the ability to plan and organize material and information flows in warehouses.
C3. Acquiring the ability to optimize logistics systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the concept of transport system - storage, explain its construction, calling its individual components.
PEK_W02 - Can describe for selected cases to propose their own solutions for transport and storage, discussing their choices, to indicate the most appropriate having regard to the strategy
PEK_W03 - Able to calculate the sample solution and transport system magayznowego at the operational level.

II. Relating to skills:
PEK_U01 - He can decide and choose the elements of the design process and transport and storage.
PEK_U02 - Has the ability to develop a system of documentation for transportation and storage.
PEK_U03 - Has the ability to estimate the cost of transport and storage system and exploit them.

III. Relating to social competences:
PEK_K01 - Works independently and interact as a team
PEK_K02 - Respects the findings doing the job.
PEK_K03 - Discussed, maintaining openness to other sentence.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introductory lecture: - The content of the lecture. - Assessment and timing tests. - Basic and further reading. - Organization of the course.	1
Lec2	Identification of logistic processes in conveying and storage. -definition Warehouse. Identify the basic processes of transport and storage. Identify the functional-process storage areas. -definition Unit load. -Fronty Handling. -Work Cargo.	2
Lec3	Methods of presentation of flow record cargo logistics storage system. -Scenografia Organizatorska. -Synoptyczne Charts. -Wykresy Sankey. -Credit Material flow process.	1
Lec4	The allocation of the objects in the planning of cargo flows. Metoda Schimigalli. computer Metody Trucking - optimization of cargo flows Problem transport route planning. Podstawowe structural solutions. Przykłady computing	2

Lec5	Designing storage structure. Magazyny: high and low storage. Magazyn the "regime" temperature. Magazyn cross-dock. Magazyn bulk materials. Magazyn liquid materials.	1
Lec6	Selection of equipment for storage. Składowanie static without racking (short repetition). Składowanie static. Składowanie dynamic.	2
Lec7	Forklift trucks. Charakterystyka universal forklift. Charakterystyka specialized forklifts.	1
Lec8	Rack Charakterystyka stacking machines. Harmonogramowanie time stacker cranes. Optymalizacja stacker cranes work.	2
Lec9	Scheduling time of mobile devices in the transport logistics warehouse systems Harmonogramowanie time forklifts. Harmonogramowanie time stacker cranes.	1
Lec10	Conveyors in logistics warehouse systems. Rodzaje conveyors. Rozwiązania construction. Zasady selection of conveyors	2
Lec11	The selection means of the flow of information. Oznaczanie pallets in the warehouse. Oznaczanie loading units in stock. Wybór of information technology in logistics storage system. Dobór reading devices 1D, 2D and RFID. (stationary scanners, radio with docking station, camera) Dobór printing devices / programming: 1D, 2D and RFID.	1
Lec12	The choice of computer-aided systems work logistic storage system Systemy WMS, MRP, ERP. Szczegółowe WMS system performance. Bazy logistic data storage systems	2
Lec13	Logistics optimization methods of storage systems. Energy consumption of storage systems Metody expert. Sposoby assess and reduce the energy consumption of selected processes magayznowych	1
Lec14	test	1
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Discussion of the organization of classes and examination of project activities. Providing basic and supplementary literature. Development of unit load forming algorithm EURO subjects piece of various dimensions, weight, size and resistance to physical exposure.	1
Proj2	Project deposition distribution of palletised goods in the warehouse, taking into account the classification: areas, zones and places.	2
Proj3	Scheduling transport cycles of selection and evaluation of technical means used in the design magazine - for example a forklift.	2

Proj4	Scheduling transport cycles of selection and evaluation of technical means used in the design magazine - for example rack stacker crane.	1
Proj5	Project completion storage subsystem piece units on the main line and picking bays.	1
Proj6	Analysis and identification of logistics for the storage system adopted in the project storage solutions for process automation.	1
Proj7	Choice concept store, technologies and processes - with diversity dimensions of goods and the size of the line of orders (from single pieces to full pallets on the same SKU).	1
Proj8	Overview of completed projects, a summary of the project activities. Credits.	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. case study
N4. self study - preparation for project class
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test
F2	PEK_U01, PEK_U02, PEK_U03	test
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	evaluation of the computational part of the project

F2	PEK_K01, PEK_K02, PEK_K03	participation in discussions of problem, the report - in the form of presentation of the group their projetów, defense project
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Korzeń Z.: „Logistyczne systemy transportu bliskiego i magazynowania” T. I; Instytut Logistyki i Magazynowania, Poznań, 1998.
2.Korzeń Z.: „Logistyczne systemy transportu bliskiego i magazynowania” T. II, Instytut Logistyki i Magazynowania, Poznań, 1999.
3.Krawczyk S. (red.): „Logistyka. Teoria i Praktyka”, T.1, DIFIN, Warszawa, 2012.
4.Krawczyk S. (red.): „Logistyka. Teoria i Praktyka”, T.2, DIFIN, Warszawa, 2012.
5.Zając P.: „Systemy magazynowe”, Oficyna Wydawnicza NDiO, Wrocław, 2010.
6.Fijałkowski J.: „Transport wewnętrzny w systemach logistycznych”; Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001.

Czasopisma specjalistyczne:
1.Logistyka
2.Nowoczesny Magazyn
3.Eurologistics

SECONDARY LITERATURE

[1]. Gudehus T.: „Logistik” T. I; Grundlagen, Verfahren und Strategien; Springer, Hamburg; 1999;
[2]. Gudehus T.: „Logistik” T. I; Netzwerke, Systeme und Lieferketteen; Springer, Hamburg; 1999;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Systems design of transportation and warehousing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2ZIP_LS_U03, K2ZIP_LS_U04, K2ZIP_LS_U05, K2ZIP_LS_U06, K2ZIP_LS_U07, K2ZIP_LS_U09, K2ZIP_LS_U11, K2ZIP_LS_U12	C1, C2, C3	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7	N1, N2, N3,
PEK_U02, PEK_U03	K2ZIP_LS_U05, K2ZIP_LS_U07, K2ZIP_LS_U11	C2, C3,	Pr1, Pr2, Pr3, Pr4, Pr5, Pr5, Pr6, Pr7, Pr8	N4, N5

SUBJECT SUPERVISOR

dr inż. Paweł Zając tel.: 71 320-27-19 email: pawel.zajac@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie eksploatacją systemów logistycznych**
Name in English: **Management of logistic systems exploitation performance**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042105**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Examination			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management,logistic processes/systems performance design and testing
2. has a basic knowledge in the field of operations research
3. has a basic knowledge in the field of spreadsheet using, e.g. Excel

SUBJECT OBJECTIVES

C1. The acquisition of the basic knowledge in the areas of theory of exploitation and reliability of technical systems and their supporting systems.
C2. Acquiring the ability to use the main maintenance methods.
C3. Acquiring the ability to solve the real-life problems, which may affect the effective performance of logistics processes being performed in exploitation systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a basic knowledge in the field of exploitation, dependability and durability of technical systems (including logistic systems).
PEK_W02 - Aquiring the knowledge necessary to plan exploitation processes for a specified type of systems and ability to their design and modification.
PEK_W03 - Aquiring the knowledge in the field of renewal processes management.

II. Relating to skills:
PEK_U01 - Aquiring the ability to use the statistical tools (e.g. RAMS tools) for the assessment of technical systems in the field of their exploitation processes performance
PEK_U02 - Aquiring the ability to define the main reliability characteristics of technical objects, including logistic objects

III. Relating to social competences:
PEK_K01 - Can think and act in a creative and enterprising way
PEK_K02 - Able to prioritize appropriately for specific tasks and problems

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the technical object exploitation problems - the main terms and definitions. Technical system logistics.	2
Lec2	System of operation and maintenance and its models. Maintenance and operation conditions	2
Lec3	Equipment exploitation process. Exploitation state and the set of exploitation states of equipment. Exploitation time and distribution of equipment exploitation time. Indicators, assessment characteristics.	2
Lec4	Maintenance and operation process of machines and equipment used in logistics.	2
Lec5	Tools and methods of technical object failure analysis. Cause and types of failures.	2
Lec6	Elements of theory of reliability - the main terms, object failure, reliability structure, dependability assessment.	2
Lec7	Technical system renewal. Scope and objectives of technical systems maintenance.	2
Lec8	Maintenance strategies and operating and maintenance prevention. Potential for the operation and maintenance.	2
Lec9	Elements of operational activities in the logistics of technical systems supporting. Maintenance of spare parts inventory.	2
Lec10	Costs in maintenance and operation process performance. Management tools used in maintenance and operation process performance.	2
		Total hours: 20

Form of classes – Project	Number of hours

Proj1	Introduction to the project course. Reliability analysis of technical objects (e.g. evaluation of reliability/unreliability functions, failure intensity)	2
Proj2	Analysis of technical objects reliability structure, definition of optimal warranty period for the specified assumptions	2
Proj3	Maintenance strategy selection with taking into account economic and reliability criteria	2
Proj4	Repairman problem	2
Proj5	Technical object reliability analysis with the use of FTA method	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for project class
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	A positive evaluation of the written test, possible additional oral exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02	A positive evaluation of the written test
F2	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	a positive evaluation of the tasks performed during the project classes
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Borkowski S., Selejdak J., Salamon Sz., Efektywność eksploatacji maszyn i urządzeń, Sekcja Wydawnicza Wydziału Zarządzania Politechniki Częstochowskiej, Częstochowa, 2006
2. Dwiliński L., Wstęp do teorii eksploatacji obiektu technicznego, Wyd. Politechniki Warszawskiej, Warszawa 1991
3. Figurski J., Podstawy eksploatacji obiektów technicznych, Międzyresortowe Centrum Naukowe Eksploatacji Majątku Trwałego, Radom 1990
4. Gołąbek A., Eksploatacja i niezawodność maszyn, Politechnika Wrocławska skrypt, Wrocław 1988
5. Kazimierczak J., Eksploatacja systemów technicznych. Wyd. Politechniki Śląskiej, Gliwice 2000
6. Legutko S., Eksploatacja maszyn. Wyd. PP, Poznań 2007
7. Niziński S., Elementy eksploatacji obiektów technicznych. Wyd. Uniwersytetu Warmińsko-Mazurskiego, Olsztyn 2000
8. Nowakowski T. Niezawodność systemów logistycznych. Wyd. PWr. Wrocław 2011
9. Oziemski S., Efektywność eksploatacji maszyn. BPE, Radom ITE, Warszawa 1999
10. Ważyńska-Fiok K., Niezawodność systemów technicznych , PWN, Warszawa 1990

SECONDARY LITERATURE
1. Bobrowski D., Modele i metody matematyczne teorii niezawodności w przykładach i zadaniach, WNT, Warszawa 1985
2. Chaberek M.: Makro i mikroekonomiczne aspekty wsparcia logistycznego. Wydawnictwo Uniw. Gdańskiego, Gdańsk 2002
3. Grabski F., Jaźwiński J., Funkcje o losowych argumentach w zagadnieniach niezawodności, bezpieczeństwa i logistyki, WKŁ, Warszawa 2009
4. Nowakowski T., Metodyka prognozowania niezawodności obiektów mechanicznych, Wyd. PWr., Wrocław 1999
5. Szopa T., Niezawodność i bezpieczeństwo, Wyd. Politechniki Warszawskiej, Warszawa 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management of logistic systems exploitation performance
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_LS_W06	C1, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10	N1, N2, N5
PEK_U01, PEK_U02	K2ZIP_LS_U08	C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Pr1, Pr2, Pr3, Pr4, Pr5	N2, N3, N4
PEK_K01, PEK_K02	K2ZIP_LS_K02, K2ZIP_LS_K03	C3	Pr1, Pr2, Pr3, Pr4, Pr5	N4

SUBJECT SUPERVISOR
dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Logistyka łańcuchów dostaw**
Name in English: **Supply chain logistics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				10
Number of hours of total student workload (CNPS)	60				30
Form of crediting	Examination				Crediting with grade
Group of courses					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management, logistic processes/systems performance design and testing
2. has a basic knowledge in the area of logistic processes performance modelling

SUBJECT OBJECTIVES

C1. Understanding the issues of making strategic and operational decisions in the development of logistics and operation of external supply chains operating in a competitive market environment.
C2. Acquiring the ability to plan and organize the flow of material and information in procurement and distribution processes.
C3. Acquiring the ability to obtain information from the literature, databases, and other sources in order to prepare research paper on a selected topic.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has an extended knowledge of the research, design, and supply chain management, especially in the phases of the supply and distribution
PEK_W02 - Can identify cooperation and integration processes in supply chains for reference desired economic results of the enterprise

II. Relating to skills:
PEK_U01 - Can use a properly chosen information and communication technologies in order to analyze and assess the supply chains performance level
PEK_U02 - Has the ability to use methods of improving the efficiency of the logistics system

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group
PEK_K02 - Can think and act in a creative way

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Supply chains. Supply chain management.	2
Lec2	Logistic cooperation in the area of supply chain management.	2
Lec3		2
Lec4	Supply chain management. The basic methods, tools and management concepts.	2
Lec5	The assessment of the integrated logistics chain performance level.	2
Lec6	Integrated logistics chain performance design.	2
Lec7	Network organization and wirtual organization.	2
Lec8	The costs and their reduction in supply chain management.	2
Lec9	Directions and concepts of improvement of supply chain management.	2
Lec10	Development trends of supply chains.	2
		Total hours: 20

Form of classes – Seminar		Number of hours
Sem1	Discussion of basic concepts and premises development of logistics chains. Distribution of seminar topics for group preparation by students.	2
Sem2	The integration and coordination of activities in the supply chain. The cooperation in an integrated supply chain.	2
Sem3	Time management, customer relations management and quality management in supply chains	2
Sem4	Methods for assessing the level of an integrated supply chain performance.	2
Sem5	Logistics network design. Directions and concepts of improvement of supply chain management. Summary of semminar activities.	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. self study - preparation for seminar
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	written exam, with the possibility of additional oral answer
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01, PEK_K02	preparation of a study on a selected topic
F2	PEK_K01, PEK_K02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	preparation of seminar presentation on a selected topic
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Bozarth C.C., Handfield R.B., Wprowadzenie do zarządzania operacjami
i łańcuchem dostaw: kompletny podręcznik logistyk i zarządzania dostawami, Helion, Gliwice 2007
2. Christopher M., Logistyka i zarządzanie łańcuchem podaży. Jak obniżyć koszty
i poprawić jakość obsługi, Wydawnictwo Profesjonalnej Szkoły Biznesu, Kraków 1998.
3. Christopher M., Strategia zarządzania dystrybucją. Praktyka logistyki biznesu,
Agencja Wydawnicza "Placet", Warszawa 1996.
4. Coyle J.J., Bardi E.J., Langley Jr C.J., Zarządzanie logistyczne, PWE, Warszawa 2002.
5. Kisperska-Moroń D. (red.), Pomiar funkcjonowania łańcuchów dostaw, Wydawnictwo AE w Katowicach, Katowice 2006.
6. Logistyka on-line. Zarządzanie łańcuchem dostaw w dobie gospodarki elektronicznej, praca zbiorowa pod red. K. Rutkowskiego, PWE Warszawa 2002.
7. Rutkowski K. (red.), Logistyka dystrybucji. Specyfika, tendencje rozwojowe, dobre praktyki, Oficyna Wydawnicza SGH, Warszawa 2005.
8. Rutkowski K. (red.), Zintegrowany łańcuch dostaw. Doświadczenia globalne
i polskie, praca zbiorowa pod red. K. Rutkowskiego, SGH, Warszawa 1999.
9. Witkowski J., Zarządzanie łańcuchem dostaw. Koncepcje, procedury, doświadczenia, PWE Warszawa 2003.

SECONDARY LITERATURE
1. Chopra S., Meindl P., Supply Chain Management. Strategy, Planning and Operation, Prentice-Hall, Inc., Upper Saddle River, New Jersey 2001.
2. Handfield R.B., Nichols E.L. Jr, Introduction to Supply Chain Management, Prentice Hall, New Jersey 1999.
3. Knolmayer G., Mertens P., Zeier A., Supply Chain Management Based on SAP Systems. Order Management in Manufacturing Companies, Springer-Verlag Berlin Heidelberg 2002.
4. Simchi-Levi D., Kaminsky P., Simchi-Levi E., Designing and Managing
the Supply Chain. Concepts, Strategies and Case Studies, The McGraw-Hill Companies, Inc. 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Supply chain logistics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_LS_W01	C1, C2	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7, Wy8, Wy9, Wy10, Se1, Se2, Se3, Se4, Se5	N1, N2, N5
PEK_U01, PEK_U02	K2ZIP_LS_U01, K2ZIP_LS_U02	C1, C2, C3	Se1, Se2, Se3, Se4, Se5	N1, N2, N3, N4
PEK_K01, PEK_K02	K2ZIP_K03, K2ZIP_LS_K01	C3	Se1, Se2, Se3, Se4, Se5	N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Logistyka łańcuchów dostaw**
Name in English: **Supply chain logistics**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042107**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				10
Number of hours of total student workload (CNPS)	60				30
Form of crediting	Examination				Crediting with grade
Group of courses					
Number of ECTS points	2				1
including number of ECTS points for practical (P) classes					1
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management, logistic processes/systems performance design and testing
2. has a basic knowledge in the area of logistics processes performance modelling
3. has a basic knowledge in the area of qualitative approach to llogistic systems performance

SUBJECT OBJECTIVES

C1. Understanding the issues of making strategic and operational decisions in the development of logistics and operation of external supply chains operating in a competitive market environment.
C2. Learn how to identify the process of cooperation and integration in the supply chain for reference desired economic results of the enterprise performance, taking into account the pro-quality purposes
C3. Acquiring the ability to obtain information from the literature, databases, and other sources in order to prepare research paper on a selected topic

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has an extended knowledge of the research, design, and supply chain management, especially in the phases of the supply and distribution
PEK_W02 - Can identify cooperation and integration processes in supply chains for reference desired economic results of the enterprise

II. Relating to skills:
PEK_U01 - Can use a properly chosen information and communication technologies in order to analyze and assess the supply chains performance level
PEK_U02 - Has the ability to use methods of improving the efficiency of the logistics system

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group
PEK_K02 - Can think and act in a creative way
PEK_K03 - He understands the need for continuous improvement of the organization, supply chain and logistics processes

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Supply chains. Supply chain management.	2
Lec2	Cooperation and integration in supply chains.	2
Lec3	Supply chain management. The basic methods, tools and management concepts. The quality of logistics processes	2
Lec4	The role of information and information systems in supply chain management.	2
Lec5	Design of integrated logistics chains. Quality management in supply chains	2
Lec6	Evaluation of the effectiveness of an integrated logistics chain performance.	2
Lec7	Network organization and wirtual organization.	2
Lec8	The costs and their reduction in supply chain management.	2
Lec9	Directions and concepts of improvement of supply chain management. Logistics Japanese companies cases	2
Lec10	Development trends of supply chains.	2
		Total hours: 20
Form of classes – Seminar		Number of hours
Sem1	Discussion of basic concepts and premises development of logistics chains. Distribution of seminar topics for group preparation by students.	2
Sem2	The integration and coordination of activities in the supply chain. The cooperation in an integrated supply chain.	2
Sem3	The basic methods, tools and concepts of supply chain management	2
Sem4	Evaluation of the effectiveness of an integrated logistics chain performance.	2
Sem5	Logistics network design. Directions and concepts of improvement of supply chain management. Summary of semminar activities.	2

	Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3. tutorials
N4. preparation of the paper and presentation on a selected topic of the seminar
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02	written exam, with the possibility of additional oral answer
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01, PEK_K02, PEK_K03	preparation of a study on a selected topic
F2	PEK_W01, PEK_W02, PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02	preparation of seminar presentation on a selected topic
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Bozarth C.C., Handfield R.B., Wprowadzenie do zarządzania operacjami
i łańcuchem dostaw: kompletny podręcznik logistyk i zarządzania dostawami, Helion, Gliwice 2007
2. Christopher M., Logistyka i zarządzanie łańcuchem podaży. Jak obniżyć koszty
i poprawić jakość obsługi, Wydawnictwo Profesjonalnej Szkoły Biznesu, Kraków 1998.
3. Christopher M., Strategia zarządzania dystrybucją. Praktyka logistyki biznesu,
Agencja Wydawnicza "Placet", Warszawa 1996.
4. Coyle J.J., Bardi E.J., Langley Jr C.J., Zarządzanie logistyczne, PWE, Warszawa 2002.
5. Kisperska-Moroń D. (red.), Pomiar funkcjonowania łańcuchów dostaw, Wydawnictwo AE w Katowicach, Katowice 2006.
6. Logistyka on-line. Zarządzanie łańcuchem dostaw w dobie gospodarki elektronicznej, praca zbiorowa pod red. K. Rutkowskiego, PWE Warszawa 2002.
7. Rutkowski K. (red.), Logistyka dystrybucji. Specyfika, tendencje rozwojowe, dobre praktyki, Oficyna Wydawnicza SGH, Warszawa 2005.
8. Zarządzanie jakością w logistyce :metody i narzędzia wspomagające : przykłady, zadania /Beata Detyna. Wałbrzych: Wydawnictwo Państwowej Wyższej Szkoły Zawodowej im. Angelusa Silesiusa, 2011.
9. Witkowski J., Zarządzanie łańcuchem dostaw. Koncepcje, procedury, doświadczenia, PWE Warszawa 2003
10.Zarys zarządzania jakością :ujęcie marketingowo-logistyczne /Wacław Szymanowski, Bożena Pawłowska, Anna Strychalska-Rudzewicz. Poznań : Ars boni et aequi, 2010.
11.Zarządzanie jakością :praca zbiorowa /pod red. Jana Bagińskiego. Warszawa : Oficyna Wydawnicza Politechniki Warszawskiej, 2004.
12. Jakość w procesie logistycznym /Elżbieta Karaś. Opole : Oficyna Wydawnicza Politechniki Opolskiej. Akademicki Inkubator Przedsiębiorczości, 2009.
13. Zarządzanie jakością w logistyce /Jerzy Łunarski. Rzeszów : Oficyna Wydawnicza Politechniki Rzeszowskiej, 2009.

SECONDARY LITERATURE
1. Chopra S., Meindl P., Supply Chain Management. Strategy, Planning and Operation, Prentice-Hall, Inc., Upper Saddle River, New Jersey 2001.
2. Handfield R.B., Nichols E.L. Jr, Introduction to Supply Chain Management, Prentice Hall, New Jersey 1999.
3. Knolmayer G., Mertens P., Zeier A., Supply Chain Management Based on SAP Systems. Order Management in Manufacturing Companies, Springer-Verlag Berlin Heidelberg 2002.
4. Simchi-Levi D., Kaminsky P., Simchi-Levi E., Designing and Managing
the Supply Chain. Concepts, Strategies and Case Studies, The McGraw-Hill Companies, Inc. 2000.
5. Zarządzanie jakością.Cz. 2,Ochrona jakości wyrobów w łańcuchu logistycznym /pod red. Wiesława Ładońskiego, Katarzyny Szołtysek ; aut. oprac. Małgorzata Kosiorowska [et al.]. Wrocław : Wydawnictwo Akademii Ekonomicznej im. Oskara Langego, 2007.
6.Logistyka firm japońskich /Jarosław Witkowski. Wrocław : Wydawnictwo Akademii Ekonomicznej im. Oskara Langego, 1999.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Supply chain logistics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02	K2ZIP_ZJ_W10	C1, C2	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7, Wy8, Wy9, Wy10, Se1, Se2, Se3, Se4, Se5	N1, N2, N5
PEK_U01, PEK_U02	K2ZIP_ZJ_U15, K2ZIP_ZJ_U16	C1, C2, C3	Se1, Se2, Se3, Se4, Se5	N1, N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K03, K2ZIP_ZJ_K08	C3	Se1, Se2, Se3, Se4, Se5	N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Logistyka dystrybucji**
Name in English: **Logistics of distribution**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Practical Logistics**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042113**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge in the areas of management, logistic processes/systems performance design and testing
2. have basic knowledge in the field of operations research
3. have a basic knowledge of spreadsheet use such as Excel

SUBJECT OBJECTIVES

C1. The acquisition of knowledge in the area of systems performance and distribution.
C2. Acquiring the ability to define the main problems and tasks that occur in the area of distribution logistics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has an extended knowledge of the research, design, and supply chain management, especially in the phase of distribution
PEK_W02 - Can identify the processes of cooperation and integration in the supply chain's downstream (relations in: system of production - distribution channel participants - client) to reference the desired economic results of the enterprise

II. Relating to skills:
PEK_U01 - Can obtain information from literature, databases and other sources
PEK_U02 - Able to integrate the information, make their interpretation and critical evaluation, and to draw conclusions and formulate and fully justify opinions
PEK_U03 - Able to prepare a research study

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group
PEK_K02 - Able to prioritize appropriately for specific tasks and problems

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course. The terms of distribution logistics and distribution system. The essence of logistics distribution. Basic tasks and capabilities in the field of distribution logistics.	2
Lec2	Distribution logistics in the system approach. Distribution strategies. The relationship between the distribution logistics and marketing.	2
Lec3	Planning the distribution network. Distribution channels (direct, indirect). Variants of the organization of distribution processes.	2
Lec4	Demand forecasting. Logistics customer service. Measuring the level of customer service - an indicator of the reliability of supply OTIF (on time, in-full, error free). Cycle of customer orders and the associated information flows.	2
Lec5	Effects and costs in the logistics of distribution (logistics costs, distribution costs). level of supply service. The effectiveness of the distribution system, methodology, criteria and evaluation tools. Tools of modern distribution.	2
		Total hours: 10

Form of classes – Project		Number of hours
Proj1	Introduction to the course. Simulation of the "beer game".	2
Proj2	Managing the flow of finished goods from producer to final consumer - the choice of distribution channels (own task / case study)	2
Proj3	Location of warehouses - justification for process selection (own task/case study)	2
Proj4	Determination of service regions - intuitive rules and quantitative methods (own task/case study)	2
Proj5	Distribution system effectiveness (own task/case study). Completion of the course.	2

	Total hours: 10

TEACHING TOOLS USED
N1. multimedia presentation N2. problem discussion N3. tutorials N4. self study - preparation for project class N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_W02	A positive evaluation of the written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	a positive evaluation of the tasks performed during the project classes
F2	PEK_W01, PEK_W02, PEK_U02, PEK_U03	A positive evaluation of the written test
P = (1/2)F1+(1/2)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Barcik R.: Logistyka dystrybucji. Wydawnictwo ATH, Bielsko-Biała 2005
2. Bozarth C., Handfield R.B.: Wprowadzenie do zarządzania operacjami i łańcuchem dostaw. Wyd. Helion, Gliwice 2007
3. Christopher M.L: Strategia zarządzania dystrybucją. Agencja Wydawnicza Placet, Warszawa 1999
4. J.Coyle, E. Bardi: The Management of Business Logistics. West Publishing Company, 1980
5. Czubała A: Dystrybucja produktów. PWE, 1996
6. Handbook of Logistics & Distribution Management. Pod red. J. Gattorna. Gower, 1994
7. D. Kempny, Logistyczna obsługa klienta, PWE, Warszawa 2001.
8. Krawczyk S.: Metody ilościowe w logistyce (przedsiębiorstwa) t.II, Wydawnictwo C. H. Beck, Warszawa 2001
9. Krawczyk S.: Zarządzanie procesami logistycznymi. PWE, Warszawa 2001
10. Rushton, J. Oxley: Handbook of Logistics and Distribution Management. Kogan Page, 1995
11. Sarjusz-Wolski Z.: Sterowanie zapasami w przedsiębiorstwie. Wyd. PWE, Warszawa 2000
12. Sarjusz-Wolski Z.: Strategia zarządzania zaopatrzeniem: Praktyka logistyki biznesu. Wyd. "Placet", Warszawa 1998
13. Stern L.W., El-Ansary A.I., Coughlan A.T.: Kanały marketingowe. Wydawnictwo Naukowe PWN, Warszawa 2002.

SECONDARY LITERATURE
1. Blanchard B. S.: Logistics Engineering and Management (5th Ed). Upper Saddle River: Pearson Prentice Hall, 2004
2. M. Christopher: The Customer Service Planner. Butterworth-Heinemann, 1992
3. Grajewski P.: Organizacja procesowa. PWE, Warszawa 2007
4. McKinnon A: Physical Distribution Systems. Routledge, 1989
5. Mokrzyszczak H.: Logistyka: podstawy procesów logistycznych. WIG, Białystok 1998
•Czasopisma:
1. The International Journal of Logistics Management
2. International Journal of Physical Distribution & Logistics Management
3. Journal of Business Logistics
4. Gospodarka Materiałowa i Logistyka
5. Logistyka

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logistics of distribution
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2ZIP_LS_W01	C1	Lec1, Lec2, Lec3, Lec4, Lec5	N1, N2, N5
PEK_U01, PEK_U02, PEK_U03	K2ZIP_U02	C1, C2	Lec1, Lec2, Lec3, Lec4, Lec5, Pr1, Pr2, Pr3, Pr4, Pr5,	N1, N2, N3, N4
PEK_K01, PEK_K02	K2ZIP_LS_K01, K2ZIP_LS_K02	C2	Pr1, Pr2, Pr3, Pr4, Pr5	N4

SUBJECT SUPERVISOR

dr inż. Sylwia Werbińska-Wojciechowska tel.: 71 320-34-27 email: Sylwia.Werbinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody i techniki eksperymentu**
Name in English: **Methods and techniques of experiments**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of statistics, mathematical analysis and linear algebra

SUBJECT OBJECTIVES

C1. Explain the purpose of carrying out experiments
C2. Explain the methods and techniques to carry out the experiment
C3. Explain the types and purposes of tools to carry out the experiment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the purpose and effect of the proposed experiment
PEK_W02 - Able to propose and define a plan of the experiment
PEK_W03 - Knows the concept and objectives of the experiment

II. Relating to skills:
PEK_U01 - Can collect data for the experiment
PEK_U02 - Can process the data of the experiment
PEK_U03 - Able to design an experiment

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, concept experiment	2
Lec2	The differences between the method and technique	2
Lec3	Basic experiment	2
Lec4	Measurement	2
Lec5	Statistical, Optimization and Quality Tools	2
Lec6	Factorial / multifactorial experiment	2
Lec7	DoE	2
Lec8	Methods for optimization of technological processes	2
Lec9	Case study	2
Lec10	Summary, examination	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Introduction, health and safety regulations, Discussion of proposed projects	2
Proj2	Choice otf the experiment	2
Proj3	Data processing	2
Proj4	Verification and Optimization	2
Proj5	Summary, projects checking, Examination	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture
N3. case study
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project / test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Ewaryst Rafajłowicz "Optimization of the experiment with applications in monitoring the quality of production" Publishing Wroclaw University of Technology
Mieczyslaw Korzyński "Methodology of the experiment" WNT

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods and techniques of experiments
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W08	C1, C2, C3	Lec1-Lec10	N1, N2, N3
PEK_U01, PEK_U02, PEK_U03	K2ZIP_OP_U11	C1, C2, C3	Proj1-Proj5	N4

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody i techniki eksperymentu**
Name in English: **Methods and techniques of experiments**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042202**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of statistics, mathematical analysis and linear algebra

SUBJECT OBJECTIVES

C1. Explain the purpose of carrying out experiments
C2. Explain the methods and techniques to carry out the experiment
C3. Explain the types and purposes of tools to carry out the experiment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the purpose and effect of the proposed experiment
PEK_W02 - Able to propose and define a plan of the experiment
PEK_W03 - Knows the concept and objectives of the experiment

II. Relating to skills:
PEK_U01 - Can collect data for the experiment
PEK_U02 - Can process the data of the experiment
PEK_U03 - Able to design an experiment

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, concept experiment	2
Lec2	The differences between the method and technique	2
Lec3	Basic experiment	2
Lec4	Measurement	2
Lec5	Statistical, Optimization and Quality Tools	2
Lec6	Factorial / multifactorial experiment	2
Lec7	DoE	2
Lec8	Methods for optimization of technological processes	2
Lec9	Case study	2
Lec10	Summary, examination	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Introduction, health and safety regulations, Discussion of proposed projects	2
Proj2	Choice otf the experiment	2
Proj3	Data processing	2
Proj4	Verification and Optimization	2
Proj5	Summary, projects checking, Examination	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. informative lecture
N3. case study
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U02	project / test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Ewaryst Rafajłowicz "Optimization of the experiment with applications in monitoring the quality of production" Publishing Wroclaw University of Technology
Mieczyslaw Korzyński "Methodology of the experiment" WNT

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods and techniques of experiments
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_ZJ_W08	C1, C2, C3	Lec1-Lec10	N1, N2
PEK_U01, PEK_U02, PEK_U02	K2ZIP_ZJ_U13	C1, C2, C3	Proj1-Proj5	N3, N4

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody kształtowania wybranych cech produktów**
Name in English: **Methods for forming of the selected products features**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042203**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of manufacturing technologies, machining methods, the basic properties of the materials
2. Student has basic skills in the selection of materials and manufacturing processes
3. Student has abilities of analyzing and synthesis of information

SUBJECT OBJECTIVES

C1. Acquiring knowledge about phenomena affecting the using wear of products. Learning about the surface engineering methods shaping functional, technological and operational properties of products.
C2. Acquisition of skills of understanding the links between the characteristics of the material and geometric properties of the surface layers and consumables products. Acquisition of skills for choosing surface engineering methods for forming selected features of the products
C3. The acquisition and consolidation of social skills include: team working abilities, responsible, accountable use of engineering knowledge

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Enumerates and briefly characterises the basic phenomena that affect the using wear of products. Explains the basic terms of surface engineering.
PEK_W02 - Characterises basic properties of surface layers and explains their effect on the usable characteristics of the products.
PEK_W03 - Explains the implementation mechanisms of surface treatment processes. Enumerates and characterises the basic groups of the processes forming of usable characteristics of the surface layers.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course topics. Rules of the course.	2
Lec2	Preview of the external factors (work conditions) influences on the products.	2
Lec3	Introduction to the surface engineering methods. Features of the products formed by surface engineering methods.	2
Lec4	Manufacturing processes for modifying of the properties superficial layers of the Fe and non-ferrous alloys.	2
Lec5	Laser processing methods of the superficial layers, CVD & PVD coating processes.	2
Lec6	Chemical and electro – chemical coating methods.	2
Lec7	Thermal spray coating processes.	2
Lec8	Surface engineering methods in the new product development.	2
Lec9	Economical issues of the implementation surface engineering methods. Surface engineering methods in manufacturing: case study.	2
Lec10	Final test.	2
		Total hours: 20

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
N3. tutorials
N4. case study
N5. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	colloquium
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
T.Burakowski, T.Wierzchoń: Inżynieria powierzchni metali, WNT 1995
L.A. Dobrzański: Materiały inżynierskie i projektowanie materiałowe. Podstawy nauki o materiałach i metaloznawstwo, WNT, 2006
A.Kimpel: Napawanie i natryskiwanie cieplne. Technologie, WNT, Warszawa, 2000
M.Blicharski, Inżynieria powierzchni, WNT 2009

SECONDARY LITERATURE
F.W.Bach, K.Mohwld, A.Laarmann, T.Wenz: Modern Surface Technology, Willey, 2006
L.A. Dobrzański: Podstawy kształtowania struktury i własności materiałów metalowych, Wydawnictwo Politechniki Śląskiej, 2007
P.Kula Inżynieria warstwy wierzchniej, Wyd. Pol. Łódz. 2000
L.A. Dobrzański: Kształtowanie struktury oraz własności materiałów inżynierskich i biomedycznych
E.Kannatey-Asibu: Principles of laser material processing, Willey, 2009
R.B. Heinmann: Plasma spray coating, Willey 2008
M. Cartier: Handbook of surface treatment and coatings, Professional Engineering Publishing 2003
Surface engineering for corrosion and wear resistance, Materials Park, OH : ASM International: Institute of Materials, 2001.
A guide to surface engineering terminology London : Institute of Materials in association with the IFHT, 1995.
Inżynieria Powierzchni, Instytut Mechaniki Precyzyjnej, Warszawa 1996-
Surface and Coatings Technology, Elsevier, 2000-
Surface Engineering, Maney Publishing, 2003 -

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods for forming of the selected products features
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W10, K2ZIP_W04	C1, C2, C3	Lec1 - Lec9	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR
dr inż. Mariusz Frankiewicz tel.: 713202083 email: mariusz.frankiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń**
Name in English: **Operation maintenance of machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042205**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure and operation of machine components and assemblies, as well as principles of their selecting and designing.
2. Well-grounded knowledge about basic manufacturing techniques.
3. Well-grounded knowledge about construction and machine control rules.

SUBJECT OBJECTIVES

C1. Getting acquainted with principles of the Total Productive Maintenance (TPM) concept.
C2. Getting acquainted with basic TPM tools and methods allowing to increase efficiency of machine stock maintenance. Getting acquainted with principles of determining indices describing progress at implementing the TPM methodology.
C3. Getting acquainted with possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of scope and principles of selecting a maintenance strategy of manufacturing machines and devices.
PEK_W02 - Knowledge of basic TPM tools and indices.
PEK_W03 - Knowledge of basic features and possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

II. Relating to skills:
PEK_U01 - Ability to use the acquired knowledge to formulate tasks aimed at improving a maintenance system of manufacturing machines and devices.
PEK_U02 - Ability to determine indices determining progress at implementing the TPM methodology.
PEK_U03 - Ability to use modern IT tools for computer-aided managing the maintenance processes.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to gain knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic problems related to maintenance of manufacturing machines and devices: service requirements, cause and effect analysis of machine failure, role and significance (benefits) of maintenance organization and planning.	2
Lec2	History and development of the TPM concept (characteristics of basic TMP pillars).	2
Lec3	Characteristics of basic TPM tools – exemplary applications.	4
Lec4	Maintenance strategies – idea of systematic and system-related attitude to maintenance problems.	2
Lec5	Measures and indices determining efficiency of implementing the TPM methodology.	2
Lec6	CMMS-class computer systems supporting maintenance management (requirements and functions of selected systems, system selection criteria).	2
Lec7	Implementing the TPM methodology to industrial practice (role and organization of Maintenance Department). Exemplary solutions of implementing a TPM program.	4
Lec8	Crediting the course.	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of selected modules of the CMMS.	2
Proj2	Spare Parts Management. The part card. Warehouse Management. The structure of the module and generated documents.	2

Proj3	Fulfilling orders for maintenance. Generating demand for materials and spare parts.	2
Proj4	Management of personell that fulfills maintenance activities. Reports from the workload. Planning service orders. The stages and the necessary data. Building schedules for maintenance execution.	2
Proj5	Reporting of orders completion. Cost analysis: planned and actual costs. Reports for maintenance indicators. Credit.	2
		Total hours: 10

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides.
N2. Own work – preparation for crediting the lecture.
N3. Own work – preparation for the project.
N4. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Credit colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Summary of the work – presentation of the project and its assessment
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Basics of operation of machines and devices. Editorial Office WSiP. Warsaw, 2007 (in Polish).
Słowiński B.: Engineering of machine operation. Editorial Office of Koszalin University of Technology. Koszalin, 2011 (in Polish).
Kaźmierczak J.: Operation of technical systems. Editorial Office of Silesian University of Technology. Gliwice, 2000 (in Polish).

SECONDARY LITERATURE

Hebda M.: Elements of the theory of technical systems operation. Editorial Office MCNEMT. Radom, 1990 (in Polish).
Żółtowski B.: Basics of machine diagnostics. Editorial Office ATR Bydgoszcz, 1996(in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_ZJ_W09	C1 - C3	Wy1 - Wy7	N1, N2, N4
PEK_U01, PEK_U02, PEK_U03	K2ZIP_ZJ_U14	C1 - C3	Pr1 - Pr5	N3, N4
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K02	C1 - C3	Wy1 - Wy7 Pr1 - Pr5	N1 - N4

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń**
Name in English: **Operation maintenance of machines and devices**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042205**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure and operation of machine components and assemblies, as well as principles of their selecting and designing.
2. Well-grounded knowledge about basic manufacturing techniques.
3. Well-grounded knowledge about construction and machine control rules.

SUBJECT OBJECTIVES

C1. Getting acquainted with principles of the Total Productive Maintenance (TPM) concept.
C2. Getting acquainted with basic TPM tools and methods allowing to increase efficiency of machine stock maintenance. Getting acquainted with principles of determining indices describing progress at implementing the TPM methodology.
C3. Getting acquainted with possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of scope and principles of selecting a maintenance strategy of manufacturing machines and devices.
PEK_W02 - Knowledge of basic TPM tools and indices.
PEK_W03 - Knowledge of basic features and possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

II. Relating to skills:
PEK_U01 - Ability to use the acquired knowledge to formulate tasks aimed at improving a maintenance system of manufacturing machines and devices.
PEK_U02 - Ability to determine indices determining progress at implementing the TPM methodology.
PEK_U03 - Ability to use modern IT tools for computer-aided managing the maintenance processes.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to gain knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic problems related to maintenance of manufacturing machines and devices: service requirements, cause and effect analysis of machine failure, role and significance (benefits) of maintenance organization and planning.	2
Lec2	History and development of the TPM concept (characteristics of basic TMP pillars).	2
Lec3	Characteristics of basic TPM tools – exemplary applications.	4
Lec4	Maintenance strategies – idea of systematic and system-related attitude to maintenance problems.	2
Lec5	Measures and indices determining efficiency of implementing the TPM methodology.	2
Lec6	CMMS-class computer systems supporting maintenance management (requirements and functions of selected systems, system selection criteria).	2
Lec7	Implementing the TPM methodology to industrial practice (role and organization of Maintenance Department). Exemplary solutions of implementing a TPM program.	4
Lec8	Crediting the course.	2
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of selected modules of the CMMS.	2
Proj2	Spare Parts Management. The part card. Warehouse Management. The structure of the module and generated documents.	2

Proj3	Fulfilling orders for maintenance. Generating demand for materials and spare parts.	2
Proj4	Management of personell that fulfills maintenance activities. Reports from the workload. Planning service orders. The stages and the necessary data. Building schedules for maintenance execution.	2
Proj5	Reporting of orders completion. Cost analysis: planned and actual costs. Reports for maintenance indicators. Credit.	2
		Total hours: 10

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides.
N2. Own work – preparation for crediting the lecture.
N3. Own work – preparation for the project.
N4. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Credit colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Summary of the work – presentation of the project and its assessmen
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Basics of operation of machines and devices. Editorial Office WSiP. Warsaw, 2007 (in Polish).
Słowiński B.: Engineering of machine operation. Editorial Office of Koszalin University of Technology. Koszalin, 2011 (in Polish).
Kaźmierczak J.: Operation of technical systems. Editorial Office of Silesian University of Technology. Gliwice, 2000 (in Polish).

SECONDARY LITERATURE

Hebda M.: Elements of the theory of technical systems operation. Editorial Office MCNEMT. Radom, 1990 (in Polish).
Żółtowski B.: Basics of machine diagnostics. Editorial Office ATR Bydgoszcz, 1996(in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W09	C1 - C3	Wy1 - Wy7	N1, N2, N4
PEK_U01, PEK_U02, PEK_U03	K2ZIP_OP_U12	C1 - C3	Pr1 - Pr5	N3, N4
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K02	C1 - C3	Wy1 - Wy7 Pr1 - Pr5	N1 - N4

SUBJECT SUPERVISOR

dr inż. Stanislaw Iżykowski tel.: 20-64 email: stanislaw.izykowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria odwrotna**
Name in English: **Reverse Engineering**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042207**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of machine design and manufacturing technologies.
2. Student has a knowledge of Computer Aided Design (CAD).
3. Student has a knowledge of geometrical metrology.

SUBJECT OBJECTIVES

C1. Providing students with knowledge of application areas of reverse engineering.
C2. Providing students with knowledge of methods of 3D scanning and reconstructions of 3D CAD models of physical objects.
C3. Producing in students the ability of applying data from 3D scanning in the evaluation of the geometrical accuracy of products and in designing new products.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define reverse engineering and describe its basic applications.
PEK_W02 - Student is able to characterize the process of reconstruction of the CAD model.
PEK_W03 - Student is able to choose a 3D scanning method depending on the type of the object to be digitized.

II. Relating to skills:
PEK_U01 - Students can evaluate the data from 3D scanning and perform basic editing operations.
PEK_U02 - Student can perform the process of comparison a model from 3D scanning with CAD data.
PEK_U03 - Student is able to use data from a 3D scanner to design a new product.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Application areas of reverse engineering.	2
Lec2	Contact methods of data acquisition. Technical and medical tomography. Optical methods of data acquisition.	2
Lec3	Basic methods of reconstructing of CAD models in reverse engineering.	2
Lec4	Advanced reconstruction methods. Assessment of accuracy in reverse engineering.	2
Lec5	Non-commercial 3D scanning systems. Case study. Final test	2
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Presentation of 3D scanners. 3D scanning of a selected object.	2
Lab2	Learning the program interface. Import and basic editing operations on3D scanning data.	2
Lab3	Orientation of models in space, best-fit function. Comparison of two models, and generating deviation maps.	2
Lab4	NURBS surface modeling - the basics.	2
Lab5	Integrating the CAD model with data from 3D scanning.	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. case study
N4. self study - preparation for laboratory class
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final test
P =		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	laboratory report
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Raja V., Fernandes K.J.: Reverse engineering: an industrial perspective, Springer, 2008, 242s.
[2] Chlebus E.: Techniki komputerowe CAx w inżynierii produkcji, WNT, Warszawa 2000

SECONDARY LITERATURE

[1] Chlebus E., Dybała E.: Reverse engineering in technical and medical applications, Virtual design and automation. 1st VIDA International Conference, Poznań, 3-4 June 2004, 2005, Str. 213-218
[2] Oczoś K., Cena I.: Rapid Inspection - metody pomiarowo-kontrolne adekwatne do rapid-technologii, Mechanik, 2008, No. 3, Str. 165-176
[3] Gawlik J., Karbowski K.: Metody odwzorowywania powierzchni w systemach inżynierii odwrotnej, Zeszyty Naukowe Politechniki Poznańskiej, Budowa Maszyn i Zarządzanie Produkcją, 2004, No. 1, Str. 187-194

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Reverse Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_W04	C1, C2	Lec1-Lec5	N1-N3, N5
PEK_U01, PEK_U02, PEK_U03	K2ZIP_OP_U03	C3	Lab1-Lab5	N4-N5

SUBJECT SUPERVISOR

dr inż. Tomasz Będza tel.: 71 320 42 08 email: tomasz.bedza@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mapowanie procesów w przedsiębiorstwie**
Name in English: **Enterprise processes mapping**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042208**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Enhanced knowledge of the enterprise operation in terms of management and production.
2. The ability to obtain information from documents, databases and other sources, the ability to interpret information.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about analyzis methods and business processes documentation.
C2. Acquisition of skills how to use the basic tools used in the process mapping in production enterprises.
C3. Acquisition of skills how to recognize the resources and information flow of across the enterprise.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge about analyzis methods and business processes documentation.
PEK_W02 - Student can characterize resources and information flow in enterprise. He can describe their flow.
PEK_W03 - Student can choose different tools and methods to analyze enterprise processes.

II. Relating to skills:
PEK_U01 - Student has the ability to use different tools of process mapping.
PEK_U02 - Student can use computer aided tools in process modeling.
PEK_U03 - Student can analyze models within compliance with the notation, accuracy and efficiency of modeling techniques.

III. Relating to social competences:
PEK_K01 - Student thinks and acts in a creative and enterprising way.
PEK_K02 - Student is able to interact and work in a group, taking the different roles as a different functions in manufacturing and service enterprises.
PEK_K03 - Student understands the need for continuous improvement of the organization, its processes and products.

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Presentation of basics of business processes mapping. Presentation of process definitions and basic information about process modeling. Presentation of basic ways of describing processess in enterprise.	2
Lec2	Presentaion of process modeling using BPMN, discussion of basic concepts. Presentaion of the scope of BPMN and its notation elements. Presentation how to create maps in BPMN. Presentation of the practical use of BPMN in enterprises.	2
Lec3	Presentaion of process modeling using Value Stream Mapping (VSM), discussion of basic concepts. Presentaion of the scope of VSM and its notation elements. Presentation how to create current state maps in VSM. Waste identification. Presentaion how to create future state maps in VSM. Presentation of the practical use of VSM in enterprises.	2
Lec4	Presentaion of process modeling using functional maps, discussion of basic concepts. Presentaion of the scope of functional maps and its notation elements. Presentation how to create functional maps. Presentation of the practical use of functional maps in enterprises.	2
Lec5	Test.	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Business processes mapping with BPMN notation	2
Proj2	Production processes mapping with VSM notation. Current and future state maps.	4
Proj3	Enterprise processes mapping with functional maps notation.	2

Proj4	Presentaion of project results in chosen company - project defensis.	2
		Total hours: 10

TEACHING TOOLS USED
N1. case study N2. self study - preparation for project class N3. project presentation N4. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	project presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Drejewicz S., „Zrozumieć BPMN modelowanie procesów biznesowych", Helion, Gliwice 2012
2. Rother M., Shook J. „Naucz się widzieć. Eliminacja marnotrawstwa poprzez Mapowanie Strumienia Wartości", WCTT Wrocław 2003 r.,
3. Rummler A. P., Brache A. P., „Podnoszenie efektywności organizacji", PWE, Warszawa 2000 r.,

SECONDARY LITERATURE

1. Skrzypek E., Hofman M., "Zarządzanie procesami w przedsiębiorstwie : identyfikowanie, pomiar, usprawnianie", Wolters Kluwer Polska, Warszawa 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Enterprise processes mapping
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W02, K2ZIP_W02, K2ZIP_W07	C1, C2, C3	Lec1, LEc2, Lec3, LEc4	N4
PEK_U01, PEK_U02, PEK_U03,	K2ZIP_OP_U03, K2ZIP_OP_U04, K2ZIP_U09	C1, C2, C3	Proj 1 - Proj 4	N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K2ZIP_OP_K01	C1, C2, C3	Proj 1 - Proj 4	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Joanna Helman tel.: 43-84 email: joanna.helman@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Recykling materiałów**
Name in English: **Recycling of materials**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042209**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of the properties of materials.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the life cycle of the product and the disposal methods of the product. Acquisition of basic knowledge about recycling methods.
C2. Understanding the need for waste management policy. Understanding the design and manufacture of the product in the context of environmental impact.
C3. The acquisition and consolidation of social skills like responsibility, honesty, fairness in the procedure observance force in academia.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Defining and understanding the issues of product life cycle.
PEK_W02 - Identifying recycling methods.
PEK_W03 - The presentation and characterization of waste management methods.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. The life cycle of the product. The problem of waste. European scale of the problem. The situation in Poland. Legislative considerations.	2
Lec2	General information about recycling. Balance of environmental burdens. Ekobilansu importance in the economy. Methods of waste disposal and waste products.	2
Lec3	Technical possibilities of identification and separation of materials.	2
Lec4	The problems of recycling polymeric materials. Classification of methods for recycling of polymeric materials. Methods for managing selected polymers as an example of recycling.	2
Lec5	Feedstock recycling for selected examples.	2
Lec6	Thermal recycling for selected examples.	2
Lec7	Recycling and characterization of materials in various industries. Recycling of packaging materials. Recycling of materials in the automotive industry. Recycling of waste electrical.	2
Lec8	Degradable materials as an alternative to recycling.	2
Lec9	Designing. Trends and prospects of recycling materials.	2
Lec10	Summary knowledge of recycling.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. tutorials
N4. problem lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	written and oral test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Plastics recycling in Europe, Marek Kozłowski 2006

SECONDARY LITERATURE
Recycling of plastics, Andrzej Błędzki; Recovery and recycling of plastics, Jacek Kijeński, Andrzej Błędzki, Regina Jeziórska; Selected aspects of car recycling, Jerzy Osiński, Piotr Żach

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Recycling of materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W01	C1,C2	Lec1-Lec10	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Joanna Pach tel.: 71-320-42-78 email: joanna.pach@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Planowanie przedsięwzięć produkcyjnych**
Name in English: **Planning of production projects**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042211**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the functioning of the production company.
2. Ability to solve problems of linear mathematics.
3. Computer skills (Windows) and spreadsheet handling skills.

SUBJECT OBJECTIVES

C1. Introduction to the issue of feasibility study of the project.
C2. Introduction to the methodology of solving decision problems using linear programming with use of the solver tool.
C3. Getting to know the problems of calculating the number of kanban cards in the production system based on "pull" approach.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of the aspects of the project feasibility study.
PEK_W02 - Knowledge of mathematical methods for solving decision problems.
PEK_W03 - Knowledge of the methodology for calculating the number of kanban cards in the system of production based on "pull" approach.

II. Relating to skills:
PEK_U01 - Ability to solve decision-making problems by using linear programming with use of the solver tool.
PEK_U02 - The ability to calculate the number of kanban cards in the production system based on "pull" approach.

III. Relating to social competences:
PEK_K01 - Awareness of the role of the engineer in the planning of production and demand for accountability and involvement in one of the most important links of the production process in the company.
PEK_K02 - Awareness of the legal aspects and impacts of engineering.
PEK_K03 - Ability to think and act in a creative and enterprising way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Feasibility study - basics and development procedure	2
Lec2	Feasibility study - example	2
Lec3	Linear programming - basics	4
Lec4	Linear programming - examples with application of slover tool	4
Lec5	The production system based on "pull" approach and control of the flow of material using kanban cards - basics and an example from industry	2
Lec6	The methodology for calculating the number of kanban cards in the system of production based on "pull" approach	4
Lec7	The methodology for calculating the number of kanban cards in the system of production based on "pull" approach - discussion of an example project	2
		Total hours: 20

Form of classes – Project		Number of hours
Proj1	Solving the decision-making production problem no 1	2
Proj2	Solving the decision-making production problem no 2	2
Proj3	Solving the decision-making transport problem	2
Proj4	Solving the decision-making "make or buy" problem no 1	2
Proj5	Solving the decision-making mix problem	2
		Total hours: 10

TEACHING TOOLS USED
N1. case study N2. problem exercises N3. self study - preparation for project class N4. project presentation N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02 PEK_K01, PEK_K02, PEK_K03	Asessment of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Planning of production projects
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W03, K2ZIP_W07	C1	Lect1 - Lect7	N1, N5
PEK_U01, PEK_U02	K2ZIP_OP_U04	C2, C3	Pr1 - Pr5	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K02	C2, C3	Pr1 - Pr5	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Studium przypadku**
Name in English: **Case study**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042212**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of scientific projects - research and industrial
2. Can prepare an offer in the form of research project proposal and research offer for the company

SUBJECT OBJECTIVES

C1. Explain the principle of scientific - research projects
C2. Explain methods of scheduling and budgeting in research projects
C3. Explain the principles of substantive implementation of research projects

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the purpose and effect of the proposed research topics
PEK_W02 - Can suggest the mode of applying for project
PEK_W03 - Can distinguish between basic research and applied research and development

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Able to work in a team

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction	2
Lec2	Types of projects	2
Lec3	Application Form	2
Lec4	Basic Research Projects, Research and Development Projects, Industrial Research Projects	2
Lec5	Funding agencies	2
Lec6	Structural Funds	2
Lec7	Preparation of the draft	2
Lec8	Research project (one executor, consortium) - a case study	2
Lec9	Research project - Structural Funds - a case study	2
Lec10	Examination	2
		Total hours: 20

TEACHING TOOLS USED

N1. case study
N2. tutorials
N3. multimedia presentation
N4. project presentation
N5. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Project Management - Case Studies - Harold Kerzner, HELION publishing house

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Case study
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2ZIP_OP_W11, K2ZIP_W01	C1, C2, C3	Lec1-Lec15	N1, N2, N3, N4, N5
PEK_K01	K2ZIP_K03, K2ZIP_K05	C1, C2, C3	Lec1-Lec15	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przedsiębiorczość innowacyjna**
Name in English: **Innovative Entrepreneurship**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Manufacturing Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042213**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge about the free market economy.
2. Ability to discuss and present one's opinion in terms of dealing with problems connected with the business idea implementation and assessment of its innovation potential.
3. Bachelor's degree and basic knowledge of finance (profit, loss, income, expenses, liquidity, balance, taxes).

SUBJECT OBJECTIVES

C1. To familiarize students with the phenomenon of entrepreneurship from the business process point of view that relates entrepreneurship and business.
C2. To familiarize students with the modern understanding of innovative enterpreneurship, innovation sources and innovation organization management (integrating technological, market and organizational changes).
C3. To familiarize students with the factors of success or factors of failure of the company, their measures and sources, finding funding sources innovative enterprises.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of ways and methods of project management, organization, planning and evaluation work in the project, knows methods of technical and economical evaluation of the innovative enterprises.
PEK_W02 - Knows methods and ways of how to assess opportunities and risks in the scope of innovative activity.
PEK_W03 - Knows how to assess and verify entrepreneurial activities that are a way of entrepreneurship realization.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Can search for information and analyze them critically.
PEK_K02 - Acting in a creative and enterprising way can work in a team in the scope of the selection of strategies and tools to
solve problems related to entrepreneurship and innovation.
PEK_K03 - Can objectively evaluate the arguments, rationally explain and justify their point of view in terms of entrepreneurial activities with the use of knowledge in the fields of innovation and business practices.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. The core of innovative entrepreneurship. The development of entrepreneurship in Poland and abroad.	2
Lec2	The entrepreneur. His qualities and competences. Personality approach. Characteristics of entrepreneurs; entrepreneurial orientation, sources of the entrepreneurial motivation. Methods of the entrepreneurship completion.	2
Lec3	Sources of ideas. The process of finding ideas.	2
Lec4	The innovativeness imperative. Definitions of key terms of innovations management. Innovation as the basis for entrepreneurial activities.	2
Lec5	The innovation process. Types of innovation and risk. Sources of innovation.	2
Lec6	Determinants and ways of development of innovative enterprises. Development methods, critical moments, learning, the social networks.	2
Lec7	Building the founding team. Market segmentation, targeting, user profiles, defining the model user. Launching business and management of small enterprise.	2
Lec8	External conditions for entrepreneurship: legal forms, commitment to the environment. Financing projects.	2
Lec9	Building a business plan.	2
Lec10	Test.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B. Glinka, S. Gudkova, Przedsiębiorczość, Wolters Kluwer Business, Warszawa 2011
[2] J. Targalski, A. Francik, Przedsiębiorczość i zarządzanie firmą. Teoria i praktyka, C.H. Beck, Warszawa 2009
[3] R. Knosala, A. Boratyńska-Sala, M. Jurczyk-Bunkowska, A. Moczała, Zarządzanie innowacjami, PWE, Warszawa 2014
[4] P. Drucker, Innowacja i przedsiębiorczość. Praktyka i zasady, PWE, Warszawa 1992
[5] J. Bessant, J. Tidd, Innovation and Enterpreneurship, Wiley and Sons, Chichester 2013
[6] W. Bygrave, A. Zacharakis, Entrepreneurship, 2nd Edition, Wiley, 2011
[7] P. Westhead, M. Wright, G. McElwee, Entrepreneurship. Perspectives and Cases, Pearson, Essex 2011

SECONDARY LITERATURE
[1] Harvard Business Review Polska, Sztuka przedsiębiorczości, ICAN Institute, Warszawa 2013
[2] B. Aulet, Przedsiębiorczość zdyscyplinowana. Od startupu do sukcesu w 24 krokach, Helion, Gliwice 2014
[3] J. Cieślik, Przedsiębiorczość dla ambitnych. Jak uruchomić własny biznes, Wydawnictwa Akademickie i Profesjonalne, Warszawa 2010
[4] M. E. Gordon, Uniwersytet Donalda Trumpa. Przedsiębiorczość, Helion, Gliwice 2009
[5] M. Jankowski, Mała wielka firma. 7 sekretów efektywnego zarządzania, Studio EMKA, Warszawa 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Innovative Entrepreneurship
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02, PEK_W03	K2ZIP_W01	C1, C2, C3	Wy1 - Wy10	N1, N2, N3
PEK_K01, PEK_K02, PEK_k03	K2ZIP_K03, K2ZIP_K05	C1, C2, C3	Wy1 - Wy10	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przedsiębiorczość innowacyjna**
Name in English: **Innovative Entrepreneurship**
Main field of study (if applicable): **Management and Manufacturing Engineering**
Specialization (if applicable): **Quality Management**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **ZPM042213**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	30				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	1				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General knowledge about the free market economy.
2. Ability to discuss and present one's opinion in terms of dealing with problems connected with the business idea implementation and assessment of its innovation potential.
3. Bachelor's degree and basic knowledge of finance (profit, loss, income, expenses, liquidity, balance, taxes).

SUBJECT OBJECTIVES

C1. To familiarize students with the phenomenon of entrepreneurship from the business process point of view that relates entrepreneurship and business.
C2. To familiarize students with the modern understanding of innovative enterpreneurship, innovation sources and innovation organization management (integrating technological, market and organizational changes).
C3. To familiarize students with the factors of success or factors of failure of the company, their measures and sources, finding funding sources innovative enterprises.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of ways and methods of project management, organization, planning and evaluation work in the project, knows methods of technical and economical evaluation of the innovative enterprises.
PEK_W02 - Knows methods and ways of how to assess opportunities and risks in the scope of innovative activity.
PEK_W03 - Knows how to assess and verify entrepreneurial activities that are a way of entrepreneurship realization.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Can search for information and analyze them critically.
PEK_K02 - Acting in a creative and enterprising way can work in a team in the scope of the selection of strategies and tools to
solve problems related to entrepreneurship and innovation.
PEK_K03 - Can objectively evaluate the arguments, rationally explain and justify their point of view in terms of entrepreneurial activities with the use of knowledge in the fields of innovation and business practices.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. The core of innovative entrepreneurship. The development of entrepreneurship in Poland and abroad.	2
Lec2	The entrepreneur. His qualities and competences. Personality approach. Characteristics of entrepreneurs; entrepreneurial orientation, sources of the entrepreneurial motivation. Methods of the entrepreneurship completion.	2
Lec3	Sources of ideas. The process of finding ideas.	2
Lec4	The innovativeness imperative. Definitions of key terms of innovations management. Innovation as the basis for entrepreneurial activities.	2
Lec5	The innovation process. Types of innovation and risk. Sources of innovation.	2
Lec6	Determinants and ways of development of innovative enterprises. Development methods, critical moments, learning, the social networks.	2
Lec7	Building the founding team. Market segmentation, targeting, user profiles, defining the model user. Launching business and management of small enterprise.	2
Lec8	External conditions for entrepreneurship: legal forms, commitment to the environment. Financing projects.	2
Lec9	Building a business plan.	2
Lec10	Test.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B. Glinka, S. Gudkova, Przedsiębiorczość, Wolters Kluwer Business, Warszawa 2011
[2] J. Targalski, A. Francik, Przedsiębiorczość i zarządzanie firmą. Teoria i praktyka, C.H. Beck, Warszawa 2009
[3] R. Knosala, A. Boratyńska-Sala, M. Jurczyk-Bunkowska, A. Moczała, Zarządzanie innowacjami, PWE, Warszawa 2014
[4] P. Drucker, Innowacja i przedsiębiorczość. Praktyka i zasady, PWE, Warszawa 1992
[5] J. Bessant, J. Tidd, Innovation and Enterpreneurship, Wiley and Sons, Chichester 2013
[6] W. Bygrave, A. Zacharakis, Entrepreneurship, 2nd Edition, Wiley, 2011
[7] P. Westhead, M. Wright, G. McElwee, Entrepreneurship. Perspectives and Cases, Pearson, Essex 2011

SECONDARY LITERATURE
[1] Harvard Business Review Polska, Sztuka przedsiębiorczości, ICAN Institute, Warszawa 2013
[2] B. Aulet, Przedsiębiorczość zdyscyplinowana. Od startupu do sukcesu w 24 krokach, Helion, Gliwice 2014
[3] J. Cieślik, Przedsiębiorczość dla ambitnych. Jak uruchomić własny biznes, Wydawnictwa Akademickie i Profesjonalne, Warszawa 2010
[4] M. E. Gordon, Uniwersytet Donalda Trumpa. Przedsiębiorczość, Helion, Gliwice 2009
[5] M. Jankowski, Mała wielka firma. 7 sekretów efektywnego zarządzania, Studio EMKA, Warszawa 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Innovative Entrepreneurship
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Management and Manufacturing Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01, PEK_W02, PEK_W03	K2ZIP_W01	C1, C2, C3	Wy1 - Wy10	N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K2ZIP_K03, K2ZIP_K05	C1, C2, C3	Wy1 - Wy10	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl