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

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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

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRAKTYKA**
Name in English:
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)					
Number of hours of total student workload (CNPS)					
Form of crediting					
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

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_U02, K1AIR_U03, K1AIR_U20, K1AIR_U22			
PEK_K01	K1AIR_K02, K1AIR_K04			

SUBJECT SUPERVISOR

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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia**
Name in English: **Chemistry**
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: **ARM031002**
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 to the divisions of chemistry usable over related courses study (material science, metallurgy, polymers)
C2. Study of basic chemical knowledge allowing for understanding ofchemical rules and physicochemical properties of
technical materials particularly metals, alloys and polymers
C3. Acquired skills of learning through bringing together knowledge from different fields of science, with particular reference to chemistry, physics, material science, ecology.

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 optics and nanotechnology

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Student is capable of thinking and acting in creative manner.
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	The structure of matter, elements, compounds	4
Lec2	The periodic table, atomic structure, groups of atoms, allotropic forms, concentration.	4
Lec3	chemical bonds, molecules	4
Lec4	The structure of solids, liquids, and gase	4
Lec5	Basic crystallography, unit cell, symmetry elements, crystallographic defect	4
Lec6	The solid state band theory, metals and alloys,	2
Lec7	Selected topics of organic chemistry - fuels, polymers	4
Lec8	Selected topics in optics.	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_W03 PEK_K01 - PEK_K03	test
P = P		

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
Chemistry
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,C3	Lec1-Lec8	1,2,3,4
PEK_W02, PEK_W03	K1AIR_W02, K1AIR_W04	C1,C2,C3	Lec1-Lec8	1,2,3,4
PEK_K01, PEK_K02, PEK_K03	K1AIR_K04, K1AIR_K05, K1AIR_K06	C1,C2,C3	Lec1-Lec8	1,2,3,4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie informacyjne**
Name in English: **Information technology**
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: **ARM031003**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		2
Lec2		1
Lec3		2
Lec4		2
Lec5		8
Lec6		2
Lec7		2
Lec8		3
Lec9		2
Lec10		4
Lec11		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	
F2	PEK_W02	
F3	PEK_W03	
F4	PEK_K01	
P = F1+F2+F3+F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Information 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	K1AIR_W12	C1, C2		N1
PEK_W02	K1AIR_W12	C3		N1
PEK_W03	K1AIR_W12, K1AIR_W14	C4,C5		N1
PEK_K01	K1AIR_K10	C5		N1

SUBJECT SUPERVISOR

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy zarządzania**
Name in English: **Management Essentials**
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: **ARM031005**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		3
Lec7		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_W02, PEK_W03,	
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
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_W15	C1-C3		N1

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska - zapis konstrukcji**
Name in English: **Engineering Graphics: Engineering Drawing**
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: **ARM031006**
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				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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		6
Proj6		2
Proj7		6
Proj8		2
Proj9		4
Proj10		2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2.
N3.
N4.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (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	
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_K01	
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering Graphics: Engineering Drawing
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_W03	C1		N1
PEK_W02	K1AIR_W03	C2		N1, N3
PEK_U01	K1AIR_U01, K1AIR_U02, K1AIR_U03, K1AIR_U13	C2		N2
PEK_U02	K1AIR_U08, K1AIR_U13	C3		N4
PEK_K01	K1AIR_K05, K1AIR_K07, K1AIR_K11	C2		N2, N3, N4

SUBJECT SUPERVISOR

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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_W03; PEK_K01; PEK_K03	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_U02; PEK_K01, PEK_K03	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	C1, C2	Lec5 - Lec10, Lec12	N1, N2, N3
PEK_U01	K1AIR_U12, K1AIR_U25	C2	La2 - La4,	N3, N4, N5
PEK-U02	K1AIR_U03, K1AIR_U12	C2	La5 - La7	N3, N4, N5
PEK_U03	K1AIR_U02	C2	La1 - La3, La6	N4, N5
PEK_K01	K1AIR_K09	C3	Lec15, La - La3	N4, N5
PEK_K02	K1AIR_K03, K1AIR_K05	C3	La5 - La7	N4, N5
PEK_K03	K1AIR_K04	C3	Lec1, La1, La8	N3, N5

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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

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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_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	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_K01	C3	Lec1 - Lec15, Cl1-Cl7	N3, N4
PEK_U02, PEK_U03	K1AIR_U01, K1AIR_U07	C2	Cl1 - Cl7	N2, N4
PEK_W01, PEK_W02	K1AIR_W01	C1	Lec1 - Lec15	N1, N3

SUBJECT SUPERVISOR

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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	N1, N2, N3, N4,
PEK_U01 , PEK_U02, PEK_U03	K1AIR_U01, K1AIR_U02, K1AIR_U06, K1AIR_U12	C1,C2,C3	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

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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_W03; PEK_K01; PEK_K03	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; PEK_K03	Class admission test, oral answers
F2	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, Lec1 - Lec15	N1, N2, N3
PEK_W02	K1AIR_W04, K1AIR_W07	C1, C2	Lec1- Lec8, Lec4	N1, N2, N3
PEK_W03	K1AIR_W04, K1AIR_W05	C1, C2	Lec9 - Lec15	N1, N2, N3
PEK_U01	K1AIR_U03, K1AIR_U12	C1, C2	La2, La6, La7	N3, N4, N5
PEK_U02	K1AIR_U03, K1AIR_U12	C2	La1, La2, La4, La6, La7	N4, N5
PEK_U03	K1AIR_U01, K1AIR_U12	C1, C2	La1- La7	N3, N4, N5
PEK_K01	K1AIR_K09	C1	Lec9 - Lec15	N3, N4, N5
PEK_K02	K1AIR_K03	C3	La1, La2, La5	N5
PEK_K03	K1AIR_K04	C3	Lec1, La1. La8	N1, N3, N5

SUBJECT SUPERVISOR

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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: **Informatyka II**
Name in English: **Software 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: **ARM031014**
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			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. Has a basic knowledge of computer algorithms
2. Knows the semantics and syntax of C

SUBJECT OBJECTIVES

C1. Explain the functions, methods and tools (UML) of software engineering, introduce the object-oriented modeling.
Prepare for practical classes with object-oriented programming
C2. Learn the ability to use procedural programming paradigm
C3. Learn skills for development of data processing programs

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Understands the essence of methodical troubleshooting and application development tools
PEK_W02 - Has knowledge of object-oriented programming paradigm and UML drawing
PEK_W03 - Can read simple programs in C ++

II. Relating to skills:
PEK_U01 - Can apply the procedural programming paradigm, ie. to break down the problem into a set of programming functions through various tasks in C
PEK_U02 - Can apply C language to the processing of complex data sets one and two-dimensional using dynamic data structures
PEK_U03 - Can test and debug programs written in C, use the C language library documentation, knows and applies the principles of proper programming style

III. Relating to social competences:
PEK_K01 - an search and critically analyze information
PEK_K02 - IS able to plan programming task, carried out in accordance with the functional requirements and the reviews

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to object-oriented programming, examples, tools, CASE	2
Lec2	Models of software development (life cycle)	2
Lec3	Object-oriented requirements analysis (UML - Use case diagrams, activity)	2
Lec4	Object-oriented design (UML - basic models, static and dynamic)	2
Lec5	Software quality, testing, change management	2
Lec6	Implementation of object-oriented (C ++) - classes level	2
Lec7	Implementation of object-oriented (C ++) - system level	2
Lec8	Written assessment	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Organizational issues, introduction into MS Visual Studio environment	2
Proj2	Signal Processing - selected waveform data generation and random failures, write to the file	2
Proj3	Signal Processing - reading a file, dynamic memory allocation of dimensional data, filtering algorithms programming	2
Proj4	Signal processing - robustness, test and debuging the program, code documentation	2
Proj5	Image processing - image reading from a file, dynamic memory allocation for multi-dimensional data	2
Proj6	Image processing - data structures	2

Proj7	Image processing - programming of selected two-dimensional data processing algorithms	2
Proj8	Image processing - image generating	2
Proj9	Image processing - fault tolerance, organization and project documentation	2
Proj10	Dynamic data structures - work with a dynamic list of one or two-way, or a tree	2
Proj11	Dynamic data structure - build a dynamic data structure based on the data stored in the file	2
Proj12	Dynamic data structures - search for items, swap, delete, sort	2
Proj13	Individual project - requirements specification, design	2
Proj14	Individual project - implementation, testing	2
Proj15	Individual project - acceptance	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - preparation for project class
N3. Self working - implementation and documenting programs
N4. Online Knowledge Base

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (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 assessment
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_K02	pre-entry tests, oral answers, statements (sorure code + documentation)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

Cohn M., Succeeding with Agile, Addison-Wesley 2010 Weisfeld M., The Object-Oriented Thought Process, Addison-Wesley, 2009
Freeman S., Pryce N., Growing Object-Oriented Software Guided By Tests, Addison-Wesley, 2010
Dathan B., Ramnath S., Object-Oriented Analysis and Design, Springer 2010 B.B
Agarwald, S.P. Tayal, M. Gupta, Software Engineering and Testing, 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Software 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_W03	K1AIR_W13	C1	Lecture 1- Lecture 8	N1
PEK_U01 - PEK_U03	K1AIR_U03	C2, C3	Project 1 - Project 15	N2, N3, N4
PEK_K01	K1AIR_K01, K1AIR_K05	C2	Project 1 - Project 15	N2, N3, N4
PEK_K02	K1AIR_K05	C3	Project 13 - Project 15	N2, N3, N4

SUBJECT SUPERVISOR

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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
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Statystyka inżynierska**
Name in English: **Statistic for Engineers**
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: **ARM031017**
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. Have basic knowledge in mathematics confirmed positive assessments on the certificate of completion of secondary school

SUBJECT OBJECTIVES

C1. Gaining basic knowledge of probability and mathematical statistics, taking into account the aspects of the application and the acquisition of skills exploration figures in the field of construction and operation of machinery, organization and management, and optimization of design, technology and systems.
C2. Gaining skills development (reduction) of data using statistical software (STATISTICA, MatLab, Gretl, R) and the possibility of a spreadsheet (Excel).
C3. Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students aiming to effectively solve problems, taking into account the responsibility, honesty and fairness in the proceedings.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - knows the basic descriptive statistics characterizing the results of measurements in engineering and the principle of grouping data and creating a series of distribution

PEK_W02 - He knows the basic theoretical distributions of discrete and continuous features and has a basic knowledge of rules of estimation of confidence intervals for the average value characteristics and its dispersion

PEK_W03 - has knowledge of verification methods, parametric and non-parametric statistical hypotheses about the mean value, of the equality of two values of the average of the value of the homogeneity of variance and multiple variance and knows methods of correlation and regression analysis for two or more continuous variables and methods of time series analysis

II. Relating to skills:

PEK_U01 - able to perform data reduction on the prior corresponding selection of statistics describing the average value, its dispersion and shape of the distribution as well as how raw data to create a series of distribution, and illustrate a set of data using a histogram, empirical distribution and graph frameset

PEK_U02 - able to fit empirical data and theoretical distribution on the basis of the estimate quantile values for given probabilities, and estimate the probability for given quantile and unable to correctly select the type of statistical test and perform testing hypotheses about the average and distribution features

PEK_U03 - is able to analyze the correlation characteristics in multivariate categorical data table and can perform regression analysis and correlation of two and more variables to estimate the values of parameters characterizing the strength and shape of the relationship

III. Relating to social competences:

PEK_K01 - Acquisition and consolidation of competence in information retrieval and its critical analysis, teamwork cooperation on improving the methods for the selection of a strategy to optimally solving problems assigned to group

PEK_K02 - understands the need for self-education, including improving the skills of attention and focus on important things, and develop the ability to independently apply their knowledge and skills and capacity building self-esteem and self-iodpowiedzialności for the results of action taken

PEK_K03 - respect the customs and rules in academia as well as independent and creative thinking

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Statistical methods of data analysis - the essence of statistical modeling. Descriptive analysis of data: forms of representation of statistical data, measures of association, variability, asymmetry and concentration.	2
Lec2	Preparation and presentation of statistical material. The grouping of data - ranks easy 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 - the point estimate. Interval estimation of the mean value and variance. confidence intervals	2
Lec4	Parametric statistical hypothesis. Testing hypotheses about the mean value, of the equality of two average values. Testing hypotheses about the rate structure and the equality of two indicators structure. Testing hypotheses about the variance and the equality of two variances.	2

Lec5	Nonparametric hypothesis testing. Chi-squared test, Kolmogorov-Smirnov. Test of independence Pearson chi-square. Depending measures based on chi-square. The odds ratio. Non-parametric tests: test the Wald-Wolfowitz, Wilcoxon signed-rank test Mann-Whitney.	2
Lec6	Analysis of correlation and regression. The method of least squares. Pearson correlation coefficients and Spearman. Linear regression function. Multivariate regression analysis and correlation. Estimation of linear multiple regression function. Test of significance for multiple regression coefficients. Estimation of multiple correlation coefficient. The coefficient of determination.	2
Lec7	Univariate analysis of variance and post-hoc tests: Tukey, Duncan and least significant difference. Kruskal-Wallis test and post-hoc test: Test Dunn. Methods of analysis of the dynamics of phenomena - time series. The methods of smoothing time series. 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. Mathematical and statistical functions Excel. Generating the vector of continuous variables with normal distribution. Descriptive statistics - calculating measures of association, variability, asymmetry and concentration. Construction ranks distribution. Graphical presentation of data collection - Histogram and empirical cumulative distribution and a graph frame area.	2
Proj2	Basic distributions encountered in mathematical statistics: the normal distribution, Student, chi-square, F Snedecor. The probability density function and cumulative distribution. Point and interval estimation of the expected value, the rate structure (faction), variance and standard deviation.	2
Proj3	Verification of statistical hypotheses. Parametric tests of significance to the expected value and the variance of the general population. Test for two variances, two medium and two indicators of the structure. Student test for paired test the homogeneity of many of variance Bartlett's test of homogeneity of many medium-sized (ANOVA).	2
Proj4	Non-parametric tests of significance - test chi-kwadrat2 Pearson, Kolmogorov sensor compatibility test,. Chi-square test of independence - kontyngencyjne boards. Mann-Whitney test. Median test and Wilcoxon signed-ranks test. Rank-sum test Kruskal-Wallis assess the relationship between the two zmiennymiDwuwymiarowa regression analysis and correlation. A scatterplot. The strength of the correlation relationship - the correlation coefficient estimation, test of significance for the correlation coefficient, parameter estimation of linear regression function, significance test for the regression coefficient (slope of the regression line), the confidence interval for the regression coefficient.	2
Proj5	Multivariate analysis of correlation and regression. The estimation of multiple regression function. Test of significance 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	One-way analysis of variance (ANOVA). Table analysis of variance of one variable for the jednoczynnikowego. Analysis of the dynamics. Time series without any periodicity and periodicity. Methods of prediction. Development trend - a trend.	2

Proj7	Analysis of the history of the event. The distribution, density function, survival function, hazard function. Life tables. Kaplan-Meier curves. Cox proportional hazards model. Rating overall uncertainty of the measurement result. Disclosure of systematic errors. Disclosure errors (errors thick). Assessment of overall uncertainty resulting from the impact of random and systematic effects. Sampling methods. Stratified sampling, collaborative, systematic. Non-random selection of trial and error load.	3
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. self study - preparation for project class
N3. problem exercises
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_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	test
F2	PEK_U02	test
F3	PEK_U03	presentation
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Bobrowski D: Probabilistyka w zastosowaniach technicznych. Warszawa 1986, WNT[2] Nowak R.: Statystyka dla fizyków. Warszawa 2002, Wydawnictwo Naukowe PWN[3] Ostasiewicz W. (red.): Statystyczne metody analizy danych. Wrocław 1999, Wydawnictwo AE we Wrocławiu[4] Zeliaś A., Pawełek B., Wanat S.: Metody statystyczne. Zadania i sprawdziany. Warszawa 2002, PWE

SECONDARY LITERATURE
[1] Bąk I., Markowicz I., Mojsiewicz M., Wawrzyniak K.: Statystyka w zadaniach. Część I i II. Warszawa 2001. Wydawnictwo Naukowo-Techniczne[2] Cieciura M., Zacharski J.: Metody probabilistyczne w ujęciu praktycznym. Warszawa 2007, VIZJA PRESS&IT Sp. z o. o.[3] Dobosz M.: Wspomagana komputerowo statystyczna analiza wyników badań. Warszawa 2001, Akademicka Oficyna Wydawnicza EXIT.[4] Frątczak E., Gach-Ciepiela U., Babiker H.: Analiza historii zdarzeń. Elementy teorii, wybrane przykłady zastosowań. Warszawa 2005, Szkoła Główna Handlowa w Warszawie.[5] Kukiełka L: Podstawy badań inżynierskich. Warszawa 2002, Wydawnictwo Naukowe PWN. [6] Maliński M.: Statystyka matematyczna wspomagana komputerowo. Gliwice 2000, Wydawnictwo Politechniki Śląskiej [7] Paleczek W.: Metody analizy danych na przykładach. Częstochowa 2004, Politechnika Częstochowska[8] Turzeniecka D.: Ocena niepewności wyniku pomiarów. Poznań 1997, Wydawnictwo Politechniki Poznańskiej

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Statistic for Engineers
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, C2, C3	Wy1, Wy2, Pr1, Pr2	N1
PEK_W02	K1AIR_W01, K1AIR_W17	C1, C2, C3	Wy3, Wy4, Wy5, Pr3, Pr4, Pr5	N1
PEK_W03	K1AIR_W14	C1, C2, C3	Wy6, Wy7, Pr6, Pr7	N1, N5
PEK_U01	K1AIR_U01, K1AIR_U02	C1, C2, C3	Pr1, Pr2	N2, N3, N4
PEK_U02	K1AIR_U01	C1, C2, C3	Pr3, Pr4, Pr5	N2, N3, N4
PEK_U03	K1AIR_U01, K1AIR_U04	C1, C2, C3	Pr6, Pr7	N2, N3, N4, N5
PEK_K01	K1AIR_K04	C3	Wy1, Pr7	N5
PEK_K02	K1AIR_K04	C3	Wy1, Pr7	N5
PEK_K03	K1AIR_K06	C3	Wy1, Wy7, Pr7	N1, N5

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Termodynamika techniczna**
Name in English: **Technical thermodynamics**
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: **ARM031018**
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 matter cover according to the physics education program in the range of Physics module
2. Ability of individual performance of laboratory experiments, enhanced by elementary manual dexterity
3. Awareness of the team working necessity and ability of its execution

SUBJECT OBJECTIVES

C1. Understanding of gas processes and possibility of its usage in technique basing onthe laws of thermodynamic
C2. Knowledge and understanding of the engines air standard cycles and ability to evaluate its efficiency
C3. Familiarisation with the practical realisation of air standard cycle for combustions engines and piston compressors

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Names and describes the laws of thermodynamics and thermodynamic processes
PEK_W02 - Characterises and explains air standard cycles and is able to evaluate its efficiency
PEK_W03 - Names and describes the procedures of the air standard cycles realization in combustion engines and piston compressors

II. Relating to skills:
PEK_U01 - Is able to calculate the level of imperfection of the adiabatic, isothermal process as an example of polytropic process
PEK_U02 - Calculates values of specific heat for gasses and volumetric efficiency of a piston compressor
PEK_U03 - Calculates and verifies coefficient of heat transfer through a plat plate as well as conductive coefficient for forced and natural convection

III. Relating to social competences:
PEK_K01 - Understand the necessity and is aware of possibilities of continuous education, particularly increasing their knowledge of technical thermodynamics (studies II and III degree),
PEK_K02 - Is aware of the importance, responsibility and the effects of engineer work from Mechanical Engineering faculty in terms of responsibility for the environment, resulting from the proper use of the knowledge of technical thermodynamics
PEK_K03 - Recognizes the need to improve professional skills, personal and social

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions: mass, the amount of pressure, temperature, volume	2
Lec2	I Law of Thermodynamics - work, heat, internal energy, power, thermodynamic system open – closed, enthalpy, volume and technical work	2
Lec3	Thermodynamic processes calculation of heat and work variations. Cycles, entropy, the efficiency of cycles	2
Lec4	Carnot Cycle, Second Law of Thermodynamics, reversible processes, irreversible entropy relationship of the Second Law of Thermodynamic	2
Lec5	The flow of gas through the nozzles, the energy balance for open movable systems, dynamic stream performance	2
Lec6	Basic air standard cycles for engine, efficiencies and comparison	2
Lec7	Piston and rotodynamic; energy balance, an indicator diagram and operation of the compressor	2
Lec8	Basic laws of heat transfer by convection, radiation and conduction	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Determination of the specific heat of the gas	2
Lab2	Practical realization of adiabatic process	2
Lab3	Examination of the adiabatic flow through a Bendemann nozzle	2
Lab4	Determination of volumetric efficiency of a piston compressor	2

Lab5	The study of isothermal process	2
Lab6	Determination of heat transfer coefficients for forced and natural convection	2
Lab7	Examination of the process of heat transfer through a flat barrier with: a) the occurrence of convection and radiation, b) applying a debilitating radiation screen	2
Lab8	Isobaric heating using heat regeneration	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
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_W02 PEK_W03	
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
P = (F1+F2+F3+F4+F5+F6+F7)/7		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technical thermodynamics
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	Lec1 Lec2 Lec3	N1.
PEK_W02	K1AIR_W02, K1AIR_W19, K1AIR_W20	C2	Lec4 Lec 5	N1.
PEK_W03	K1AIR_W02	C3	Lec6 Lec7 Lec8	N1.
PEK_U01	K1AIR_U09, K1AIR_U10	C1	La2 La5	N2. N2. N3.
PEK_U02	K1AIR_U09, K1AIR_U10	C2	la1 La4	N2. N2. N3.
PEK_U03	K1AIR_U09, K1AIR_U10	C3	la1 La4	N2. N2. N3.
PEK_K01	K1AIR_K01	C1 C2 C3	Lec1, Lec2, Lec3	N1. N2.
PEK_K02	K1AIR_K02	C1 C2 C3	Lec7 Lec8	N2. N3.
PEK_K03	K1AIR_K09, K1AIR_K12	C1 C2 C3	Lec8 La8	N2. N3.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka III**
Name in English: **Software Engineering III**
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: **ARM031019**
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. He/she knows the semantics and syntax of C
2. He/she can write, test and debug programs written in C
3. Has knowledge of object-oriented programming paradigm and writing UML

SUBJECT OBJECTIVES

C1. Learn the skills to apply object-oriented programming paradigm for solving practical tasks

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is able to implement a C ++ program from a given specification and UML
PEK_U02 - Is able to apply object-oriented programming paradigm, ie. Modeled in UML, then implement in C ++ program for a given problem
PEK_U03 - Can apply the correct style of programming, test, and debug a program developed and compile the code

III. Relating to social competences:
PEK_K01 - Can search and critically analyze information
PEK_K02 - Is able to plan programming task, prioritize and implement activities in accordance with the requirements of the job

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Class, attribute, method, constructor, destructor, object, overloading methods	2
Proj2	Accessors overloaded constructor, copy constructor, new and delete operators	2
Proj3	Inheritance, functions befriended	2
Proj4	Operators, operator overloading, this pointer	2
Proj5	Streams, File operations	2
Proj6	Association, aggregation, composition	2
Proj7	polymorphism	2
Proj8	Simulation of the control system	2
Proj9	MasterMind game / Pond / etc	2
Proj10	Templates	2
Proj11	Exceptions	2
Proj12	Object-oriented modeling with UML	2
Proj13	Implementation of modelled program	2
Proj14	Testing and debugging, source code documentation	2
Proj15	Assessment	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. Self work - implementation, testing, documentation
N3. Online knowledge base

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	Verbal answers, quizzes, reports (source code + UML documentation)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Liberty, C++ dla każdego, Helion 2002
B. Stroustrup, Język C++, WNT 2002
J.Grębosz, Symfonia C++, Editions 2000 rok 2006
B. Eckel, Thinking in C++ Edycja polska, Helion 2002

SECONDARY LITERATURE
N. M. Josuttis, C++. Programowanie zorientowane obiektowo. Vademecum profesjonalisty, Helion 2003
M.Flenov, C++ Elementarz hakera, Helion 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Software Engineering III
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_U03	K1AIR_U02, K1AIR_U03	C1	Laboratory 1 - 14	N1, N2, N3
PEK_K01	K1AIR_K01	C1	Laboratory 1 - 14	N1, N2, N3
PEK_K02	K1AIR_K02, K1AIR_K04, K1AIR_K05	C1	Laboratory 1 - 14	N1, N2, N3

SUBJECT SUPERVISOR

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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:

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_U01	K1AIR_U07, K1AIR_U08, K1AIR_U14	C1	LA1, LA2, LA3, LA4,LA5, LA6, LA9, LA10, LA13, LA14, LA15	N1, N2
PEK_U02	K1AIR_U07, K1AIR_U14	C2	LA5, LA6, LA7, LA8, LA11, LA12, LA13, LA14, LA15	N1, N2
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

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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

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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

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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,	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_K01, PEK_K02	Report, defence of the project
F2	PEK_U01, PEK_U02	Evaluation of the computational part of the project
F3	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	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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy wspomagające podejmowanie decyzji**
Name in English: **Systems of decision support**
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: **ARM031026**
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					
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		1

Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		1
Proj2		2
Proj3		7
Proj4		2
Proj5		2
Proj6		1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem exercises
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_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_U03	
F2	PEK_U01 ¸ PEK_U03	
F3	PEK_U01 ¸ PEK_U03, PEK_K01, PEK_K02	
P = 0.2F1+0.6F2+0.2F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Systems of decision support
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_W16	C1		N1 N5
PEK_U01-PEK_U03	K1AIR_U15	C1		N1 -N5
PEK_K01-PEK_K02	K1AIR_K03, K1AIR_K05	C3		N4

SUBJECT SUPERVISOR

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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: **ARM031027**
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			2	1	
including number of ECTS points for direct teacher-student contact (BK) classes			1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the manufacture techniques: welding, casting and plastic working.
C2. Acquiring the ability to select an appropriate bonding technology, casting and plastic forming from the viewpoint of mechanization and automation.
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:

II. Relating to skills:
PEK_U01 - Student can choose the right welding, casting or plastic forming technology of basic engineering materials.
PEK_U02 - The student can, for a simple product, analyze and design the tooling for the implementation of the casting process.
PEK_U03 - Student is able to critically determine the basic capabilities of mechanization and automation of chipless forming.

III. Relating to social competences:
PEK_K01 - Finding information and its critical analysis, objectively examine the arguments of rational explanations and justifications own point of view, using knowledge of welding, foundry and plastic forming.
PEK_K02 - Student should understand the need for continuous training and increasing their knowledge and skills with changing technical requirements and social issues.
PEK_K03 - Student should observe the customs and rules in an academic environment.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Shielded manual metal arc welding.	2
Lab2	Gas shielded tungsten and metal arc welding. Robotic welding.	2
Lab3	Soldering and brazing.	2
Lab4	Thermal oxygen and plasma cutting. Stresses and deformations in welding.	2
Lab5	Safety in welding. Fuel gas welding.	2
Lab6	Materials and equipment used for the preparation of the molding and core sands. Methods of manufacturing and testing molding and core sands properties.	2
Lab7	Methods for manual manufacturing of foundry molds and cores.	2
Lab8	Methods for automatic manufacturing of foundry molds and cores.	2
Lab9	Production of molds and cores from self-and thermosetting molding sands.	2
Lab10	Manufacturing the castings in metal molds.	2
Lab11	Cold deformation and annealing of metals.	2
Lab12	Rolled metal sheets and profiles.	2
Lab13	Squeezing metallurgical and machine parts.	2
Lab14	Manufacture of metal in the process of drawing.	2
Lab15	Expression - cut, bending and pressing.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Distribution of design subject from the welding part. Determination of preliminary assumptions of designed welded construction.	1

Proj2	Analysis of welded construction manufacturability for a specific type of production. Figures drawn to the applicable standards. Selection of materials and determining the process parameters.	2
Proj3	Preparation of documentation/operation sheet. Devices specification, time and cost of manufacture calculation .	2
Proj4	Distribution of design subject from the casting part. Determination of preliminary assumptions of designed cast element.	1
Proj5	Analysis of cast element manufacturability for a specific type of production. Figures drawn to the applicable standards. Selection of materials and determining the process parameters.	2
Proj6	Preparation of documentation/operation sheet. Devices specification, time and cost of manufacture calculation .	2
Proj7	Distribution of design subject from plastic forming part. Determination of preliminary assumptions of designed forming element with selected method of plastic working.	1
Proj8	Analysis of designed forming element manufacturability for a specific type of production. Figures drawn to the applicable standards. Selection of materials and determining the process parameters.	2
Proj9	Preparation of documentation/operation sheet. Devices specification, time and cost of manufacture calculation .	2
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for project class
N3. self study - preparation for laboratory class
N4. project presentation
N5. 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_U03	
F2	PEK_K01 - PEK_K03	
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_W01 - PEK_W03	
F2	PEK_U01 - PEK_U03	
F3	PEK_K01 - PEK_K03	
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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_U01 - PEK_U03	K1AIR_U03, K1AIR_U04, K1AIR_U12, K1AIR_U22	C1 - C3		N1, N3, N5
PEK_K01 - PEK_K03	K1AIR_K03, K1AIR_K05, K1AIR_K10	C3		N2, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-obróbka ubytkowa**
Name in English: **Production Technics - Machining**
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: **ARM031028**
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		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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		3
Lec2		3
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		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_W03PEK_K01; PEK_K02; 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_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Production Technics - Machining
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; C3		N1
PEK_U01; PEK_U02; PEK_U03	K1AIR_U02, K1AIR_U03, K1AIR_U04	C1; C2; C3		N2; N3
PEK_K01; PEK_K02; PEK_K03	K1AIR_K03, K1AIR_K04, K1AIR_K05, K1AIR_K12	C1; C2; C3		N1; N2; N3

SUBJECT SUPERVISOR
Prof. dr hab. inż. Piotr Cichosz tel.: 21-57 email: piotr.cichosz@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_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, PEK_K01	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_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	N1-N3
PEK_W02	K1AIR_W06	C1, C2	Lec1-Lec13	N1-N3
PEK_U01	K1AIR_U01, K1AIR_U02, K1AIR_U13	C1, C2	Lab1-Lab8 Proj1-Proj6	N1-N3
PEK_U02	K1AIR_U01, K1AIR_U02, K1AIR_U13	C1, C2	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

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy i algorytmy przetwarzania sygnałów**
Name in English: **Fundamentals of algorithms and signal processing.**
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: **ARM031031**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory	Number of hours

Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. self study - preparation for laboratory class
N4.

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	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of algorithms and signal processing.
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_U11	C1, C2		N1, N3, N4
PEK_U02	K1AIR_U11	C1, C2, C3		N1, N3, N4
PEK_U03	K1AIR_U11	C3, C4		N1, N2, N3, N4
PEK_K01	K1AIR_U11	C3, C4		N4
PEK_K02	K1AIR_K03	C1, C2, C3, C4		N1, N4

SUBJECT SUPERVISOR

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy robotyki i automatyzacji**
Name in English: **Basics of robotics and automation**
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: **ARM031033**
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	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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		4
Lab3		4
Lab4		4
Lab5		4
Lab6		4
Lab7		4
Lab8		2
Lab9		2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
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	
P = 1		

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

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of robotics and automation
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_W08, K1AIR_W09	C1,C3		N1,N2,N4
PEK_W02	K1AIR_W08, K1AIR_W09	C2		N1,N2,N4
PEK_W03	K1AIR_W08, K1AIR_W09	C1		N1,N2,N4
PEK_U01-PEK_U03	K1AIR_U07, K1AIR_U22	C1,C3		N3, N4

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy napędowe hydrauliczne i pneumatyczne**
Name in English: **Hydraulic and pneumatic 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: **ARM031034**
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 fluid mechanics.
2. The student is able to solve ordinary differential equations which are mathematical models of components and systems, hydrostatic.
3. The student has mastered the basic issues of classical mechanics.

SUBJECT OBJECTIVES

C1. To familiarize students with the basic rights of the hydrostatic propulsion systems in fundamental rights hydrostatic system
C2. To familiarize students with the elements of hydraulic and the principle of their action.
C3. To familiarize students with the configuration simple hydrostatic power transmission.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the carried out activities the student should be able to define the requirements for hydraulic oil in power transmission.
PEK_W02 - As a result of the carried out activities the student should be able to describe the principle of operation of the basic elements of the hydrostatic system.
PEK_W03 - As a result of the carried out activities the student should be able to characterize the work of basic hydrostatic power transmission.

II. Relating to skills:
PEK_U01 - As a result of the carried out activities the student should be able to analyze the work items and hydrostatic systems.
PEK_U02 - As a result of the carried out activities the student should be able to calculate the basic parameters of the hydrostatic drive system.
PEK_U03 - As a result of the carried out activities the student should be able to interpret basic elements and characteristics of hydrostatic systems.

III. Relating to social competences:
PEK_K01 - As a result of the carried out activities the student should possess the ability to analyze information with different levels of complexity.
PEK_K02 - As a result of the carried out activities the student should possess ability to objectively evaluate arguments, rational and justify their own point of view, using knowledge of hydrostatic power transmission.
PEK_K03 - As a result of the carried out activities the student should possess ability to respect the Customs and rules in academia.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction	1
Lec2	The basic symbolism of the elements and hydraulic and pneumatic systems.	1
Lec3	Hydraulic fluids-properties and characteristics	2
Lec4	Pollution-sources, causes and effects-filtration	1
Lec5	Positive displacement pumps-classification, characteristics, fitness.	2
Lec6	Valves-classification, types, functions.	4
Lec7	Hydraulic losses and volumetric hydraulic machines and in the layout.	2
Lec8	Skills: hydraulic, and the total alcoholic strength by volume.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, overview of content, requirements and forms of assessment.	2
Lab2	Experimental determination of the properties of the working liquid-bulk modulus.	2
Lab3	Experimental determination of the nature of the resistance in the ducts of the hydraulic-linear resistance.	2

Lab4	Local resistance in hydraulic systems. Venturi as the resistance of local phenomenon of cavitation.	2
Lab5	Experimental designation of characteristics of the positive displacement pump.	2
Lab6	Static characteristics of a conventional horizontal splitter.	2
Lab7	Description hydraulic transients-experimental determination of basic indicators.	2
Lab8	Passing of the course	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 PEK_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 PEK_K01-PEK_K03	paper, quiz, oral response report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Kollek W.: The base design of drives and hydraulic control. Publisher Oficyna Wydawnicza PWr, Wrocław 2004
[2] Kollek W.: Gear pumps. Construction and operation. Publisher Zakład Narodowy im. Ossilońskich, Wrocław 1996.
[3] Stryczek S.; Hydrostatic drive-elements and systems. Publisher WNT 1984.
[4] Osiecki A.: Hydrostatic drive. Publisher WNT, Warszawa 1996.

SECONDARY LITERATURE
[1] Szydelski Z.; Drive and hydraulic control systems in vehicles and self-propelled machines. Publisher WNT 1980.
[2] Kollek W., Osiński P.: Modelling and design of gear pumps. Publisher Oficyna Wydawnicza PWr, Wrocław 2009
[3] Kollek W.: Basic issues of the theory of hydraulic drives. Publisher NOT, Wrocław 1978.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydraulic and pneumatic 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_W02	C1	Wy1,Wy2,Wy3	N1,N2
PEK_W02	K1AIR_W01	C2	Wy4, Wy5,Wy6	N1,N2
PEK_W03	K1AIR_W01, K1AIR_W02	C3	Wy7,Wy8	N1,N2
PEK_U01	K1AIR_U09, K1AIR_U27	C1,C2	La1,La2,La4,La5,La6	N3,N4,N5
PEK_U02	K1AIR_U07	C3	La3,La4,La7	N3,N4,N5
PEK_U03	K1AIR_U07, K1AIR_U27	C1,C3	La8,La2	N3,N4,N5
PEK_K01-PEK_K03	K1AIR_K05	n.d.	La1 do La8, Wy1 do Wy8	n.d.

SUBJECT SUPERVISOR

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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: **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. 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

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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. Understanding 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:

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_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_K01, PEK_K02, PEK_K03	K1AIR_K02, K1AIR_K05, K1AIR_K08, K1AIR_K09	C1, C2, C3	Lec2 - Lec14	N1

SUBJECT SUPERVISOR

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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: **obligatory**
Subject code: **ARM031041**
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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka I**
Name in English: **Programming 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: **ARM031042**
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		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	0.7		1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		1
Lec2		1
Lec3		1
Lec4		1
Lec5		1
Lec6		2
Lec7		1
Lec8		1
Lec9		1
Lec10		1
Lec11		1
Lec12		1
Lec13		2
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1		2
Cl2		2
Cl3		2
Cl4		2
Cl5		2
Cl6		2
Cl7		2
Cl8		1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		2
Proj6		2
Proj7		2
Proj8		1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for project class
N3. report preparation
N4. problem discussion
N5. problem 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	
F2	PEK_U01	
P = (F1+F2)/2		

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_W01	
F2	PEK_U01	
F3	PEK_K01	
P = (F1+F2+F3)/3		

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	
F2	PEK_U01	
F3	PEK_K01	
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming 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_W12	C1		N1, N2, N3, N4, N5
PEK_U01	K1AIR_U02, K1AIR_U16	C1, C3		N1, N2, N3, N4, N5
PEK_K01	K1AIR_K03, K1AIR_K05	C3		N1, N2, N3

SUBJECT SUPERVISOR

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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: **obligatory**
Subject code: **ARM031043**
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

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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: **ARM031044**
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	Examination				
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 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

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory i systemy pomiarowe**
Name in English: **Sensors and measuring 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: **ARM031102**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		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 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,	
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	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors and measuring 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_W10	C1		N1
PEK_W02	K1AIR_W05	C1		N1
PEK_W03	K1AIR_W05	C1		N1
PEK_U01	K1AIR_U10	C2		N2-N4
PEK_U02	K1AIR_U09	C2		N2-N4
PEK_U03	K1AIR_U11	C2		N2-N4
PEK_K01	K1AIR_K01	C3		N3-N4

PEK_K02	K1AIR_K03, K1AIR_KE_K01	C3		N2
PEK_K03	K1AIR_K05	C3		N2-N4

SUBJECT SUPERVISOR

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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: **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. 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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszyny technologiczne**
Name in English: **Manufacturing machines**
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: **ARM031104**
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. The student has sound knowledge of and can communicate through engineering drawing.
2. The student has basic knowledge of manufacturing techniques.

SUBJECT OBJECTIVES

C1. The student is to familiarize herself/himself with the structure and the technological and utility characteristics of machine tools.
C2. The student is to familiarize herself/himself with the functionalities of the principal types of machine tools.
C3. The student is to acquire the skill of checking the main functional characteristics of machine tools.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the structure of and distinguishes the main types of machine tools and can describe their functionalities.
PEK_W02 - The student knows the structure and principles of operation of automatics and numerically controlled machine tools and can distinguish them from conventional machine tools.
PEK_W03 - The student knows the robotized solutions used in manufacturing processes.

II. Relating to skills:
PEK_U01 - The student can select proper manufacturing machines and equipment for specific technological tasks.
PEK_U02 - The student can exploit the acquired knowledge to investigate the properties of numerically controlled machine tools.
PEK_U03 - The student can analyse the operation of automated manufacturing system and link its performance with designated characteristics.

III. Relating to social competences:
PEK_K01 - The student understands the need for lifelong learning within the range of mechanics and machine building engineer activity and improving her/his professional and social competences.
PEK_K02 - The student can critically analyze the functioning of a manufacturing system in order to improve its performance.
PEK_K03 - The student is aware of the responsibility for her/his works and its effect on the functioning of the enterprise.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The technological and utility characteristics of machine tools.	1
Lec2	The work components and assemblies of machine tools.	2
Lec3	The drives and principle work mechanisms of machine tools.	2
Lec4	A survey of the main types of machine tools and their functionalities Part 1.	2
Lec5	A survey of the main types of machine tools and their functionalities Part 2.	2
Lec6	Automation of production processes, construction and operation of automatic lathes and manufacturing systems.	2
Lec7	The development of numerically controlled machine tools.	2
Lec8	Robotization in manufacturing processes.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory and discuss safety rules.	1
Lab2	Checking the geometric accuracy of machine tool on the example of lathes.	2
Lab3	The measurement of the power losses of machine tool at idle running and its overall efficiency.	2
Lab4	The measurement of noise of machine operation.	2
Lab5	The testing of the mechanism translating rotational motion to linear motion.	2

Lab6	The measurements of energy loss in the spindle rolling bearings.	2
Lab7	Positioning accuracy of machine sliding assemblies.	2
Lab8	Selected issues the dynamic properties of machines.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
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	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	entrance tests, reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Honczarenko J.: Obrabiarki sterowane numerycznie. WNT, Warszawa 2008
2. Kosmol J.: Automatyzacja obrabiarek i obróbki. WNT, Warszawa 2000
3. Kwapisz L., Przybył R., Froncki W.: Obrabiarki. Wyd. Politechniki Łódzkiej, Łódź 1999

SECONDARY LITERATURE
1. Weck M.: Werkzeugmaschinen - Fertigungssysteme. Band 1. Maschinenarten, Bauformen und Anwendungsbereiche. VDI-Verlag, Düsseldorf 1996
2. Wrotny L.T.: Obrabiarki skrawające do metali. WNT, Warszawa 1979

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing 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	K1AIR_W06	C1,C2	Lec1 - Lec8	N1, N2
PEK_U01 - PEK_U03	K1AIR_U09	C3	Lab1 - Lab8	N3, N4, N5
PEK_K01 - PEK_K03	K1AIR_K05, K1AIR_K06	C1 - C3	Lec1 - Lec8, Lab1 - Lab8	N1 - N5

SUBJECT SUPERVISOR

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
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: **ARM031109**
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. Know the terms used in automation and the types of control systems and the description and characteristics of automation components and automation systems.
2. He knows the characteristics of electric and hydraulic motors and also conventional propulsion systems. He have knowledge of the possibility of motor control.

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Project		Number of hours
Proj1		2
Proj2		6
Proj3		2
Proj4		6
Proj5		6
Proj6		3
Proj7		6
Proj8		8
Proj9		3
Proj10		3
		Total hours: 45

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. tutorials
N3. 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_U03, PEK_K01-PEK_K03	
P = F1		

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
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_KE_U02, K1AIR_U17	C1		N1, N2
PEK_U02	K1AIR_U03, K1AIR_U04, K1AIR_U12	C1, C2		N1, N2
PEK_U03	K1AIR_U01, K1AIR_U23	C3		N1-N3
PEK_K01	K1AIR_K01	C3		N1, N3
PEK_K02	K1AIR_K03, K1AIR_KE_K01	C3		N1, N3
PEK_K03	K1AIR_K11	C3		N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Proseminarium dyplomowe**
Name in English: **Diploma proseminar**
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: **ARM031110**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		2
Sem2		2
Sem3		2
Sem4		2
Sem5		6
Sem6		1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion
N3.

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	
F2	PEK_U02-PEK_U03, PEK_K01-PEK_K03	
P = (2F1+F2)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma proseminar
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_U03	K1AIR_KE_U01, K1AIR_KE_U05	C1		N1-N3
PEK_UK01-PEK_K03	K1AIR_K03	C2-C4		N1-N3

SUBJECT SUPERVISOR

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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: **ARM031113**
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. 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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Thesis seminar**
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: **ARM031113**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		1
Sem2		13
Sem3		1
		Total hours: 15

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_U02, PEK_U03, PEK_K01-PEK_K03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Thesis seminar
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_U03	K1AIR_KE_U01, K1AIR_KE_U05, K1AIR_U20	C1-C5		N1, N2

PEK_K01- PEK_K03	K1AIR_K03, K1AIR_K05, K1AIR_K06	C1-C5		N1-N4

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane sterowniki**
Name in English: **Advanced 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: **ARM031114**
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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Demonstrate advanced properties of industrial controllers.
C2. Present 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	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	Software tools and programming LOGO!	2
Lec5	Software tools S7-1200	2
Lec6	Programming the S7-1200	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	LOGO! - Software tools, configuration	2
Lab3	LOGO! - Programming in FBD	2
Lab4	LOGO! - Programming in LAD	2
Lab5	S7-1200 - software tools, configuration	2
Lab6	S7-1200 - programming in LAD	2
Lab7	S7-1200 - programming in FBD	2
Lab8	Process visualization with HMI	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, Sterowniki S7-1200 w praktyce inżynierskiej. BTC 2013

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced 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, PEK_W02, PEK_W03	K1AIR_W09	C1-C3	Lec1-Lec7	N1
PEK_U01, PEK_U012, PEK_U03,	K1AIR_U08, K1AIR_U16	C1-C3	Lab1-Lab8	N2, N3
PEK_K01, PEK_K02	K1AIR_K03, K1AIR_K05	C1-C3	Lec1-Lec7, Lab1-Lab8	N1- N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elektrotechnika praktyczna**
Name in English: **Practical electrotechnics**
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: **ARM031116**
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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Knowing the rules for construction of low-voltage electrical installations.
C2. Getting to know the criteria of effectiveness of protection against installations with an operating voltage up to 1kV.
C3. Knowledge of the principles of the organization of safe operation of electrical equipment and first aid in cases of electric shock.
C4. Acquiring the ability to perform basic research of low-voltage electrical installations.
C5. Perform basic switching operations in power installations and control of operating voltages up to 1kV.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student explains the construction of low-voltage electrical installations and knows the rules for the selection of its individual components.
PEK_W02 - The student has knowledge of systems and means of protection against used in low voltage installations.
PEK_W03 - The student knows the rules of the organization safe operation of electrical equipment and first aid in cases of electric shock.

II. Relating to skills:
PEK_U01 - A student performs basic measurements of electrical installations with rated voltages up to 1kV.
PEK_U02 - A student performs basic switching operations and elementary corrective actions in electrical systems up to 1kV.

III. Relating to social competences:
PEK_K01 - Students interact effectively in a team carrying out the measurements and connecting the electrical installation

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	General characteristics of regulations and standards relating to the construction equipment, installations and electrical networks	2
Lec2	Network systems and low-voltage installations. Types, principles of construction and design.	2
Lec3	Electrical machines and equipment. Types, principles of construction, types of protection from overload and short circuits.	2
Lec4	Protection class electrical appliances. International Protection Rating of enclosure electrical device.	2
Lec5	Basic security measures used in low voltage installations.	2
Lec6	Fault protection measures used in low voltage installations.	2
Lec7	The organization safe operation of electrical equipment.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Admission: - Familiarize students with the principles of safety in the laboratory; - Familiarize students with support equipment	1
Lab2	Performing measuring from the list in the Practical Electrotechnics Laboratory: Fault loop impedance measurements. Measurement of protective conductor continuity. Insulation resistance wires. Measurements RCDs. Earth resistance measurements.	7

Lab3	Performing exercises switching from the list in the Practical Electrotechnics Laboratory: Combining basic circuit low voltage electrical installations (way switches, circuit breakers cross, bistable switches, stair machines, dusk sensors, PIR motion detectors).	7
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. informative lecture
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	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	activity in the classroom
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] IEC 60364 Electrical Installations for Buildings

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Practical electrotechnics
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	Lec1 - Lec3	N1, N2, N4, N5
PEK_W02	K1AIR_W11	C2	Lec4 - Lec6	N1, N2, N4, N5
PEK_W03	K1AIR_W11	C3	Lec7	N1, N2, N4, N5
PEK_U01	K1AIR_U02, K1AIR_U03, K1AIR_U10, K1AIR_U22	C4	Lab1 - Lab2	N3, N5
PEK_U02	K1AIR_U02, K1AIR_U13	C5	Lab1, Lab3	N3, N5
PEK_K01	K1AIR_K03, K1AIR_K05, K1AIR_K10	C4, C5	Lab2, Lab3	N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technika w medycynie**
Name in English: **Technology in Medicine**
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: **ARM031120**
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 mechanics and strength of materials.
2. Knowledge of the basics of mechanical design.
3. Knowledge of powertrains.

SUBJECT OBJECTIVES

C1. Presentation of the basic issues of the biomechanics of the human body.
C2. Discussion of the design and operation the equipment and systems that support treatments and surgery
C3. Overview of the design and operation of selected artificial organs.
C4. Discussion of technical means supporting the human locomotion.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Have the knowledge about the design and operating principle of selected devices supporting the body functions of man.
PEK_W02 - Have the knowledge about systems supporting the planning and execution of surgical operations.
PEK_W03 - Have a basic knowledge of anatomy and biomechanics of human organs and systems.

II. Relating to skills:
PEK_U01 - Able to carry out tests of physical parameters of selected devices used for the treatment and support of medical operations.
PEK_U02 - Able to be measured kinematic and dynamic parameters describing human movement.
PEK_U03 - He/She can use data from medical imaging to create three-dimensional models of parts of the osteoarticular system.

III. Relating to social competences:
PEK_K01 - Able to cooperate and work in a group, adopting different roles in it.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Medical manipulators and robots, their genesis and history, design solutions used in medical manipulators, tools for laparoscopic surgery, telemedicine	2
Lec2	Navigation systems for the operating room: purpose, classification, optical and magnetic navigation -operating principle, examples of mechanical components construction, examples of applications in clinical practice.	2
Lec3	Prostheses upper and lower limbs; functions, classification, discussion prostheses design solutions, drive systems prostheses, bionic prostheses.	3
Lec4	Technical means used in the rehabilitation of the bone-joint and muscular systems. Device for the active and passive rehabilitation of the limbs. Exoskeletons to assist locomotion of disabled persons. Rehabilitation systems using biofeedback.	2
Lec5	Long bones systems stabilization - their development, external fixatorrs for the treatment of bone fractures and their elongation. Influence of stabilser structure on the biomechanics of the bone tissue regeneration.	2
Lec6	Technical support for the cardiovascular system: artificial heart, the idea of building applied solutions, materials, controls system; pacemakers, extracorporeal circulatory systems, the technique of minimally invasive vascular angioplasty; vascular stents, stengrafts, design, operation, applied design solutions.	2
Lec7	Medical imaging: the construction and operation of CT scanners- types of structure, scope; magnetic resonance imaging - applications; intravascular ultrasound; algorithms reconstruct three-dimensional images of internal organs.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	The use of computer navigation with medical imaging in medicine.	3

Lab2	Robotic application in medicine. Controlling of humanoid robots.	3
Lab3	Analysis of ground reaction forces during gait.	3
Lab4	Application 3D printig technology in medicine.	3
Lab5	The elelctronic navigation application to mandible motion examination.	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	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	report of laboratory, 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 (in polish)

Podsędkowski L.: Medical robots. Design and applications. Wydawnictwo Naukowo - Techniczne, Warsaw, 2011 (in polish)

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technology in Medicine
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, K1AIR_W13	C2, C3, C4		N1, N2
PEK_W02	K1AIR_KE_W04, K1AIR_W13, K1AIR_W17	C2, C3, C4		N1, N2, N3
PEK_W03	K1AIR_W17	C1		N1, N2, N3
PEK_U01	K1AIR_U06, K1AIR_U10	C4		N3
PEK_U02	K1AIR_U04, K1AIR_U06, K1AIR_U07	C1, C4		N3
PEK_U03	K1AIR_U01, K1AIR_U09, K1AIR_U10	C2, C3		N3
PEK_K01	K1AIR_K05, K1AIR_KE_K01	C1-C4		N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Biomechanika inżynierska**
Name in English: **Biomedical Engineering**
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: **ARM031121**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		1
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
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	
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	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Biomedical 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	K1AIR_W13, K1AIR_W17	C1, C2		N1, N2
PEK_U01, PEK_U02	K1AIR_U03, K1AIR_U04, K1AIR_U09, K1AIR_U10	C1, C3		N3, N4
PEK_K01	K1AIR_K01, K1AIR_K02, K1AIR_K05	C1, C2, C3		

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English:
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: **ARM031150**
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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.
N2. 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, PEK_K01	
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

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	K1AIR_KE_U01, K1AIR_KE_U05			
PEK_K01	K1AIR_K05			

SUBJECT SUPERVISOR

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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: **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				

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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory w systemach wytwórczych**
Name in English: **Sensors in manufacturing 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: **ARM031203**
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. The student has sound knowledge of and can communicate through engineering drawing.
2. The student has basic knowledge relating to the design-construction process, structure, functioning and operation of the main machine elements and assemblies and the principles of their matching and constructing.
3. The student has sound knowledge of the structure of machine tools and their functionalities.

SUBJECT OBJECTIVES

C1. The student is to get to know the structure, characteristics and principles of operation of the sensors used in manufacturing systems.
C2. The student is to acquire knowledge relating to the location and functions performed by sensors in manufacturing systems.
C3. The student is to acquire the skill of selecting proper sensors in the design of manufacturing systems and their use for diagnosis and supervision purposes.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the structure, characteristics and principles of operation of the sensors used in manufacturing systems.
PEK_W02 - The student knows what functions sensors perform in manufacturing systems and can indicate the locations of the sensors.
PEK_W03 - The student knows the fundamentals of the diagnostics and supervision of manufacturing systems and the strategies used.

II. Relating to skills:
PEK_U01 - The student can select sensors proper for the functions performed in manufacturing systems.
PEK_U02 - The student can design a measurement chain used in the diagnosis and supervision systems of manufacturing systems.
PEK_U03 - The student can determine the main characteristics of the sensors used in manufacturing systems.

III. Relating to social competences:
PEK_K01 - The student understands the need for lifelong learning within the range of mechanics and machine building engineer activity and improving her/his professional and social competences.
PEK_K02 - The student can critically analyze the functioning of a manufacturing system in order to improve its performance.
PEK_K03 - The student is aware of the responsibility for her/his own work and its effect on the functioning of the enterprise.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role of sensors in manufacturing, the classifications of sensors.	1
Lec2	Physical operating principles of sensors and their basic characteristics.	2
Lec3	Sensors in machine tools and industrial robots.	2
Lec4	Sensors for measurements the geometry of the workpieces.	2
Lec5	Sensors for tool systems.	2
Lec6	Sensors for monitoring the machining process.	2
Lec7	Sensors for monitoring the various manufacturing processes.	2
Lec8	Sensors used in transport, storage and assembly systems.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to sensors and discuss safety rules.	2
Lab2	Possibilities of measurement using of strain gauges and configuring the measuring circuit.	2
Lab3	The determination of the characteristics of potentiometric sensors.	2
Lab4	Configuring the measuring circuit for determining the angle of rotation of the spindle.	2
Lab5	The determination of the characteristics of the selected limit switches.	2

Lab6	Comparison of selected methods of temperature measurement.	2
Lab7	The measurement of cutting force components using piezoelectric dynamometer.	2
Lab8	The measurement capabilities of laser interferometer.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
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	individual presentation
F2	PEK_W01 - PEK_W03	colloquium
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 - PEK_U03, PEK_K01 - PEK_K03,	entrance tests and reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Czabanowski R.: Sensory i systemy pomiarowe. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2010
2. Honczarenko J.: Obrabiarki sterowane numerycznie. WNT. Warszawa 2008
3. Tönshoff H.K., Inasaki I.: Sensors in Manufacturing. Wiley-VCH Verlag. Weinheim - New York - Chichester - Brisbane - Singapore - Toronto 2001
4. Turkowski M.: Przemysłowe sensory i przetworniki pomiarowe. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2000
5. Soloman S.: Sensors and Control Systems in Manufacturing, Second Edition, McGraw-Hill Professional, New York, Chicago, San Francisco, 2010

SECONDARY LITERATURE

1. Bishop R.H.: The Mechatronics Handbook. CRC Press. Boca Raton London New York Washington, D.C., 2002
2. Bishop R.H.: Mechatronic Systems, Sensors, and Actuators. Fundamentals and Modeling. CRC Press. Boca Raton, London, New York 2008
3. Fleischer J., Denkena B., Winfough B., Mori M.: Workpiece and Tool Handling in Metal Cutting Machines. Annals of the CIRP. Vol. 55/2/2006, pp.817-839
4. Fraden J.: Handbook of modern sensors. Physics, designs and applications. Springer Science + Business Media. New York 2004
5. Jemielniak K.: Automatyczna diagnostyka stanu narzędzia i procesu skrawania. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2002
6. Nawrocki W.: Sensory i systemy pomiarowe. Wydawnictwo Politechniki Poznańskiej. Poznań 2001
7. Nyce D.S.: Linear Position Sensors - Theory and Application. John Wiley & Sons 2004
8. Wilson J.S.: Sensor technology handbook. Elsevier. Amsterdam - Boston - Heidelberg - London - New York - Oxford - Paris - San Diego - San Francisco - Singapore - Sydney - Tokyo 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors in manufacturing 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_W03	K1AIR_PT_W05, K1AIR_W05, K1AIR_W10	C1 - C2	Lec1 - Lec8	N1, N2
PEK_U01 - PEK_U03	K1AIR_U10, K1AIR_U11, K1AIR_U23	C3	Lab1 - Lab8	N3, N4, N5
PEK_K01 - PEK_K03	K1AIR_K06, K1AIR_PT_K01	C1 - C3	Lec1 - Lec8, Lab1 - Lab8	N1-N5

SUBJECT SUPERVISOR

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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:

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] Sydo M. Wprowadzenie do CAD, Wydawnictwo naukowe PWN/MIKOM, 2009
[2] Gendarz P.: Wspomaganie komputerowe CAD/CAM (I-DEAS, Unigraphics,AutoCAD), Gliwice: Wyd. Pol., 2007
[3] Mechen P.: Od koncepcji do wytwarzania. Seria wydawnicza CAx dla praktyków.

SECONDARY LITERATURE
[1] Pacyna J.: Parametryczne projektowanie CAD z wykorzystaniem systemu Unigraphics NX. Ofic. Wyd. Pol. Rzesz., 2005
[2] http://nxcad.pl

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_U01, PEK_U02	K1AIR_PT_U03	C1, C2	Pr1 - Pr12	N1, N2, N3, N4

PEK_U03	K1AIR_U13	C3	Pr13, Pr14	N3, N4
PEK_K01	K1AIR_K02	C2	Pr8, Pr11	N2

SUBJECT SUPERVISOR

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
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: **ARM031209**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Project	Number of hours

Proj1		2
Proj2		6
Proj3		6
Proj4		4
Proj5		4
Proj6		4
Proj7		4
Proj8		9
Proj9		4
Proj10		2
		Total hours: 45

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. tutorials
N3. 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_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	
P = F1		

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
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_U01, K1AIR_U02	C1,C2		N1, N2
PEK_U02	K1AIR_U03, K1AIR_U04	C1, C2		N1, N2
PEK_U03	K1AIR_U07, K1AIR_U08	C3		N1, N2
PEK_K01	K1AIR_K02, K1AIR_K03	C1, C2, C3		N1, N2, N3
PEK_K02	K1AIR_K05	C1, C2, C3		N1, N2, N3
PEK_K03	K1AIR_PT_K01	C1, C2, C3		N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Proseminarium dyplomowe**
Name in English: **Diploma proseminar**
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: **ARM031210**
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. The student has the knowledge covered by the curriculum of the first level studies.

SUBJECT OBJECTIVES

C1. The students are to acquire skills in presenting the content of the diploma thesis and defending its theses.
C2. Preparation of the students for the diploma examination.
C3. Motivation of the students to do the diploma thesis on time.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student can prepare answers to the diploma examination problems and intelligently answer the questions asked.
PEK_U02 - The student can prepare a lucid presentation and discuss the progress in carrying out the diploma thesis.
PEK_U03 - The student can easily discuss topics relating to the main field of study.

III. Relating to social competences:

PEK_K01 - The student understands the need for lifelong learning within the range of automation and robotics engineer activity and improving her/his professional and social competences.
PEK_K02 - The student understands the need for critical discussion of the results of engineering work done as part of team.
PEK_K03 - The student is aware of the responsibility for her/his own work and its effect on the functioning of the enterprise.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	The discussion of the realization mode of proseminar, the assignment of diploma examination issues to which answers are to be prepared, the determination of the order in which the diploma thesis are to be presented.	1
Sem2	The discussion the rules for writing diploma thesis and anti-plagiarism actions.	2
Sem3	The discussion, by the students, of the diploma examination issues selected from group A.	2
Sem4	The discussion, by the students, of the diploma examination issues selected from group B.	2
Sem5	The discussion, by the students, of the diploma examination issues selected from group C.	2
Sem6	Reporting on the current progress of the diploma thesis and a discussion. Part 1.	2
Sem7	Reporting on the current progress of the diploma thesis and a discussion. Part 2.	2
Sem8	Reporting on the current progress of the diploma thesis and a discussion. Part 3.	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - self studies and preparation for examination
N2. self study - preparation for project class
N3. multimedia presentation
N4. 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_U01, PEK_K01 - PEK_K03	grading the prepared answers to the diploma examination questions
F2	PEK_U02 - PEK_U03, PEK_K01 - PEK_K03	grading the presentation and the ability to discuss
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Wiszniewski A.: Sztuka pisania. Videograf II, Katowice 2003
2. Wiszniewski A.: Sztuka mówienia. Videograf II, Katowice 2003
3.Internal Decree of the Rector No. 75/2015 of 2 October 2015. on the verification of the undergraduate, engineering and masters thesis by The University Anti-plagiarism System.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma proseminar
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_U01, K1AIR_U06	C1	Sem2 - Sem5	N1, N2
PEK_U02 - PEK_U03	K1AIR_PT_U05, K1AIR_PT_U06	C2, C3	Sem6 - Sem8	N3, N4
PEK_K01 - PEK_K03	K1AIR_K01, K1AIR_K06	C1 -C3	Sem1 - Sem8	N1 - N4

SUBJECT SUPERVISOR

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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

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma seminar**
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: **ARM031213**
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. The student has the knowledge covered by the curriculum of the first level studies.

SUBJECT OBJECTIVES

C1. Strengthening the rules for writing diploma thesis.
C2. The students are to acquire skills in presenting the content of the diploma thesis and defending its theses.
C3. Motivation of the students to do the diploma thesis on time.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - For the specified diploma thesis goal and range the student can develop a plan of carrying out the diploma thesis, determine its structure and write the thesis on her/his own.
PEK_U02 - The student can prepare a lucid presentation and discuss the progress in carrying out the diploma thesis.
PEK_U03 - The student can easily discuss topics relating to the main field of study.

III. Relating to social competences:

PEK_K01 - The student understands the need for lifelong learning within the range of automation and robotics engineer activity and improving her/his professional and social competences.
PEK_K02 - The student understands the need for critical discussion of the results of engineering work done as part of team.
PEK_K03 - The student is aware of the responsibility for her/his own work and its effect on the functioning of the enterprise.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	The discussion of the realization mode of proseminar, the determination of the order in which the diploma thesis are to be presented, the repetition the rules for writing diploma thesis and anti-plagiarism actions.	3
Sem2	Presentations of the current progress of the diploma thesis and a discussion. Part 1.	3
Sem3	Presentations of the current progress of the diploma thesis and a discussion. Part 2.	3
Sem4	Presentations of the current progress of the diploma thesis and a discussion. Part 3.	3
Sem5	Presentations of the current progress of the diploma thesis and a discussion. Part 4. Recapitulation of the seminar.	3
		Total hours: 15

TEACHING TOOLS USED

N1. self study - self studies and preparation for diploma examination
N2. self study - preparation for diploma thesis
N3. multimedia presentation progress towards the diploma thesis
N4. 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	Sem1 - Sem5	grading the presentation and the ability to discuss
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Internal Decree of the Rector No. 75/2015 of 2 October 2015. on the verification of the undergraduate, engineering and masters thesis by the University Anti-plagiarism System

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma seminar
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_U03	K1AIR_PT_U05, K1AIR_PT_U06, K1AIR_U23	C1 - C3	Sem1 - Sem5	N1 - N4
PEK_K01 - PEK_K03	K1AIR_K03, K1AIR_K06	C1 - C3	Sem1 - Sem5	N1 - N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **CAD/MES w modelowaniu procesów technologicznych**
Name in English: **CAD/FEM in modeling 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: **optional**
Subject code: **ARM031214**
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. Have a basic knowledge of the technological processes.
2. Have a basic knowledge of design in 3D.
3. Have a basic understanding of the strength of materials, mechanics and the theory of machines and mechanisms.

SUBJECT OBJECTIVES

C1. To gain the knowledge in the field of modern engineering tools for analysis and optimization of technological processes.
C2. To gain the basic knowledge and skills to construct mathematical models of the technological processes.
C3. To understand the influence of the process parameters on the forming forces.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know the construction of mathematical models of the technological processes.
PEK_W02 - Have a basic knowledge of the possible applications of the finite element method to the process analysis and optimization of the technological processes.
PEK_W03 - Know the basic relationships between material properties and parameters of forming process.

II. Relating to skills:
PEK_U01 - It gains the skills necessary to build mathematical models of the technological processes.
PEK_U02 - Is able to perform the calculation and initial optimization of the plastic forming process.
PEK_U03 - Is able to determine the critical parameters of forming process based on mathematical model.

III. Relating to social competences:
PEK_K01 - It acquires conviction about the responsibility for the work.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to modeling the technological processes.	1
Lec2	Basics of FEM issues .	2
Lec3	Basics of FEM issues .	2
Lec4	Models of materials, stress-strain curves, yield criterion.	2
Lec5	Schematization of forming processes.	2
Lec6	Methodology of problem solving nonlinear FEA.	2
Lec7	Methodology of mathematical modeling of forming processes.	2
Lec8	Examples of FEM modeling in the development of technological processes.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Introduction to computer simulation of the technological 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.	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	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	project rating
P = F1		

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
CAD/FEM in modeling 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_W03	K1AIR_PT_W02, K1AIR_PT_W03, K1AIR_PT_W04	C1, C2, C3	Wy1 -Wy7	N1, N4
PEK_U01 - PEK_U03	K1AIR_PT_U02, K1AIR_PT_U03, K1AIR_U07	C1, C2, C3		N2, N3
PEK_K01	K1AIR_PT_K01	C3		N2

SUBJECT SUPERVISOR

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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: **ARM031215**
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 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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Dynamika maszyn**
Name in English: **Dynamics of machines**
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: **ARM031216**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - self studies and preparation for examination
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_W02, PEK_W03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dynamics of 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	K1AIR_W05, K1AIR_W06	C1, C2, C3		N1, N2
PEK_W02	K1AIR_W05, K1AIR_W06	C3		N1, N2
PEK_W03	K1AIR_W05, K1AIR_W06	C1, C2, C3		N1, N2

SUBJECT SUPERVISOR

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English:
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: **ARM031250**
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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.
N2. 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, PEK_K01	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

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	K1AIR_PT_U06			
PEK_K01	K1AIR_K05			

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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

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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.	Lec1-7	N1.
PEK_W02	K1AIR_W02, K1AIR_W11	C2.	Lec2-4	N1.
PEK_W03	K1AIR_W11	C2.	Lec5-7	N1.
PEK_U01	K1AIR_U09	C1.,C3,	Cl1-3	N2.

PEK_U02	K1AIR_U09	C2,.C3.	Cl5	N2.
PEK_U03	K1AIR_U09	C2.,C3.	Cl6,7	N2.
PEK_K01	K1AIR_K06	C1.,C2.,C3.	Lec1-8, Cl1-8	N1.,N2.
PEK_K02	K1AIR_K03	C1.,C2.,C3.	Lec8, Cl1-8	N1.,N2.
PEK_K03	K1AIR_K01	C1.,C2.,C3.	Lec1-8,Cl1-8	N1.,N2.

SUBJECT SUPERVISOR

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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: **Fizyka**
Name in English: **Physics**
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: **FZP001067**
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)	90	60	30		
Form of crediting	Examination	Crediting with grade	Crediting with grade		
Group of courses					
Number of ECTS points	3	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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Competences in subjects Mathematics and Physics with Astronomy for graduate of the Secondary School.

SUBJECT OBJECTIVES

C1. C1. Gain basic knowledge from selected areas of classical and modern Physics.
C1.1. Principles of kinematics, dynamics and law of conservation of impulse, energy and momentum.
C1.2. Vibration and wave motion.
C1.3. Basics of Phenomenological and Statistical Physics.
C1.4. Electrostatics, Magnetostatics and Electromagnetic Induction.
C1.5. Specific theory of relativity.
C1.6. Quantum physics, physics of the atom, physics of the atomic nucleus.
C2. C2. Gain skills on qualitative understanding of selected principles and laws of Classical and Modern Physics as well as quantitative analysis selected phenomena from this area of knowledge.
C3. C3. Acquire experience of basic measurements methods and techniques of selected physical quantities and gain skills in:
C3.1. Performing basic measurements of physical quantities.
C3.2. Numerical analysis and processing of experimental data with evaluation of measurement uncertainties.
C3.3. Preparation of written report from performed measurements with application of used software.
C4. C4. Development of social competences including emotional intelligence involving the ability to work in a student group. Fixation of sense of responsibility and honesty in academe and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - PEK_W01 knows: a) basics of the vector calculus in the Cartesian coordinate system, c) basics of the unit analysis, the physical quantity concept and the rules of instant estimation of values; the importance of physics in the surrounding world and the everyday life as well as discoveries and achievements of a selected classical and modern physics for the progress of the civilization,
PEK_W02 - has a basic knowledge on the dynamics of the progressive movement, has a knowledge on: a) the conception of the mass and force, b) the condition of applicability of the Newton laws and the correct writing of the equations of motion, c) the formulation of the second law of dynamics using the concept of momentum, d) the formulation of the momentum conservation law.
PEK_W03 - has a knowledge on fields of conservative forces, is able to determine the following physical quantities: the work and the power of a mechanical force, the kinetic and potential energies; knows: a) the law of work and kinetic energy, b) relationship between conservative forces and the potential energy, c) is able to formulate the law of conservation of the mechanical energy.
PEK_W04 - is able to define: the torque, the angular momentum and the moment of inertia for the material points, the system of the material points and the rigid body, the kinetic energy of the system of the material points and the rigid body in the rotary movement, knows the second law of the dynamics for the rotation of a rigid body about a fixed axis, is able to formulate and prove the law of the angular-momentum conservation for: the single particle, the system of the material points, and the rigid body.
PEK_W05 - has a knowledge on the dynamics of the periodic motion, and the detailed knowledge of: a) the harmonic motion of the simple and physical pendula, the particle performing the harmonic oscillations in the vicinity of the balanced state, b) the damped oscillations, c) the forced oscillations and the mechanical resonance.
PEK_W06 - has a knowledge of the wave motion and has the detailed knowledge of: a) basic properties of the mechanical waves (including the sound) and their sources, b) the monochromatic plane wave equations and basic physical quantities of the wave motion, c) velocities connected to the wave motion, d) relations between the wave velocity (including the sound) and the elastic properties of the medium, the mechanical energy transported by the waves, e) the transportation of the mechanical energy by the waves, f) the dependence between the wave intensity and the distance from the wave source, g) the Doppler effect, h) the acoustic-wave interference and the clumping.
PEK_W07 – has a basic knowledge on the principles of the phenomenological thermodynamics, knows basic thermodynamic concepts, the heat transportation and its description, the functions of the thermodynamic state, the thermodynamic processes (the ideal gas, the ideal gas equation), has detailed knowledge on; a) the

thermodynamic temperature scale, b) the conversions of the ideal gas, c) the internal energy and the entropy of the system, d) the work made by gas and the heat exchange in thermodynamic processes of the ideal gas, e) methods of evaluation of the changes of the entropy of the ideal gas, f) the thermodynamics of the heat engines and their efficiency in the direct and reverse cycles, g) the Bolzmann-Planck entropy (the statistical interpretation of the entropy), h) the Bolzmann (barometric formula) and Maxwell distribution functions, i) the average square velocity of the particles of the ideal gas, the microscopic interpretation of the temperature and pressure of the ideal gas; the principle of the equal partition of the heat energy.
PEK_W8 - knows basic mathematical tools of the vector-field analysis: the operators of gradient, divergence, rotation, knows the Gauss-Ostrogradskii and Stokes theorems.
PEK_W9 - has a basic knowledge on the properties of the gravitational and electro-magnetic fields, has a knowledge on the generation of the gravitational, electrostatic, and magnetostatic fields; has a knowledge on the magnetostatics particularly in; a) the impact of the magnetic field on the electric charges and the current carrying conductors (the Lorentz force), b) the Biot-Savart and Ampere laws and their applications for determining the intensity and induction of the magnetic fields of the selected sources (linear and circular current-carrying conductors, coil), c) the definition of unit of the magnetic field intensity; is able to describe quantitatively the potential energy of the magnetic dipole and the torque acting on the magnetic dipole in an external magnetic field; has a knowledge on the energy and the energy density of the electromagnetic field. Furthermore, he/she has a knowledge on the electromagnetic induction phenomenon (knows the Faraday law and the Lenz rule), has a knowledge on the Maxwell equations (the integral form of them) and the material equations.
PEK_W10 has a basic knowledge on the properties of the electromagnetic waves (including the light) and their applications, in particular, knows the concept of the flat monochromatic electromagnetic wave and: a) the wave spectrum, b) the dependence of the refration index on the relative electric and magnetic permeabilities of the medium; has knowledge on the energy and momentum transportation with the waves, the Poynting vector, the interaction of the incident wave with a surface; has a basic knowledge concerning: a) dispersion phenomena, the total internal reflection, method of polarizing the light, the Malus law, b) the light interference in thin film systems, c) the light diffraction, d) the resolution efficiency of the optical systems (the Reyleigh criterion), e) aberrations in the optical systems and animal (human) eyes and correction methods.
PEK_W11- has a knowledge on the special theory of relativity and its applications. In particular he/she knows and understands the Einstein's postulates, the Lorentz transformations and resulting consequences (time dilation, length contraction). Has a basic knowledge on the relativistic dynamics, in particular, knows the concepts of the relativistic momentum of the particle, the relativistic kinetic an total energies, knows the relativistic equation of motion and the relativistic momentum and energy relationship, the equivalence of the mass and the energy and the need to apply the results of the special theory of relativity in the global positioning systems.
PEK_W12- has a basic knowledge on the fundamentals of the quantum physics, the physics of the atom, the solid state physics and some applications; has a detailed knowledge on: a) the black-body radiation, b) the Bohr model of the Hydrogen atom (the energy and angular momentum quantization) and quantum energy levels of the electron in the atom (Franck-Hertz experiment), c) the fotoelectric and Compton effects, d) the interaction of the light with the matter and the fundamentals of the laser working, e) particle-wave duality of the light and the elementary particles (de Broglie hypothesis, the matter waves), f) the Heisenberg uncertainty principle, g) the wave function and its interpretation, h) the (stationary and time dependent) Schrodinger equations, i) the Schrodinger equation of the particle in the infinitely-deep potential wall, j) the quantum tunelling and its applications, k) spin and spin magnetic moment of the electron (Stern-Gerlach experiment), m) the Pauli exclusion principle, quantum numbers of the electrons in the atoms, electronic configurations of the elements of the Mendeleev table, n) specific properties of solids
PEK_W13- has a knowledge on the fundamentals of the physics of the atomic nucleus, in particular, knows indicators that characterize the nucleus and the nuclear forces, has a knowledge concerning a) the bound energy of the nucleons and its importance for the nuclear energy generation, nuclear synthesis b) the laws of the the radiative decay, c) date determination using the isotopes, d) physical principles of the imaging with nuclear magnetic resonance.
PEK_W14- has a knowledge on the basics of the elementary-particle physics and astrophysics, in particular, knows: a) the basic types of the fundamental interactions, b) the standard model of the elementary particles

(leptons, quarks, hadrons, Higgs Boson); c) the structure and types of the matter in the Universe and the standard model of the Universe expansion (the big band, the Hubble law, the cosmic background radiation, the dark matter, the predictable future of the Universe).

II. Relating to skills:

PEK_U01 - PEK_U01 - is able to: a) efficiently apply vector calculus used in physics, b) define and use the conceptions of the instantaneous velocity, the tangential, radial and total acceleration and the orientations of them in the space.

PEK_U02 - can: a) prove the law of the momentum conservation, b) correctly formulate the vector equation of motion and its scalar version in the Cartesian coordinate system, c) solve (ie determine time dependence of basic kinematic quantities) scalar equations of motion taking into account the initial conditions, d) solve problems concerning the collision dynamics using the principle of the momentum conservation.

PEK_U03 - is able to; a) verify the conservative nature of the forces, b) derive and apply the law of conservation of the mechanical energy, c) apply the law of conservation of the mechanical energy to solve problems, d) calculate the mechanical work and the power of the fixed and variable forces, the kinetic and potential energies, changes in the kinetic energy of the particle / body with the theorem on the work and the kinetic energy, e) determine the force vector knowing the analytic form of the potential energy.

PEK_U04 – can derive the law of conservation of momentum of the system of material points, correctly write and solve the equation of the rotational motion with fixed rotation axis and of the translational-rotational motion of the rigid body. Can determine: a) torque, b) angular momentum of single particles and rigid bodies, c) kinetic energy of the rotational motion, work and power in the rotational motion, e) change of the kinetic energy of the rotational motion using the theorem on the work and the kinetic energy; moreover can apply the law of the conservation of the angular momentum to writing and solving specific problems in the rigid-body dynamics.

PEK_U05 - is able to properly describe and analyze equations of periodic motion of: a) pendulums: mathematical, physical as well as particles under potential force, performing small oscillations around the position of equilibrium, b) damping oscillations, c) sinusoidal driving force oscillations. Can determine: periods of vibration, time dependencies of kinematic and dynamic quantities of periodic vibrations, characterize the phenomenon of mechanical resonance and explain its importance (positive and negative) in mechanical elements.

PEK_U06 - can: a) write the wave equation for the monochromatic mechanical plane wave, b) determine values of the basic physical quantities of the wave motion (length and frequency, wave vector, repetition rate, phase velocity, velocity of media particles), c) quantitatively characterize the energy transported by the mechanical waves, and the Doppler, interference and beats phenomena, d) interpret and calculate the loudness level of the sound sources.

PEK_U07 – is able to use the first and the second law of thermodynamics for quantitative and qualitative description of different processes of ideal gas and determine values: a) the heat added to the system, the work done by the ideal gas, changes of the internal energy in gas processes, b) the efficiency of the heat engines working in the direct or reverse cycle. Can: analyze and draw graphics representing processes of the ideal gas, derive the Mayer formula and the equation of the adiabatic process, calculate the heat transfer between materials. He/she can: a) evaluate the dependence of the pressure on the height using the Bolzmann distribution function, b) derive the mean square value of the velocity of the particles in an ideal gas, c) derive the state equation of the ideal gas, d) apply the principle of the equal partition of the heat energy, e) explain the microscopic nature of the temperature and pressure of the ideal gas.

PEK_U08 – can efficiently use mathematical tools of the vector-field analysis to solve simple problems of the electromagnetism.

PEK_U09 – is able to: a) point out the sources of the gravitational and electromagnetic fields, b) derive the Newton and Coulomb laws from the Gauss laws and show the potential character of the gravitational/electrostatic field, c) apply the knowledge of the gravitational field for quantitative and qualitative characteristics of the field, produced by the mass or the system of masses. In particular has skills enabling the calculation of the vectors of the gravitational field intensity for the spherically symmetric mass distribution and the gravitational potential energy, the potential energy of electric/magnetic dipole and torque that acts on the dipole in an external electromagnetic field, the density of energy of the electromagnetic field, on the basis of the Gauss law. He/she is able to describe: a) the magnetostatic field quantitatively (determine the magnetic induction and intensity using the Biot-Savart and Ampere laws) for specific sources of the field (linear and circular current carrying conductor, the coil), b) the motion of the electric charges in the magnetic field (the cyclotron, a selector of the particle velocity, the mass spectrometer), c) determine the force that acts on the conductor with the current placed in the magnetic field, d) to determine the unit of the electric current intensity; has skills enabling the application of the knowledge on the electromagnetic induction to the qualitative and quantitative characterization of the current generators; is able to clarify the non-potential character of the electric field induced by the variable magnetic field; to explain the

meaning of the Lenz rule and to characterize the phenomenon of the electromagnetic induction in the context of the energy conservation law; is able to correctly and precisely explain the meaning of the Maxwell equations (in the integral form) and material equations.
PEK_U10 – is able to apply the knowledge on the physics of the electromagnetic waves and optics (the laws of the geometric optics) to explain and quantitatively analyze specific optical phenomena (the total internal reflection, the interference, the diffraction, the polarization, the dispersion) as well as to quantitatively characterize the resolution ability of optical instruments, wave field, and the energy transportation by waves.
PEK_U11 – is able to apply the knowledge of the special theory of relativity for interpretation of its consequences, in particular to characterize relationships between kinematic and dynamic quantities, measured in two moving relative to each other inertial frames of reference. In particular can a) explain longitudinal, relativistic Doppler effect, b) explain the physical meaning of the formula E = mc2, c) quantitatively analyze the kinematics and dynamics of the linear motion of body under influence of constant force, d), justify the need of applying the special theory of relativity in the global positioning satellite systems.
PEK_U12 – can apply the knowledge on the fundamentals of the quantum physics to the analysis of simple problems and to the quantitative interpretation of specific topics and physical effects which take place on the nanometer or subnanometer scale of the lengths. In particular he/she is able to: a) present the quantization of the energy levels in the Bohr model of the Hydrogene atom, b) explain the importance of the fotoelectric effect and of the experiments by Compton, Franck-Hertz, Stern-Gerlach in the development of the quantum mechanics, c) explain the particle nature of the light, d) explain the particle-wave duality of the light and of the elementary particles, e) explain the wave-function interpretation, f) solve one-dimensional stationary Schrodinger equation of the particle in an infinite potential wall, g) point out the applications of the tunneling effect.
PEK_U13 – can: a) explain physics of the energy generation in the nuclear reactors and tokomaks on the basis of the nucleon-bounding energy, b) indicate and characterize positive and negative aspects of the nuclear energetics, c) characterize the types of the radiative decays, d) characterize the fusion of light nuclea insight the Sun, e) estimate the age of the materials on the basis of the radiative decay law, f) explain physical aspects of imaging the tissues and organs using the magnetic resonance
PEK_U14 – can characterize: a) types of the fundamental interactions, b) the standard model of the elementary particles, c) structure and types of the matter in the Universe, e) the standard model of the expanding Universe.
PEK_U15 – can use simple apparatus to measure values of physical quantities and perform simple and complex measurements of physical quantities using the manual of the test-bench.
PEK_U16 – can elaborate the results of measurements, perform the analysis of the measurement uncertainties

and edit the report of the measurements made in the Laboratory of the Fundamentals of Physics using the knowledge PEK_W01 - PEK_W14, skills PEK_01 - PEK_U14, and computational tools (the text editors, office packages, computational environments).

III. Relating to social competences:
PEK_K01 - PEK_K01 – Searching and objective and critical analysis of information or arguments, rational explanation and justification of their point of view using the knowledge of physics.
PEK_K02 – understanding the need for self- assessment and self-education, including improvement of attention concentration on important issues, developing the capacity for self-knowledge and acquired skills and ability to self- assessment, self-control and responsibility for the results of actions taken.
PEK_K03 – independent and creative thinking
PEK_K04 – work in a team and relying on improving methods for the selection of a strategy to optimally solve the tasks assigned to the group.

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Lec 1 Organizational matters. The physical quantities, their role in everyday life and in civilization progress. The bases of kinematics, reference frames, curvilinear motion. (1h) Lec 1,2 Physical quantities. Bases of kinematics and Newton’s dynamics. Equations of motion (2h) Lec 2 Work and mechanical energy. The law of conservation of mechanical energy (1h) Lec 3 Dynamics of the material points system. The principle of conservation of momentum. Collisions.(2h) Lec 4,5 Kinematics and dynamics of rotational motion of the rigid body. The principle of conservation of the angular momentum. (4h) Lec 6,7 Oscillations around stable equilibrium state. (3h) Lec 7,8 Basic properties of mechanical waves. Elements of acoustics. Wave energy. (2h) Lec 8,9 First and second principles of thermodynamics. Ideal gas conversions. Entropy. Real gases (2h) Lec 9,10,11 Gravitational interactions, central field, potential and energy of gravitational field. (2h) Lec 11,12 Magnetostatic field. Interaction of magnetic field with current currying conductor. (2h) Lec 12,13 Electromagnetic induction. Maxwell equations. Electromagnetic waves. (3h) Lec 14 Elements of relativistic kinematics and dynamics. (2h) Lec 15 Physics of the atom, atomic nucleus, elementary particles. Elements of astrophysics (2h)	30
		Total hours: 30
Form of classes – Classes		Number of hours

Cl1	Cl. 1, 2, 3,4 Solving selected problems of dynamics of the linear, curvilinear, and rotary motion, with use of mechanical work, kinetic and potential energy, and laws of conservation of mechanical energy, momentum and angular momentum. (4h) Cl. 5 Test - evaluation of educational effects relating to skills: PEK_U01, PEK_U06, PEK_K01, PEK_K03 (1h) Cl. 6,7,8 Analyzing and solving problems of kinematics and dynamics of oscillations and wave movement.(3h) Cl. 9,10 Solving problems of thermodynamics. (2h) Cl. 11,12 Analyzing and solving problems of electrodynamics and theory of relativity. (2h) Cl. 13,14 Analyzing and solving problems of quantum physics. (2h) Cl. 15 Test – evaluation of educational effects relating to skills: PEK_U07, PEK_U12, PEK_K01, EK_K03 (1h)	15
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Lab 1 Introduction to LPF: issues of organization and conducting of classes, introduction of student with: a) the safety rules for measurements (short health and safety training), b) how to prepare writing reports, c) the basics of the measurement uncertainty analysis. Performance of simple measurements.(2h) Lab 2 Making measurements using analog and digital gauges. Statistical processing of simple and complex results of measurements, estimation of simple and complex measurement uncertainty, graphical presentation of the results of measurements and measurement uncertainty, preparation of the report.(2h) Lab 3 Making measurements of selected mechanical quantities +++, developing reports (2h) Lab 4 Making measurements of selected thermodynamical quantities +++, developing reports (2h) Lab 5 Making measurements of selected electromagnetic quantities +++, developing reports (2h) Lab 6 Making measurements of selected optical or quantum quantities +++, developing reports (2h) Lab 7 Supplementary classes, crediting test concerning principles of calculation of measurements uncertainties (2h) Lab 8 Crediting of laboratory exercises. (1h)	15
		Total hours: 15

TEACHING TOOLS USED

N1. N1. Lecture with multimedia presentations (Power Point), demonstrations and showing physical phenomena. N2. Exercises - solving and discussing physical problems. N3. Laboratory exercises - performance and discussion of measurements. Processing of measurements results and estimation of their uncertainties. Evaluation of reports from performed laboratory measurements. N4. Own work - solving problems in frames of preparation to exercises. N5. Own work - preparation of laboratory experiments and measurements. N6. Own work - individual studies of material presented during lecture. N7. Consultations. N8. Laboratory exercises and problems solving - written 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_W14,	Written/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_U16; PEK_K01-PEK_K04	Oral answers, discussions, written tests.
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_U16; PEK_K01-PEK_K04	Oral answers, written tests and reports of laboratory exercises.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tomy 1.2., Wydawnictwo Naukowe PWN, Warszawa 2003; J. Walker, Podstawy fizyki. Zbiór zadań, PWN, Warszawa 2005 i 2011.
[2] Paul A. Tipler, Ralph A. Llewellyn, Fizyka współczesna, Wydawnictwo Naukowe PWN, Warszawa 2012;
[3] I.W. Sawieliew, Wykłady z fizyki, tom 1. i 2., Wydawnictwa Naukowe PWN, Warszawa, 2003.
[4] W. Salejda, Fizyka a postęp cywilizacyjny (45,35 MB), Metodologia fizyki (1,1MB); available at http://www.if.pwr.wroc.pl/index.php?menu=studia&left_menu=jkf

SECONDARY LITERATURE
[1] J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1. i 2., WNT, Warszawa 2008.
[2] J. Orear, Fizyka, tom 1. i 2., WNT, Warszawa 2008.
[3] Z. Kleszczewski, Fizyka klasyczna, Wyd. Politechniki Śląskiej, Gliwice 2001.
[4] L. Jacak, Krótki wykład z fizyki ogólnej, Oficyna Wydawnicza PWr, Wrocław 2001;
[5] K. Sierański, K. Jezierski, B. Kołodka, Wzory i prawa z objaśnieniami, cz. 1. i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 2005; K. Sierański, J. Szatkowski, Wzory i prawa z objaśnieniami, cz. 3., Oficyna Wydawnicza SCRIPTA, Wrocław 2008.
[6] Witryna dydaktyczna Instytutu Fizyki PWr w zakładce Jednolite kursy fizyki znajdują się zalecane e-materiał dydaktyczne.
LITERATURA UZUPEŁNIAJĄCA W JĘZYKU ANGIELSKIM:
[1] H.D. Young, R.A. Freedman, SEAR'S AND ZEMANSKY'S UNIVERSITY PHYSICS WITH MODERN PHYSICS, Addison-Wesley Publishing Company, wyd. 12. z 2008 r.
[2] D.C. Giancoli, Physics Principles with Applications, 6th Ed., Addison-Wesley, 2005; Physics: Principles with Applications with MasteringPhysics, 6th Ed., Addison-Wesley 2009.
[3] R.A. Serway, Physics for Scientists and Engineers with Modern Physics, 8th Ed., Brooks/Cole, Belmont 2009;
[4] [4] P.A. Tipler, G. Mosca, Physics for Scientists and Engineers, Extended Version, W. H. Freeman 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Physics
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_W14	K1AIR_W02	C1, C2, C4		N1, N6
PEK_W08÷PEK_W10	K1AIR_W11	C1, C2, C4		N1, N6
PEK_U01÷PEK_U14	K1AIR_U01	C1, C2		N1, N2, N4, N6, N7
PEK_U15÷PEK_U16	K1AIR_U10	C3		N3, N5, N6, N7, N8
PEK_K01÷PEK_K04	K1AIR_K01, K1AIR_K05, K1AIR_K07	C4		N1÷N8
PEK_U06, PEK_U07	K1AIR_U10	C2		N2, N4, N7, N8
PEK_U09	K1AIR_U10	C2		N3, N5, N7, N8

PEK_K01- PEK_K08	K1AIR_K02	C1, C2, C3		N1 - N7

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK HUMANISTYCZNY (Ochrona własności)**
Name in English:
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: **HMH100035BK**
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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		2
		Total hours: 2

TEACHING TOOLS USED

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	wg kart opracowanych przez SNH	
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

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_W18	wg kart opracowanych przez SNH		wg kart opracowanych przez SNH
PEK_K01	K1AIR_K10	wg kart opracowanych przez SNH		wg kart opracowanych przez SNH

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYKI OBCE**
Name in English: **Block of Foreign languages**
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: **JZL100655BK**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)					
Form of crediting					
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Block of Foreign languages
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_U03	K1AIR_U05, K1AIR_U18, K1AIR_U23, K1AIR_U24, K1AIR_U26	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.
PEK_K01 - PEK_K02	K1AIR_K02, K1AIR_K05, K1AIR_K12	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Algebra z geometrią analityczną**
Name in English: **Algebra and Analytic 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: **MAP001039**
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	1.5	1.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		4
Lec2		4
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		3
Lec10		2
Lec11		2
Lec12		3
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1		2
Cl2		2
Cl3		2
Cl4		3
Cl5		2
Cl6		3
Cl7		1
		Total hours: 15

TEACHING TOOLS USED

N1.
N2.
N3. tutorials
N4.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W3 PEK_K02	

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	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Algebra and Analytic 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	K1AIR_W01	C1, C4		N1, N3, N4
PEK_W02	K1AIR_W01	C2, C4		N1, N3, N4
PEK_W03	K1AIR_W01	C3, C4		N1, N3, N4
PEK_U01	K1AIR_U06	C1, C4		N2, N3, N4
PEK_U02	K1AIR_U06	C2, C4		N2, N3, N4
PEK_U03	K1AIR_U06	C3, C4		N2, N3, N4
PEK_K01-K02	K1AIR_K05	C1-C4		N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza matematyczna**
Name in English: **Mathematical analysis**
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: **MAP001091**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45	30			
Number of hours of total student workload (CNPS)	150	90			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	5	3			
including number of ECTS points for practical (P) classes		3			
including number of ECTS points for direct teacher-student contact (BK) classes	3.0	2.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		3
Lec2		2
Lec3		4
Lec4		2
Lec5		2
Lec6		3
Lec7		4
Lec8		3
Lec9		3
Lec10		3
Lec11		3
Lec12		2
Lec13		4
Lec14		2
Lec15		3
Lec16		2
		Total hours: 45
Form of classes – Classes		Number of hours
Cl1		8
Cl2		3
Cl3		2
Cl4		2
Cl5		3
Cl6		2
Cl7		4
Cl8		4
Cl9		2
		Total hours: 30

TEACHING TOOLS USED

N1.
N2.
N3. tutorials
N4.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (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_K02	
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_U04 PEK_K01-PEK_K02	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mathematical analysis
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		N1, N3, N4
PEK_W02	K1AIR_W01	C2, C4		N1, N3, N4

PEK_W03	K1AIR_W01	C3, C4		N1, N3, N4
PEK_U01	K1AIR_U02	C1, C4		N2, N3, N4
PEK_U02	K1AIR_U02	C2, C4		N2, N3, N4
PEK_U03	K1AIR_U02	C2, C4		N2, N3, N4
PEK_U04	K1AIR_U02	C3, C4		N2, N3, N4
PEK_K01-K02	K1AIR_K05	C1-C4		N1-N4

SUBJECT SUPERVISOR

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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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK ZAJĘCIA SPORTOWE**
Name in English: **Block of Sports Activities**
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: **WFW000000BK**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					
Number of hours of total student workload (CNPS)					
Form of crediting					
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Block of Sports Activities
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_K01	K1AIR_K12	wg kart przygotowanych przez SWFiS		wg kart przygotowanych przez SWFiS

SUBJECT SUPERVISOR