Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy negocjacji**
Name in English: **THE BASIS OF NEGOTIATIONS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **HMH100035BK**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

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		1
Lec5		1
Lec6		1
Lec7		1
		Total hours: 10

TEACHING TOOLS USED

N1.
N2. case study
N3.
N4.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
THE BASIS OF NEGOTIATIONS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W,U,K	K2MBM_W09, K2MBM_W11	C1-4		N1-4

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK KURSÓW HUMANISTYCZNYCH**
Name in English: **Block of humanistic courses**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **HMH100035BK.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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		10
		Total hours: 10

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
Block of humanistic courses
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W	K2MBM_W09, K2MBM_W11	wg kart opracowanych przez SNH		wg kart opracowanych przez SNH

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYK OBCY (B2+, C1+)**
Name in English:
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **JZM042050.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		10			
Number of hours of total student workload (CNPS)		30			
Form of crediting		Crediting with grade			
Group of courses					
Number of ECTS points		1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes		0.5			

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 – Classes		Number of hours
Cl1		10
		Total hours: 10

TEACHING TOOLS USED

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	wg kart przygotowanych przez SJO	
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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U	K2MBM_U02, K2MBM_U03, K2MBM_U15, K2MBM_U18	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO
PEK_K	K2MBM_K02	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYKI OBCE (A1/A2/B1)**
Name in English:
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **JZM042051.**
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		1.5			

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

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2MBM_U02, K2MBM_U03, K2MBM_U06, K2MBM_U18	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO
PEK_K01	K2MBM_K02	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO

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: **Inżynieria maszyn roboczych**
Name in English: **Heavy Engineering Vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM041129**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Crediting with grade			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	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Positive mark from drive system of vehicles and off-road vehicle engineering,
2. Analytical thinking,
3. Competence in foreign languages,

SUBJECT OBJECTIVES

C1. The aim of the course is to expand knowledge in systems and structures of engineering vehicles, and their components.
C2. The aim of the course is to acquire practical knowledge about principle of operation of different machines, their purpose and the calculation of the basic values characterizing their work.
C3. The aim of the course is to acquire practical skills of design calculations selected processes and the aim is to acquaint listeners with the automation process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - is able to select the proper working machine to the task, identify the processes while working cycle and perform basic calculations of the expected results. Sure recognizes working machines due to their intended use and functionality.

PEK_W02 - can describe the processes of mining with the use of different tools shapes, knows the rules of system operation and driving mechanisms, explains how to automate processes and difficulties arising from the introduction of automatic or semi-automatic working cycle.

PEK_W03 - can calculate basic values for the selected process, look in the literature ratios and relationships necessary to complete the project

II. Relating to skills:

PEK_U01 - is able to formulate and solve problems related to the functioning of machines, it estimates the expected result when calculating instruments

PEK_U02 - able to propose their own ideas of working arm and their control systems performing similar functions

PEK_U03 - is using literature to interpret the results obtained during the execution of the project and use the catalogs

III. Relating to social competences:

PEK_K01 - iis creative in action and actually selects the order of operations

PEK_K02 - aesthetically performs assigned projects

PEK_K03 - is aware of the completion of the master degree, as a leader

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	General information about working machines (purpose, principles of construction, classification).	2
Lec2	The structures and systems design representative of working machines: cutting and loading machines (drilling ground and underground longwall shearers and paving, bulldozers, rippers, scrapers, graders, loaders, continuously operated excavators and bucket digging, dredging). Examples and implemented functions.	2
Lec3	Machines for lifting and transport, examples of calculations, the use of civil and industrial.	2
Lec4	Selected auxiliary machinery, the need to use, examples.	2
Lec5	Fundamentals of engineering cutting and loading excavated material	2
Lec6	Characteristics of the basic processes of mining, tools, machines, shape and technological requirements of tools for cutting.	2
Lec7	Basics cantilever construction teams working, practical examples.	2
Lec8	Types and design solutions of the driving system for working arm mechanisms	2
Lec9	The automation and examples of working machines: A) Automate the process of loading by wheel loader B) Automate the process of excavating material by excavator	2

Lec10	Construction, principle of operation, working methods, technical characteristics, the base of estimating of material flow of selected machines: A) wheel loaders; B) dozers, scrapers, C) graders, road rollers, pavers bitumen; D) stationary and mobile cranes.	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	The project includes the execution of the calculations selected component forming part of the working machine. The scope of work includes the estimation of loads acting on the structure, conduct simplified calculations of strength, a proposal for own solution and execution of drawings.	10
		Total hours: 10

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-PEK_W03	written - oral test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W03, PEK_U01 - PEK_U03	project positive mark
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Inżynieria maszyn roboczych. Część 1. Podstawy urabiania, jazdy, podnoszenia i obrotu, Pieczonka Kazimierz, rok wydania: 2009 (wydanie II poprawione)

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Heavy Engineering Vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W1-PEK_W3	K2MBM_KE_W01	C1, C2	L1-L12	N1
PEK_U1-PEK_U3	K2MBM_KE_U01	C3	P	N2
PEK_K1-PEK_K3	K2MBM_K10	C1-C3	P	N2, N1

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie układów wieloczłonowych**
Name in English: **Modelling of multibody systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				60	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes				1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of the theory of machines and mechanisms
3. Ability to analyze the kinematics and kinetostatics of mechanisms

SUBJECT OBJECTIVES

C1. Understanding of building of discrete computational multibody models
C2. Understanding the principles of planning research, taking into account the working conditions (kinematic excitations, dynamic excitations, forces, torques, masses in multibody dynamic analysis of computer systems
C3. Ability to critically assess the results of simulations of machinery in computer systems for dynamic analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Ability to apply professional computer system for simulating and analyzing dynamic multibody
PEK_U02 - The ability to model the loads and the nature of work and the ability to analyze the mechanism of the results of the simulation of the multi-segment
PEK_U03 - The ability to compute the kinematics and dynamics of selected groups of mechanisms

III. Relating to social competences:

PEK_K01 - Knowledge of how to take responsibility for own work
PEK_K02 - Acquires care about the aesthetics of the work, including projects and reports

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of building a multibody models	2
Proj2	Basics of modeling mechanisms in the MD.Adams system - modeling links, kinematic pairs, kinematic excitations	2
Proj3	Basics of modeling mechanisms in the MD.Adams system - modeling loads and perform calculations and analysis of results	2
Proj4	Kinematic and kinetostatic analysis of linkage mechanisms - building virtual models	2
Proj5	The analysis of kinematic and dynamic properties of the linkage mechanism (project)	2
Proj6	Analysis of gears (normal, planetary and differential) - principles of construction of virtual model	2
Proj7	The analysis of kinematic and dynamic properties of the gears (project)	2
Proj8	Building models of manipulators - direct and inverse task of kinematics	3
Proj9	Simulation researches of manipulators (project)	3
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02,PEK_U03, PEK_K01, PEK_K02	Evaluation of the Projects
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003. 2. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007 3. MD. Adams – Reference Manual, 2008 4. Haug E.J.: Computer Aided Kinematics and Dynamics of Mechanical Systems. Allyn and Bacon, Boston 1989 5. Norton R., L.: Design of Machinery, An introduction to the synthesis and analysis of mechanisms of machines. WCB, McGraw-Hill, Boston, 1999. 6. Shabana A. Ahmed: Computational Dynamics, . A
Wiley-Interscience Publications, NewYork, 1994.

SECONDARY LITERATURE

1. Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna wydawnicza PWr. Wrocław 1996. 2. Waldron J., Kinzel G.; Kinematics, dynamics and design of machinery, John Wiley & Sons, Inc. New York, 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modelling of multibody systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_U04	C1	Pr1 to Pr3	N2, N3
PEK_U02, PEK_U03	K2MBM_U05, K2MBM_U09	C1, C2, C3	Pr4 to Pr9	N1, N2, N3, N4
PEK_K01, PEK_K02	K2MBM_K03, K2MBM_K05	C1, C2, C3	Pr4 to Pr9	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Monika Prucnal-Wiesztort tel.: 71 320-27-10 email: Monika.Prucnal@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**
Name in English: **Strength of materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042009**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the strength of homogeneous materials.
2. Methods of determination of strength parameters of construction materials
3. Knowledge of processes modifying mechanical properties of construction materials

SUBJECT OBJECTIVES

C1. Explanation of the nature and results of a distinct behaviour of heterogeneous materials, with particular focus on metallic materials including fractures and/or exposed to subcritical crack grow and materials fracturing due to deformations located in shear bands.
C2. Adoption of the criteria and assessment principles for material resistance to subcritical crack grow, as well as the criteria for controlling shear fracture development and the criteria for creep fracture.
C3. Determining the possibilities and principles of practical application of the acquired knowledge in order to prevent catastrophic fracture development, and to predict and evaluate durability, as well as quality and reliability improvement.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The students are able to determine the potential causes and effects of particular types of material fracture, and propose a method to address the problem.

PEK_W02 - The students are able to propose an assessment methodology for material resistance to fracture, and use the obtained results to select a method to prevent the potential consequences of brittle, ductile and creep fracture.

PEK_W03 - The students are able to evaluate the differences between, and results of particular types of damage and propose actions which delay and/or eliminate the most dangerous material damage, i.e. fracture. In other words, the students have basic impact on the quality of production processes, reliability and durability of finished products, and thereby on safety and the costs of production, exploitation, monitoring and renovations

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Principles of the analysis of potential damages and their consequences. Risk assessment criteria. The importance of the knowledge about damage mechanism.	2
Lec2	Maps of strain, local damage and material fracture mechanisms.	2
Lec3	The methodology for testing resistance to catastrophic fracture development in plane strain state (KIC) and plane stress condition (KC).	2
Lec4	Possibilities and principles of practical application of KIC for the purposes of predicting and preventing catastrophic fracture development.	2
Lec5	Methods for predicting and evaluating the durability of materials working in creep regime.	2
Lec6	Criteria and principles of preventing and/or controlling fracture caused by the localization of strains in shear bands. Examples of practical applications.	2
Lec7	Diagrams of yield strains depending on the localization of strains and the fracture of materials during cold deformation.	2
Lec8	Maps of strain mechanisms and the mechanisms of fracture of materials during hot deformation. Principles and examples of multi-criteria selection of materials. Definition and meaning of material index.	2
Lec9	Principles of using the maps to prevent fracture.	2
Lec10	Causes and effects of properties degradation due to the processing and exploitation of materials in particular conditions. Methods for testing the degree of degradation of mechanical properties of a material and its impact on the assumed durability of a technical structure (examples).	2
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W-02, PEK_W03	Class test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Neimitz A.: Mechanika pękania. PWN, Warszawa 1998. German J. Podstawy mechaniki pękania, Wyd. Politechniki Krakowska, 2011. Frost H.J., Ashby M.F. Deformation-Mechanism Maps, Pergamon, Oxford, 1982. Ashby F. M.: Materials selection in mechanical design. Elsevier 2005. Dzidowski E. S.: Mechanizm pękania poślizgowego w aspekcie dekohezji sterowanej metali. Wyd.PWr., Wrocław 1990. Dzidowski E. S.: Physical concept of shear fracture mesomechanism and its applications. Central European Journal of Engineering, 2011, nr 1(3), s. 217-233.

SECONDARY LITERATURE

Broek D.: Elementary engineering - fracture mechanics. Noordhoff Int. Publishing, Leyden, 1974. Ashby M. F.: Jones D. R.: Materiały inżynierskie. Własności i zastosowania. WNT, Warszawa 1995. Dzidowski E. S.: Jak projektować, wytwarzać i eksploatować rury do bezpiecznej pracy pod ciśnieniem. Rudy i Metale, 2008, nr 11, s. 714-721.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_W03	C1-c3	Lec1-Lec15	N1-N2

SUBJECT SUPERVISOR

dr inż. Grzegorz Chruścielski tel.: 3393 email: grzegorz.chruscielski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zintegrowane systemy wytwarzania**
Name in English: **Integrated manufacturing systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042013**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Possess a knowledge on methods and technique of manufacture and industrial engineering
2. Able to design a process of manufacture by machining and chip-less methods
3. Possess a knowledge on CAD, CAM CAPP systems, able to use CAD/CAM programs

SUBJECT OBJECTIVES

C1. Cognition of informatics systems of an enterprise and a sense of well-ordered flow of part information
C2. Cognition of advanced, engineering techniques and tools allowing to resolve of problems, manufacturing system improvement and rules their integration
C3. Cognition of informatics platforms used for manufacturing process integration

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Able to define tasks of informatics subsystem for manufacturing processes by machining ad chip-less methods

PEK_W02 - Able to select of proper programs aiding of engineering, assuring information flow consistency

PEK_W03 - Able to indicate sources of manufacture disturbances and efficient organizing of the process

II. Relating to skills:

III. Relating to social competences:

PEK_K01 - Know role of man in integrated manufacturing systems

PEK_K02 - Able to teem working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scale of production, sources of manufacture disturbances, importance of efficient process organization	1
Lec2	Activity fields of the enterprise and related specific informatics sub systems	1
Lec3	Subsystems of manufacturing, aims and task of integration, connection of inhomogeneous components as a whole for improvement of effectiveness of production course in disturbances and variable conditions of manufacture	1
Lec4	Conception of computer integrated manufacture, platforms of integration	1
Lec5	Data flow between CAD and CAM systems. Methods of aiding of design and technology records defined rules of integrated product model creation, comprising design and technological features	1
Lec6	Informatics architecture of integrated system of manufacture, informatics strategy, CIM, integration of technical and organizational features aiming efficient product manufacture	2
Lec7	Integration of CAX systems as base for integration systems of manufacture	1
Lec8	Process planing (CAPP) in the frame of integrated systems	2
Lec9	Integrated design and concurrent engineering, the role in manufacturing preparation time shortening, common features, differences	1
Lec10	Specific features of chip-less methods in CAD/CAM and CAPP systems, the role of external CAE systems and expert systems	2
Lec11	Linear and batch production, methods of production smoothness ensure, synchronization and balance of production, manufacturing nests and Flexible manufacturing systems	1
Lec12	Integrated CAD/CAM/CAE programs, designing and product live cycle management (PLM)	2
Lec13	Enterprice models, visualization of information flow	2
Lec14	Business and engineering areas integration, problems with exchange of different type of information, development of exchange information on product systems, standard IS95.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. tutorials
N4. self study, preparation for colloquium

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Griffin R. W., Management footing of organizations, PWN, Warszawa 2007.
Pająk E., Production managemet. Product, technology, organization., PWN, Warszawa
Lisowski E., Axiomatization and integration of designing tasksTech. PK publishing, Krakow, 2007
E. Chlebus; CAX computer techniques in engineering. WNT 2000.
Kasprzak T. (ed.), Reference models in business management, Difin, Warszawa 2005,

SECONDARY LITERATURE

Hobbs, Chris. A practical approach to WBEM / CIM management / Boca Raton [etc.] : Auerbach, cop. 2004.
Walsh R. A., tytuł: McGraw-Hill machining and metalworking handbook,
McGraw-Hill, 2006
Talavage, Joseph. Flexible manufacturing systems in practice : applications, design, and simulation / New York ; Basel : Marcel Dekker, 2010.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Integrated manufacturing systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W03	K2MBM_W04, K2MBM_W06, K2MBM_W07, K2MBM_W09	C1, C3	Lec1 - Lec3, Lec11 - Lec14	N1, N2, N3
PEK_W02	K2MBM_W05, K2MBM_W06, K2MBM_W07	C1 - C3	Lec4, Lec5 - Lec10, Lec12, Lec13	N1, N2, N3
PEK_K01-PEK_K02	K2MBM_K04, K2MBM_K10	C1 - C3		N1, N2, N3,

SUBJECT SUPERVISOR

dr inż. Adam Niechajowicz tel.: 40-49 email: adam.niechajowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania maszyn**
Name in English: **Fundamentals of Machinery Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042014**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Crediting with grade			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	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to manufacturability of a design and manufacturing technologies.
2. Basic knowledge in the field of materials science and strength of materials.

SUBJECT OBJECTIVES

C1. Acquiring of knowledge of the heuristic methods of group and the individual designing.
C2. Acquiring of skills in the field of utilization of methodological tools in the initial stage of designing and algorithmic tools in the phase of purpose specifying.
C3. Acquiring of an ability of practical application of knowledge of designing, technology and organization.
C4. Acquiring of an ability to organize work in a team and to fulfil own specified tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a detailed knowledge of individual and group designing.
PEK_W02 - Has a detailed knowledge of existing tools used in the initial and the final stage of the designing process.
PEK_W03 - Has a detailed knowledge of the methods of assessment and classifying of developed concepts.

II. Relating to skills:
PEK_U01 - Can organize work for others in a project group, as well as fulfil the assigned tasks in the group.
PEK_U02 - Can search for information in the available literature on the techniques and methods of searching solutions in the designing process.
PEK_U03 - Can formulate guidelines for the designing process based on specific requirements and limitations.

III. Relating to social competences:
PEK_K01 - Can think creatively.
PEK_K02 - Can make a report of a carried out engineering work.
PEK_K03 - Can determine the consequences of decisions made in a group in which he works.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, assessment rules and literature. Creation of models of a real problem - the process and technological ones.	2
Lec2	Utilization of methods of more detailed characterization of designing goal in widespread technical systems (e.g. brake structures, recuperative units, steering mechanisms, etc.).	2
Lec3	Practical usage of heuristic and algorithmic methods: morphological table, tree of solutions, example and own design.	2
Lec4	Synthesis - example and practice of process and system designing. Synthesis of own evaluation criteria.	2
Lec5	Organizing initial solutions. Assessment of preliminary designing solutions.	2
Lec6	Detailing of selected - pre-designed device or system	2
Lec7	Selection of models - functional and analytical. Initial calculations.	2
Lec8	Documentation of the project.	2
Lec9	Remodelling of an own algorithm of designing.	2
Lec10	Methods of popularising solutions. Summary of the lectures and additional explanations.	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Scope of the project, rules of assessment, literature. Construction of object models (e.g. structures of: brakes, recuperation systems, steering mechanisms, etc.). Selection of the designing object.	2
Proj2	A practical usage of heuristic and algorithmic methods (morphological table, tree of solutions for own project).	1

Proj3	Synthesis of own evaluation criteria - example and practice. Classifying significance of criteria.	1
Proj4	Creating and managing initial solutions. Preliminary assessment of designing solutions. More detailed characterization of the selected pre-designed device.	2
Proj5	Preparation of technical documentation.	4
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of the project preparation. Presentation of the project.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Dietrich M. (red), Fundamentals of Machinery Design, PWN, Warszawa, editions after 2000 (in Polish).
[2] Dziama A. Methodology of Machinery Design, PWN, Warszawa, 1985 (in Polish).
[3] Góralski A. (red), Task, Method, Solution: Technics of Creative Thinking, WNT, Warszawa, 1977 (in Polish).
[4] Pahl G., Beitz W.: Engineering Design, WNT, Warszawa 1984 (in Polish).
[5] Skarbiński M., Skarbiński J.: Manufacturability of Machinery Design. PWN Warszawa 1982 (in Polish).

SECONDARY LITERATURE

[1] Dziama A. et al. (red),Fundamentals of Machinery Design, PWN, Warszawa, 2002 (in Polish).
[2] Kurmaz L. et al. Fundamentals of Machinery Design, PWN, Warszawa, after 2000 (in Polish).
[3] Kurmaz L. et al. Fundamentals of Machinery Design, PWN, Warszawa, after 2000 (in Polish).
[4] Norton R. L.: Machine Design: An Integrated Approach. 3/E. Prentice Hall, 2006.
[5] Pahl G., Beitz W. et al. Engineering Design. A Systematic Approach. Springer, 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Machinery Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W06	C1	Lec1 - Lec10	N1, N2
PEK_W02	K2MBM_W06	C2	Lec1 - Lec10	N1, N2
PEK_W03	K2MBM_W06	C1, C2	Lec4, Lec5	N1, N2
PEK_U01	K2MBM_U14	C2, C4	Proj1 - Proj6	N3
PEK_U02	K2MBM_U01	C3	Proj2	N3
PEK_U03	K2MBM_U07	C2, C3	Proj1	N2, N3
PEK_K01	K2MBM_K10	C1, C2	Proj1 - Proj4	N3
PEK_K02	K2MBM_K03	C3	Proj5	N3, N4
PEK_K03	K2MBM_K05	C4	Proj1 - Proj4	N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Franciszek Przystupa tel.: 71 320-21-55 email: franciszek.przystupa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie maszyn i urządzeń**
Name in English: **Machines and devices control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042015**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of electronics, electrotechnics, automatics and the most common used control systems.
2. Student possess basic knowledge of calsic mechanics and fluid mechanics.
3. Student possess basic knowledge of consrtuction of simple hydraulic systems and components: pumps, motors, cylinders and valves.

SUBJECT OBJECTIVES

C1. Get knowledge and skills in area of construction and working and application principle of automatics devices (sensors, controllers, actuators, operator panel) and software in machines and devices.
C2. Acquaint students with working principle of electrohydraulic components with continous operation (proportional valves and servovalves) and its application in hydraulic drive systems.
C3. Acquaint students with control and regulations techniques selected parameters of hydraulic drive systems especiallyspeed of hydraulic actuator.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - In the result of lesson student schould be able to explane design rules, programm and starting the most common used machines control systems.

PEK_W02 - In the result of lesson student schould be able to explane design rules of machines equipped with hydraulic and electrohydraulic drive.

PEK_W03 - In the result of lesson student schould be able to call and describe advanced automatics systems equipped with different kinds of regulators.

II. Relating to skills:

PEK_U01 - In the result of lesson student schould be able to select apptioprate components machines control systems and programm control device to propertly realize specified functions.

PEK_U02 - In the result of lesson student schould be able to design and build hydraulic and electrohydraulic systems performing defined functions.

PEK_U03 - In the result of lesson student schould be able to prepare to operation electrohydraulic device and plan and execute tests. On the basis of tests results student schould be able to formulate appriopriate conclusions.

III. Relating to social competences:

PEK_K01 - Student can cooperate and work in the group during building hydraulic and electrohydraulic systems and during report preparation.

PEK_K02 - Student can plan and execute tests during laboratory.

PEK_K03 - Student can propertly identify and solve problems during program control systems and building hydraulic and electrohydraulic systems. Student can formulate appriopriate conclusions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Structure and types of control systems. Sensors, their typer, properties and examples.	1
Lec2	Requirements for automation systems, reliability and availability, MTBF	1
Lec3	Industrial controllers, modes of control systems working. PLC controllers, their constructions, operation, programming and application examples.	2
Lec4	Safety acpects in machines and devices, compatibility requirements, statements and standards, examples of sefety devices. Systems of industrial communication and dispersed control systems.	1
Lec5	Numerical control systemsCNC, their construction and operation, displacements measurement in CNC machine tool, functions of selected CNC systems assemblies, interpolation, position regulation, possibilities of NC programs generation, standard STEP-NC.	2
Lec6	Electrical servodrives (NC axies): analog and digital, their properties and examples. Linear direct drives.	2
Lec7	Control RC systems of industrial robots. Construction and types of industrial robots. Methods of industrial robots programming.	1
Lec8	Human-machine interfaces HMI, their functions, signals, symbols, requirements, control panels and HMI examples. Superior control systems, vizualizations systems and SCADA control systems.	1

Lec9	Methods of speed control of hydraulic actuator.	2
Lec10	Proportional valves as control components in systems.	1
Lec11	Hydraulic regulators and proportional directional control valves.	1
Lec12	Logic valves in proportional technique.	1
Lec13	Load-sensing - systems, efficiencies.	1
Lec14	Controllers and regulators in hydraulic systems.	2
Lec15	Regulation systems with electrohydraulic servovalves.	1
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Sensors in automation systems.	1
Lab2	Examples of logic systems.	1
Lab3	Construction of sequence control system.	1
Lab4	Continous regulation systems, controlles sets selection and regulation quality tests.	2
Lab5	Programming controllers freely programmed PLC.	2
Lab6	Numerical control systems of CNC machines tool.	2
Lab7	RC control systems of industrial robots.	1
Lab8	Reversible systems.	1
Lab9	Fast movement systems.	1
Lab10	Throttle-serial speed control of hydraulic actuator.	2
Lab11	Throttle-parallel speed control of hydraulic actuator.	1
Lab12	Volumetric speed control of hydraulic actuator.	1
Lab13	Hydraulic actuator control with proportional directional control valve.	2
Lab14	Hydraulic actuator control with Load-sensing directional control valve.	1
Lab15	Position regulation system with electrohydraulic servovalve.	1
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation
N4. work at test stands for programm machines control devices.
N5. work at electrohydraulic test stand for student's individual systems building.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02, PEK_U03	oral response for practical verification of design, programm and building control systems.
F2	PEK_U03	report
F3	PEK_U01, PEK_U02; PEK_K01-PEK_K03	student's activity note.
P = (2F1+F2+F3)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Presentation – slides for lectures (electronic version),
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Tomasiak E.: Hydraulic and pneumatic drives and control (in polish). Wydawnictwo Polit. Slaskiej, Gliwice, 2001
Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.
Kosmol J.: Automation of machine tool and machining (in polish). WNT, 2000.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.
Norvelle F. D.: Electrohydraulic control systems. Prentice-Hall INC, New Jersey 2000.

SECONDARY LITERATURE

Legierski T., Wyrwał J., Kasprzyk J., Hajda J.: Programming PLC controllers (in polish). WNT, 1998.
Palczak E.: Dynamics of hydraulic components and systems (in polish). Wydawnictwo Ossolineum, Wrocław, 1999.
Honczarenko J.: Industrial robots: construction and application (in polish). WNT, 2004.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Machines and devices control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W04	C1 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N1
PEK_W02	K2MBM_W06	C2 C3	Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N1
PEK_W03	K2MBM_W04	C1 C3	Lec6 Lec11 Lec13 Lec14 Lec15	N1
PEK_U01	K2MBM_U13	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N2 N3 N4
PEK_U02	K2MBM_U09, K2MBM_U13	C2 C3	Lab8 Lab9 Lab10 Lab11 Lab13 Lab14	N3 N5
PEK_U03	K2MBM_U05, K2MBM_U11	C2 C3	Lab1 Lab4 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N5
PEK_K01	K2MBM_K03, K2MBM_K04, K2MBM_K10	C2 C3	Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N5
PEK_K02	K2MBM_K05, K2MBM_K10	C2 C3	Lab1 Lab4 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N3 N4 N5
PEK_K03	K2MBM_K06, K2MBM_K10	C1 C2 C3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Lab15	N2 N4 N5

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-45-99 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Matematyka inżynierska**
Name in English: **Engineering mathematics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042016**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the issues presented in the courses "Mathematical Analysis", "Algebra and Analytic Geometry" and "Engineering Statistics".

SUBJECT OBJECTIVES

C1. Students should obtain basic knowledge from the linear programming and its applicability
C2. Participants learn to formulate optimization problems in the field of management and construction, technology and systems designing
C3. Students should obtain ability to solve optimization problems using dedicated computer programs
C4. Participants obtain and consolidate social skills including emotional intelligence involving the ability to work in a group to solve problems effectively with regard to accountability, integrity and fairness in the proceedings

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - As a result of the course students are able to formulate and solve the problems in the field of linear programming and decision support

PEK_W02 - Student should know linear programming basics and the idea of the simplex algorithm, learn basis of a complex sensitivity analysis of optimum solutions

PEK_W03 - At the end of the course student has a knowledge from discrete programming and basic algorithms of its solution, knows transportation algorithms and network programming and can apply the knowledge to solve corresponding optimization problems

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Operations research as a tool to support decision-making processes - classification decision-making processes. Methods of decision making under conditions of certainty. Linear programming (PL) - linear model of decision-making, decisions acceptable and optimal. Graphical method.	2
Lec2	Methods for solving PL. Formulation and solution of problems PL – interpretation of the results. Simplex method.	2
Lec3	Comprehensive analysis of the optimal solution.	2
Lec4	Classical transportation models and algorithms.	2
Lec5	Transportation model (unbalanced, with limited bandwidth routes). The problem of localization of production.	2
Lec6	Examples of problems that may be transferred into the transportation problem models. Problems of warehousing, transportation and production.	2
Lec7	Introduction to graph theory. Project management (network programming). The maximum flow in a network. Ford-Fulkerson algorithm. Decision trees.	2
Lec8	Minimum spanning tree. The shortest routes in the graph.	2
Lec9	Deterministic Network Models (CPM, PERT). Time and cost analysis. Gantt charts. Resource optimization in network.	2
Lec10	Final exam.	2
		Total hours: 20

TEACHING TOOLS USED

N1. informative lecture

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering mathematics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W01	C1, C2. C3	Le1	N1
PEK_W02	K2MBM_W01	C1, C2. C3	Le2, Le3	N1
PEK_W03	K2MBM_W01	C1, C2. C3	Le4 - Le9	N1

SUBJECT SUPERVISOR

dr inż. Anna Jodejko-Pietruczuk tel.: 71 320-28-17 email: Anna.Jodejko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika analityczna**
Name in English: **Analytical Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042017**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	10			
Number of hours of total student workload (CNPS)	120	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	4	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	1.4			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of Lagrangian mechanics in the dynamics of mechanical holonomic systems (for systems with constrains depending and not depending from time). Knowledge of vibration analysis of linear holonomic conservative systems with many degrees of freedom.
C2. Knowledge of the dynamics of a rigid body in case of the spherical rotation about a fixed point. The using in to the gyroscope (in approximate theory range). Elementary knowledge of the theory of mass collisions (elastic and inelastic collision)
C3. Ability to independently analyze complex mechanical systems with a holonomic constrains which are not depend on time to determine : differential equations of movement, natural vibration frequency spectrum, the modal matrix. The ability of dynamic analysis of rigid bodies in case of the spherical rotation about a fixed point and gyroscope.
C4. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and socjety

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can define a discrete mechanical holonomic system and its possible and virtual displacements. He knows the fundamental problem of dynamics. He knows the classification of dynamical systems in respect of the constrain types. He knows the general equation of dynamics and the principle of virtual work.
PEK_W02 - He knows the notion of generalized coordinates and configuration space of a dynamical system. He knows the concept of generalized forces (active and inertia). He knows the Lagrange's equations of the first and second kind.
PEK_W03 - He knows the variational interpretation of virtual displacements, the central equation of the dynamics and the Hamilton's principle. He has an elementary knowledge of gyroscopic systems and collision theory.

II. Relating to skills:
PEK_U01 - He is able to apply the virtual work principle and d'Alembert's principle for holonomic systems
PEK_U02 - He can derive the differential equations of motion of discrete dynamical systems by using Lagrange's equations and by using the energy conservation law for conservative holonomic systems.
PEK_U03 - He can calculate the spectrum of natural frequencies and can determine the modal matrix for discrete conservative linear systems. He is able to analyze the dynamics of the gyro using the approximate theory (gyroscopic moment and reaction forces in the supports). He can calculate the collision coefficients in inelastic collision.

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

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Curriculum. Requirements. Examples of dynamic systems. Constrains and their types, classification systems for the sake of the constrain types (holonomic systems), possible velocities and possible displacements.	2
Lec2	The fundamental problem of dynamics, virtual displacement, the notion of ideal constraints, the general equation of dynamics, the virtual work principle.	2
Lec3	The dynamic general equation for the rotational and planar motion of rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples). Generalized forces. Configuration space. Lagrange's equations (of II type).	2
Lec5	Lagrange's equations (cont. examples, applications). Lagrangian.Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	2
Lec6	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes. Harmonically forced vibration, frequency characteristics, an example of oscillation analysis of two- degree- of- freedom system.	2
Lec7	The dynamics of a rigid body in general motion: the orientation, the recognition issue. Kinematics and dynamics of rigid body in case the spherical rotation about a fixed point (reminder of the course Mechanics II), the angular momentum in the general movement.	2
Lec8	The dynamic equations for general motion of rigid body (Euler's equation).	2
Lec9	Gyroscope (approximate theory).	2
Lec10	Variational approach of Lagrangian mechanics.	2
		Total hours: 20
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements. Solving of static problems by using a principle of virtual work	2
Cl2	Solving of dynamic problems by using a dynamic general equation (d'Alembert' s principle).	2
Cl3	Derivation of motion differential equations based on the energy conservation law and Lagrange's equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl4	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl5	Final test	2
		Total hours: 10

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Final test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analytical Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_W01, K2MBM_W02	C1, C2	Lec 1 to Lec 10	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K2MBM_U02, K2MBM_U04	C3	Cl 1 to Cl 4	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K06	C4	Cl 1 to Cl 4	N1,N2, N3,N4

SUBJECT SUPERVISOR

dr inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie materiałów inżynierskich**
Name in English: **Design of Engineering Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042018**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in such disciplines as: Materials science, Strength of materials, Manufacturing technology, processing and recycling of materials, design and examination methods of structure and properties of materials.
2. Skills in usage of technical data and specialized computer software.
3. Skills in collaboration with other users of engineering materials and specialists in the fields of design, manufacturing, processing, and application of materials.

SUBJECT OBJECTIVES

C1. Obtaining the skills in design of chemical composition and structure of engineering materials to produce products with desired mechanical and operational properties.
C2. Obtaining the skills in materials selection for technical applications.
C3. Obtaining the skills in failure analysis of materials and design of repair processes for improvement of products durability.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Possesses advanced knowledge on structure- properties relationship as well as on strengthening mechanisms in materials and their practical usage for material design of products.

PEK_W02 - Knows the fundamentals and design philosophy of modern engineering materials.

PEK_W03 - Knows the criteria and methodology of materials selection and can participate in engineering design of products.

II. Relating to skills:

PEK_U01 - Able to design the materials structure in order to obtain the desired operational properties of product.

PEK_U02 - Able to select a material for a specific product with consideration of economical and ecological aspects.

PEK_U03 - Able to conduct the failure analysis of material and design the repair process for improvement of product durability.

III. Relating to social competences:

PEK_K01 - Possesses the collaboration skills and able to lead the research teams in engineering design process.

PEK_K02 - Possesses the skills of objective evaluation of arguments and formulation of rational conclusions concerning the use of engineering materials for different products and operational conditions.

PEK_K03 - Is prepared to conduct the research on materials design of products.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to design of materials. Effect of chemical composition, processing and microstructure on the properties of materials.	2
Lec2	The role and significance of alloy phase diagrams in design of materials.	1
Lec3	Strengthening mechanisms in metals and alloys - theory and practice.	3
Lec4	Metal matrix composites - fundamentals in design.	2
Lec5	Criteria and quantitative methods of materials selection in engineering design.	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Selection of material for chosen structural component - project - part I.	2
Proj2	Design of chemical composition of steel with desired hardenability.	2
Proj3	Design of microstructure of steel in the process of heat treatment - part I.	2
Proj4	Design of microstructure of steel in the process of heat treatment - part II.	2
Proj5	Selection of material for chosen structural component - project- part II.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - preparation for project class
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03	short test, oral answers, report, discussion
F2	PEK_U01÷PEK_U03; PEK_K01-PEK_K03	defence of project
P = 0,3F1+07F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
O. Wyatt, Introduction to Materials engineering; M.F. Ashby, Selection of Materials in Engineering Design, G.E. Totten, Steel Heat Treatment; W. Dudzinski, Structural Materials in Machine Construction

SECONDARY LITERATURE
M.F. Ashby, D. Jones, Engineering Materials 2; W.F, Hosford, Physical Metallurgy

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of Engineering Materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_W05, K2MBM_W10	C1, C2	Lec1÷Lec5	N1, N2, N3
PEK_U01 - PEK_U03	K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C1, C2, C3	Pr1÷Pr5	N1, N2, N3, N4
PEK_K01	K2MBM_K03, K2MBM_K06, K2MBM_K07, K2MBM_K09, K2MBM_K10	C2, C3	Pr1÷Pr5	N1, N2, N4, N5

SUBJECT SUPERVISOR

dr inż. Krzysztof Widanka tel.: 320-37-00 email: krzysztof.widanka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria powierzchni**
Name in English: **Surface engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042019**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students should have a well-established expertise in manufacturing, especially machining treatments, as well as a basic understanding of measurements of geometric and surface.
2. Students should have a well-established knowledge of the technical drawing, mathematics, physics and materials science.
3. The student should be able to overall planning of the experiment and solve simple technical problems.

SUBJECT OBJECTIVES

C1. To provide knowledge about the possibilities of shaping and describing certain geometric and physical characteristics of the surface layer.
C2. Presentation of the influence of physical characteristics of the surface layer on its future, performance characteristics and the ability to modify the functional properties of the surface layer.
C3. Presentation of the ways to measure the geometrical and physical characteristics of the surface layer.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students should define the surface layer and its main features physical attributes and geometry.
PEK_W02 - Students should know the ability to modify the characteristics of the surface layer due to the expected performance characteristics.
PEK_W03 - Students should know the basic methods of coating.

II. Relating to skills:
PEK_U01 - The student should be able to analyze data from the literature, planning experiments and analyzing the results.
PEK_U02 - Students should have the ability to analyze and describe the physical and geometrical characteristics of the surface layer and the influence of these characteristics by modifying the operating characteristics of the surface layer.
PEK_U03 - The student should be able to use the devices for measuring the physical geometry and the surface layer of the object.

III. Relating to social competences:
PEK_K01 - Students should be able to work in a group and be aware of the responsibility of the collective work.
PEK_K02 - Students should understand the need for continuous learning and increasing their knowledge and skills with the changing technical and social considerations.
PEK_K03 - Students should be aware of coexistence and relations of knowledge and skills in many fields of science.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristic properties of the surface layer (SL) of an object	2
Lec2	The ways and test methods and measurement SL 2D and 3D roughness	2
Lec3	Functional features of the surface in operation of machinery and equipment. Methods for modifying the physical and geometrical characteristics of SL with chip and chipless methods.	2
Lec4	Methods for modifying the physical and geometrical characteristics of SL with chipless methods. The correlation between physical attributes and geometric properties of the SL and its functional features	2
Lec5	Coating	1
Lec6	Colloquium	1
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Analysis of surface changes in the machining process I	2
Lab2	Analysis of surface changes in the machining process II	2
Lab3	Measurement of shape and position of machine parts	2
Lab4	Application of wavelet analysis, fractal and FFT to describe the condition of the surface	2
Lab5	Mathematical modeling of surface structures	2

	Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F2	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F3	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F4	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F5	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
P = (F1+F2+F3+F4+F5)/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Burakowski T., Wierzchoń T, tytuł: Inzynieria powierzchni, wydawnictwo: WNT, Warszawa 2005

SECONDARY LITERATURE

1. Oczos K., Lubimov V., tytuł: Struktura geometryczna powierzchni. Podstawyklasyfikacji., wydawnictwo: Oficyna Wydawnicza Politechniki Rzeszowskiej, rok: 2003
2. Wieczorowski M., Cellary A., Chajda J., tytuł: Przewodnik po pomiarach nierównosci powierzchni czyli o chropowatości i nie tylko, wydawnictwo: Zakład WydawniczyM-Druk, Poznan, rok: 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Surface engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2MBM_W08	C1; C2; C3	Lec1 - Lec5	N1; N3; N5
PEK_U01; PEK_U02; PEK_U03	K2MBM_U05, K2MBM_U08, K2MBM_U11	C1; C2; C3	La1 - La5	N2; N4
PEK_K01; PEK_K02; PEK_K03	K2MBM_K05, K2MBM_K06, K2MBM_K07	C1; C2; C3	La1 - La5	N2; N4

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie ustrojów maszyn**
Name in English: **Machines structures modeling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042020**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			20	
Number of hours of total student workload (CNPS)	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	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of machines load carrying structures
2. Recommendations for fatigue design of machines load carrying structures
3. Ability to design basic machines load carrying structures.
Ability of CAD/CAE application in modeling.

SUBJECT OBJECTIVES

C1. Introduction to the design of complex structures
C2. Individual modeling of complex structures, load application, supports, connections and material
C3. Introduction to the advanced analysis methods used in the complex structures design

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge in the field of modeling of complex machines load carrying structures
PEK_W02 - Knowledge in the field of advanced non-geometric and non-linear analysis
PEK_W03 - Knowledge in the field of structural dynamics

II. Relating to skills:
PEK_U01 - Ability to develop correct simulation model of complex structures in the field of: statics, buckling, dynamics and thermoelasticity
PEK_U02 - Ability to perform advanced non-geometric and non-linear analysis
PEK_U03 - Ability to perform dynamic analysis of machines load carrying structures

III. Relating to social competences:
PEK_K01 - Acquire skills in the responsibility of performed tasks
PEK_K02 - Acquire skills of creative engineering
PEK_K03 - Acquire skills of team work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Design of load carrying structure	2
Lec2	Modeling of complex structures, load application, supports, connections and material	2
Lec3	Advanced analysis of the non-geometric and non-linear type of the structures	2
Lec4	Structural dynamics	2
Lec5	Heat flux analysis in the carrying structures in constant and unstable conditions	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Introduction, standards of the practice classes, CAD/FEM software first steps	2
Proj2	Introduction to the project task, scope of work, assignment the work for students	2
Proj3	Concept design of machine element	2
Proj4	Boundary conditions definition for static, dynamic and thermic analysis	2
Proj5	Preparation of models of selected machine elements: geometry model, discrete model	2
Proj6	Assembly design, connectors, parameters set-up	2
Proj7	Developments of numerical models of selected elements: boundary conditions	2
Proj8	Advanced strength analysis simulations (non-linear, dynamics, thermoelaticity)	2
Proj9	Design modifications	2
Proj10	Report preparation	2
		Total hours: 20

TEACHING TOOLS USED

N1. Design tasks assignments
N2. Multimedia presentation
N3. Individual work – self learning and study for exam
N4. Individual work – project development

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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 (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01 - PEK_K03	Evaluation of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusinski E., Czmochowski J., Smolnicki T. The advanced finite element method in the construction of load-bearing (in polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rusiński E.: Principles of design of bearing structures of vehicles (in polish). Oficyna Wyd. PWr Wrocław 2002
Czmochowski J.:Identification of modal models of mining machines in lignite mining (in polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2008
Borkowski W., Konopka S., Prochowski L.: Dynamics of working machines (in polish), WNT, Warszawa 1996
Rakowski G., Kacprzak Z.:Finite element method in structural mechanics (in polish), Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
Dobrociński S.: Modeling of thermal stress calculation problems (in polish). WNT, Warszawa 2000

SECONDARY LITERATURE

Rusiński E., Czmochowski J., Kowalczyk M., Moczko P., Pietrusiak D., Przybyłek G., Smolnicki T., Stańco M.: Assessment of the technical basic opencast mining machines (in polish), Oficyna Wyd. PWr Wrocław 2015
Pieczonka K.:Engineering of work machines. Part I. The basics of mining, driving, lifting and turning (in polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007
Dudczak A.: Excavators. Theory and design (in polish), PWN, Warszawa 2000
Augustyn J., Śledziewski, Technology of steel welded constructions (in polish), Arkady, Warszawa 1981
Ferenc K., Ferenc J.:Welded constructions. Designing connections. (in polish) WNT, Warszawa 2000
Gryboś R.: Machine vibrations (in polish), Wydawnictwo Politechniki Śląskiej, Gliwice 1998
Kostowski E.:Heat flow (in polish). Wydawnictwo Politechniki Śląskiej, Gliwice 2000
Niezgoda T.: Numerical analysis of selected issues of thermomechanics. (in polish) WAT, Warszawa, 1992
Skrzypek J.: Plasticity and creep. Theory, applications, tasks. (in polish) PWN, Warszawa 1986

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Machines structures modeling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W06	C1, C2	Lec1, Lec2, Lec4, Lec5	N2, N3
PEK_W02	K2MBM_W06	C2	Lec2	N2, N3
PEK_W03	K2MBM_W05, K2MBM_W06	C3	Lec3, Lec5	N2, N3
PEK_U01	K2MBM_U01, K2MBM_U09	C2	Proj1, Proj2, Proj4, Proj5, Proj7	N1, N4
PEK_U02	K2MBM_U04, K2MBM_U07, K2MBM_U09	C3	Proj9	N1, N4
PEK_U03	K2MBM_U01, K2MBM_U07, K2MBM_U09	C1, C2, C3	Proj3, Proj6, Proj8, Proj10	N1, N4
PEK_K01-PEK_K03	K2MBM_K09	C1, C2, C3	Proj1-Proj10	N1, N4

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszyny technologiczne**
Name in English: **Manufacturing machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042021**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has an established knowledge in the area of use and communication using engineering drawing.
2. The student has a basic knowledge of manufacturing techniques.
3. The student has an established knowledge in the field of machine tools structure and their technological capabilities.

SUBJECT OBJECTIVES

C1. Getting to know with the possibilities of integration of technological machines with automated manufacturing systems.
C2. Getting to know the components of flexible solutions applied in automated manufacturing.
C3. Getting to know the flow streams of workpieces, tools, cutting fluids and chips in flexible automated manufacturing.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student has a systematic knowledge of the construction, technical and operational characteristics, instrumentation and technological capabilities of different types of machines manufacturing; has a systematic knowledge about the elements of the manufacturing system and awareness of the importance of using these systems in the manufacturing process.

PEK_W02 - The student knows the structure of the flexible manufacturing system and can describe its main components.

PEK_W03 - The student knows the functionalities of the manufacturing system and can propose different automation solutions for this system.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The functional structure of the manufacturing system.	2
Lec2	The conditions for the development of the flexible automation of manufacturing and its implementation concepts.	2
Lec3	Machine tools used in flexible manufacturing system (FMS).	2
Lec4	Devices for removing burrs from workpieces.	2
Lec5	Coolants, chips disposal and washing workpieces.	2
Lec6	Tool management system in FMS.	2
Lec7	Part management system in FMS.	2
Lec8	Handling, transport and storage systems in FMS.	2
Lec9	Information systems in FMS.	2
Lec10	The supervision and diagnosis of FMS operation.	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Honczarenko J.: Elastyczna automatyzacja wytwarzania. WNT, Warszawa 2000.
2. Krzyżanowski J.: Wprowadzenie do elastycznych systemów wytwórczych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005

SECONDARY LITERATURE

1. Kief H.B.: FFS-Handbuch,Carl Hanser Verlag 1998.
2. Luggen W.W.: Flexible manufacturing cells and systems, Prentice-Hall, Inc. Engelwood Cliffs, NJ, 1991

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_W07	C1-C3	Lec1-Lec10	N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Wacław Skoczyński tel.: 26-39 email: waclaw.skoczynski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie produkcją**
Name in English: **Production Management**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042022**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows and understands the nature of the management process and the basic functions of management.
2. Understands the basic concepts and basic economic rights and economic phenomena and their effects.
3. Posesses a basic knowledge of manufacturing processes.

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of production and manufacturing processes.
C2. Knowledge of methods and techniques for managing different types of manufacturing processes.
C3. The acquisition of skills in planning, organizing and controlling of production processes.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Distinguishes and characterizes different types of production systems.
PEK_W02 - Can define the concepts of production and technological processes.
PEK_W03 - Has knowledge of the methods and techniques of production systems management.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristics of manufacturing organizations and production systems.	1
Lec2	Manufacturing system, its organization and components. Classification of production processes.	1
Lec3	Types and forms of production. Methods of organization of production systems.	1
Lec4	Methods of manufacturing control systems (pull, push and squeeze).	2
Lec5	Characteristics of bottlenecks in manufacturing processes.	1
Lec6	Methods of manufacturing inventory management.	2
Lec7	Principles of planning and scheduling.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Chlebus E.: "Techniki komputerowe CAx w inżynierii produkcji", Wydawnictwa Naukowo-Techniczne, Warszawa 2000,
2. Durlik I.: "Inżynieria zarządzania : Cz. 1 i Cz.2", Wydawnictwo Placet, Warszawa 2007,
3. Liwowski B.: "Podstawowe zagadnienia zarządzania produkcją", Oficyna Ekonomiczna, Kraków 2006

SECONDARY LITERATURE

1. Rogowski A..: "Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie", Wydawnictwa Fachowe CeDeWu, Warszawa 2010, 2. Burchart-Korol D.: "Zarządzanie produkcją i usługami", Wydawnictwo Politechniki Śląskiej, Gliwice 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Production Management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_W10	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7	N1

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania elementów i zespołów maszyn**
Name in English: **Testing of Elements and Assemblies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042023**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			20		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has ordered knowledge of mathematics and the laws of physics, mechanics.
2. Student is able to use and retrive information from the literature and the Internet.

SUBJECT OBJECTIVES

C1. Knowledge of research methods used in solid mechanics.
C2. Knowledge of test equipment and measuring.
C3. Knowledge of registration and processings of measurement results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can choose the right measurement method based on the test piece of machinery and carry out a measurement.

PEK_U02 - Student can prepare a report and discussion the results.

III. Relating to social competences:

PEK_K01 - Student is able to think and act creatively.

PEK_K02 - Student is able to work on tasks independently and in groups.

PEK_K03 - Student understands the need and knows the possibility of lifelong learning.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Shadows methods in machine elements investigations.	3
Lab2	Holographic interferometry application in displacements measurements of machine elements.	3
Lab3	Speckle photography application in solids investigations.	3
Lab4	Application of photoelasticity method in experimental design of machine elements.	3
Lab5	Determine of fluid velocity distribution using laser method.	3
Lab6	Strain gage method application in machines testing.	3
Lab7	Mark	2
		Total hours: 20

TEACHING TOOLS USED

N1. self study - preparation for laboratory class

N2. laboratory experiment

N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

F1	PEK_U01, PEK_U02, PEK_K01, PEK_K02, PEK_K03	Lab exercise reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Orłoś Z., Doświadczalna analiza odkształceń i naprężeń, PWN, Warszawa 1977 (in Polish).
Szczepiński W., Metody doświadczalne mechaniki ciała stałego, PWN, Warszawa1984 (in Polish).
Będziński R., Biomechanika inżynierska. Zagadnienia wybrane, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997 (in Polish).
Roliński Z., Tensometria oporowa: podstawy teoretyczne i przykłady zastosowań, WNT, Warszawa 1981 (in Polish).

SECONDARY LITERATURE

Roliński Z., Tensometria oporowa: podstawy teoretyczne i przykłady zastosowań, WNT, Warszawa 1981 (in Polish).
J.W. Dally, Experimental Stress Analysis, College House Enterprises Llc, 2005.
Beckwith T.G., Mechanical Measurements, Prentice Hall, 1995.
Rastogi K., Optical Measurement Techniques and Applications., Artech House, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Testing of Elements and Assemblies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2MBM_U05, K2MBM_U11, K2MBM_U12	C1, C2, C3		N1, N2, N3
PEK_K01, PEK_K02, PEK_K03	K2MBM_K10	C1, C2, C3		N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Sylwia Szotek tel.: 71 320-29-83 email: Sylwia.Szotek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042134**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					20
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Cross-sectional knowledge on the problems taught in the I and II degree of the studies.

SUBJECT OBJECTIVES

C1. To acquire the skill of presenting the diploma work.
C2. To acquire the skill of discussing the fundamental problems learnt in the I and II degree of the studies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student is supposed to be have the skill of discussing the problems presented in their diploma work as well as the fundamental problems learnt in the I and II degree of the studies.

III. Relating to social competences:

PEK_K01 - The student understands the need for continuing their education process and knows the educational possibilities

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, discussion of the structure and the way of editing the diploma work.	2
Sem2	Introductory discussion on the diploma works.	2
Sem3	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the fundamental areas.	2
Sem4	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the design area.	2
Sem5	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the technology area.	2
Sem6	Presentation of the students' work effects.	8
Sem7	Summary.	2
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

F1	PEK_U01, PEK, K01	Problem discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U, PEK_K	K2MBM_K07, K2MBM_U17	C1,C2	SEM	N1-N3

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy diagnostyki i degradacji maszyn**
Name in English: **Rudiments of the diagnostics and degradation of machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042135**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of destructive processes in engineering materials (fracture mechanics, strength of materials).
2. Basic knowledge of steel features and its application on supporting structures.
3. Basic knowledge of statistical data analysis

SUBJECT OBJECTIVES

C1. Knowledge of basic diagnostic methods and estimation of machines' degradation degree
C2. Knowledge of analysis and estimation of diagnostic signals

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - basic research and measurement methods
PEK_W02 - basic signal analysis methods
PEK_W03 - methods of estimation of machines' degradation

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Diagnostic symptoms	2
Lec2	Basic processing of diagnostic signals.	2
Lec3		1
Lec4	Thermography	1
Lec5		1
Lec6		1
Lec7		1
Lec8	Long-term experiment. Loading history estimation.	2
Lec9	Origin of degradation theory. Introduction.	2
Lec10	Modeling of degradation process in machines.	2
Lec11	Material degradation.	4
Lec12	Structure corrosion and machines degradation.	1
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Dudek D. Elementy dynamiki maszyn górnictwa odkrywkowego. Ofic. Wyd. PWr, 1994[2] Cempel Cz., Tomaszewski F., Diagnostyka maszyn. Zasady ogólne. Przykłady zastosowań. MCNEMT Radom 1992[3] Bartelmus W. Diagnostyka maszyn górniczych. Wyd. Śląsk, 1998[4] Żółtowski B. Podstawy diagnostyki maszyn. Wyd. ATR w Bydgoszczy, 1996[5] Żółtowski B., Cempel Cz. Inżynieria diagnostyki maszyn. Inst. Tech. i Ekspl. PIB, 2004

SECONDARY LITERATURE

[1] Rudowski G. Termowizja i jej zastosowanie. WKL, 1978[2] Morel J. Drgania maszyn i diagnostyka ich stanu technicznego. Polskie Towarzystwo Diagnostyki Technicznej 1998[3] Engel Z. Ochrona środowiska przed drganiami i hałasem. PWN 2001[4] Babiarz S., Dudek D. Kronika awarii i katastrof maszyn podstawowych polskim górnictwie odkrywkowym. Oficyna Wyd. PWr, 2007[5] Będziński R. Pomiary naprężeń metodą elastooptyczną. Wyd. P.Poznańskiej, 1975

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Rudiments of the diagnostics and degradation of machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W06	C1,C2,C3		N1,N2
PEK_W02	K2MBM_KE_W06	C1,C2,C3		N1,N2
PEK_W02	K2MBM_KE_W06	C1,C2,C3		N1,N2

SUBJECT SUPERVISOR

dr inż. Weronika Huss email: weronika.huss@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria ruchu pojazdów**
Name in English: **Theory of vehicle movement**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042136**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		10
Number of hours of total student workload (CNPS)	120		30		60
Form of crediting	Examination		Crediting with grade		Crediting with grade
Group of courses					
Number of ECTS points	4		1		2
including number of ECTS points for practical (P) classes			1		2
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The ability to carry out mathematical calculations and knowledge of the physical laws known in higher education institutes of technology
2. The ability to group work, the ability to conduct research and use of basic measuring equipment
3. Has the ability to independently solve the tasks of design, interpretation of results and preparation of proposals /conclusions

SUBJECT OBJECTIVES

C1. The aim of the course is to broaden the knowledge of vehicle movement theory. The student becomes familiar with the types of land transportation vehicles of their principles of operation of the application. Students can draw the energy balance of movement, knows and is able to calculate the thermal motion of various wheeled and tracked vehicles. He can discuss the different vehicle suspension systems and understands the concept of stability.
C2. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology. Purchasing responsibility for own work and group.
C3. The aim of the course is to analyze individual problem of transportation in rail traffic, and the acquisition of practical knowledge in the design of the railway traffic

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - student is able to explain the functional diagrams wheeled and tracked vehicles, carry out a comparative analysis, familiar areas of their application
PEK_W02 - student is able to define and describe the mechanics of the movement of the wheels meningeal and how to move different categories of vehicles, to make a balance of power. Student distinguishes phenomena occurring during linear motion and curvilinear
PEK_W03 - he student is able to explain and compare the impact of different chassis structures the stability of the vehicle. Recognizes different suspension systems of vehicles both tracked and wheeled. It also has a knowledge of the operation of vehicles.

II. Relating to skills:
PEK_U01 - student can obtain information from the literature and to interpret them in terms of issues related to the theory of motion wheeled and tracked vehicles
PEK_U02 - student is able to analyze the results of the experiment and verify them with the literature and to interpret and formulate conclusions
PEK_U03 - student is able to calculate the energy costs of selected transport vehicles

III. Relating to social competences:
PEK_K01 - student is able to make decisions as a responsible engineer transport taking into account their impact on the environment
PEK_K02 - student is responsible for self and group work
PEK_K03 - student is aware of the legal action taken as an engineer

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Types of transport in land transport vehicles - functional diagrams, basic concepts of traffic engineering unconventional, analogies bionic	2
Lec2	chassis systems of wheeled vehicles - Functional diagrams, application areas, comparative analysis	2
Lec3	Mechanical movement of the wheel - turning, traction-slip, driven inhibition	2
Lec4	Differentials and No Spin- kinematics and dynamics	2

Lec5	Rectilinear motion - motion resistance, traction calculation for different substrates, the balance of power	2
Lec6	Curvilinear motion - side drift tires, the impact of the abolition of the rolling resistance and adhesion, oversteer, understeer, resistance to motion, impact on vehicle motion ESP	2
Lec7	Multi-axis drives Issues - non-compliance, kinematic, circulating power, the balance of power	2
Lec8	Braking - the kinetic energy of the vehicle, braking traction to surfaces, braking distance, control systems skidding when braking	2
Lec9	The stability of wheeled vehicles of various chassis structures systems, static stability, dynamic, passive and active safety systems; Suspension systems for wheeled transport vehicles - aspects of operational stability, driver comfort	2
Lec10	Integrated chassis tracked vehicles - Functional diagrams, application areas, comparative analysis; Caterpillars steel and elastomer - construction defects ways to bring the advantages of drive tracks	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Classes organizational procedures for obtaining laboratory safety, laboratory presentation of content, and perform this topic: Stability experimental invastigation in wheeled l vehicles	2
Lab2	Operational tests of wheel load distribution and kinematic parameters and dynamic of tyres vehicles	2
Lab3	Experimental research process of articulated vehicle snaking	2
Lab4	The study of kinematics and resistance of an articulated vehicle turning on a wheeled chassis	2
Lab5	Research vehicle braking efficiency	2
		Total hours: 10
Form of classes – Seminar		Number of hours
Sem1	Effect of the center of gravity for rolling stability vehicles, anti-lock braking systems on motorcycles, Braking distance, deceleration, gear selection manual /mechanic gearbox.	2
Sem2	The braking force division between the vehicle axles, braking of the tractor-trailer sets. Resistance of movement of the vehicle. Air resistance, rolling resistance, grading resistance; resistance of inertia	2
Sem3	Moments of stabilization in the steering and undercarriage; measure the cross-roll suspension systems, anti-lock braking system, Electronic stability the path of movement of the vehicle.	2
Sem4	Effect of a passenger car tire design for traction vehicle; coefficient of adhesion and method of measurement, determination of the center of gravity of the vehicle.	2
Sem5	Gradeability, vehicle speed limit on the curve; Determination of collision speed based on their deformation.	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. traditional lecture with the use of transparencies and slides
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	Wy1-Wy10	written-oral exam
P = ocena z egzaminu		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	La1-La5	short test, oral response, the report
P = ocena średnia z pozytywnych ocen z zajęć		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	Sem1-Sem5	presentation of a speech, participate in discussions of problem
P = ocena z wygłoszonego referatu z uwzględnieniem udziału w dyskusjach		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Dudziński P., Theorie der Lenksysteme fur industrielle Radfahrzeuge, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2007
2. Mitschke M., Dynamika samochodu. Tom I. Napęd i hamowanie, WKiŁ, Warszawa, 1987
3. Arczyński S., Mechanik ruchu samochodu, WNT, Warszawa, 1994
4. Siłka W., teoria ruchu samochodu, WNT Warszawa, 2002
5. Prochowski L., Mechanika ruchu, WKIŁ, Warszawa, 2005
6. Madej J., Teoria ruchu pojazdów szynowych, Oficyna Wydawnicza Politechniki Warszawskiej, Wrocław, 2005
7. Andrzejewski R., Dynamika pneumatycznego koła jezdnego, WNT Warszawa, 2010

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory of vehicle movement
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W01	C1	Lec1-Lec10	N1, N2
PEK_W02	K2MBM_KE_W02	C1	Lec1-Lec10	N1, N2
PEK_W03	K2MBM_KE_W09	C1	Lec1-Lec10	N1, N2
PEK_U01	K2MBM_KE_U01	C2	La1-La5	N1, N3
PEK_U02	K2MBM_U14	C2	La1-La5	N1, N3
PEK_U03	K2MBM_KE_U02	C2, C3	La1-La5, Sem1-Sem5	N1, N2, N3
PEK_K01	K2MBM_K01, K2MBM_K03	C2, C3	La1-La5, Sem1-Sem5	N1, N2, N3
PEK_K02	K2MBM_K04, K2MBM_K05	C1, C2, C3	La1-La5, Sem1-Sem5	N1, N2, N3
PEK_K03	K2MBM_K09	C1, C2, C3	La1-La5, Sem1-Sem5	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042137**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				180	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				6	
including number of ECTS points for practical (P) classes				6	
including number of ECTS points for direct teacher-student contact (BK) classes				2.8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has knowledge of the basics of constructing typical nodes and machine parts
2. Can perform strength calculations of machine elements
3. Can perform a kinematic analysis of basic machinery and equipment

SUBJECT OBJECTIVES

C1. Familiarization with the principles of constructing machinery and equipment, as well as any structural nodes
C2. Acquire the ability to define and analyze the load (working conditions) of a machine or machine
C3. Acquiring the skills of a structural design

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - He can do the structural design of the complex system of a machine or device
PEK_U02 - It can correctly formulate the kinetic and kinematic conditions that a machine or machine assembly is subjected to
PEK_U03 - Able to optimize complex assemblies of machines and equipment

III. Relating to social competences:

PEK_K01 - Acquires the ability to take responsibility for the work done
PEK_K02 - Think and act in a creative way
PEK_K03 - Acquires the skill of teamwork

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Presentation of the purpose and scope of the transitional work, the proposal of the topics of construction work	3
Proj2	Analysis of existing construction solutions (multimedia presentation)	3
Proj3	Analysis of the concept of solving the construction problem and acceptance of the initial constructional form	3
Proj4	Analysis of the selection of materials for particular elements of the project team (machines, machines)	3
Proj5	Determination of the load acting on the whole team and individual members in different configurations (kinematic analysis)	3
Proj6	Calculation of section dimensions based on analytical formulas and / or computer methods	6
Proj7	Verification of the strength of the joints used (welds, screw joints, bolts, etc.)	6
Proj8	Development of design documentation (assembly drawing and executive drawings)	3
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01-PEK_K03	The rating for the execution of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Basics of machine construction (in Polish) pod red. Marka Dietricha, T. 1÷3,WNT Warszawa 2006
Kurmaz L. W., Kurmaz O. L., Design of nodes and machine parts (in Polish), Wyd. PŚw, Kielce 2006
Kurmaz L. W., Kurmaz O. L.,Constructing the base nodes and machine parts. Construction manual (in Polish), Wyd. PŚw, Kielce 2011
Gronowicz A.: Principles of kinematic systems analysis (in Polish). Oficyna Wydawnicza Politechniki Wroclawskiej, Wroclaw 2003
Ferenc K., Ferenc J.Ł Welded constructions (in Polish), WNT, Warszawa 2000
Rusiński E.: Principles of design of load bearing structures of motor vehicles (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002

SECONDARY LITERATURE

Piątkiewicz A., Sobolski R., Cranes (in Polish), WNT, Warszawa 1977
Pieczonka K.: Engineering of work machines. Vol. 1. Fundamentals of mining, driving, lifting and turning (in Polish), Oficyna Wyd. PWr, Wrocław 2007
Construction machinery, Characteristics and application (in Polish), praca zbiorowa pod kier. prof. I. Bracha, Arkady, Warszawa 1974
ISO 8686-1:1999 Cranes. Principles of calculating and associating loads. General provisions (in Polish)
EN 1993-1-1:2006. Eurokod 3: Design of steel structures

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Pre-final project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K2MBM_KE_U04, K2MBM_U01, K2MBM_U07, K2MBM_U09	C1-C3	Proj1-Proj8	N1-N4
PEK_K01-PEK_K03	K2MBM_K04, K2MBM_K05, K2MBM_K10	C3	Proj1-Proj8	N1-N3

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Dynamika maszyn roboczych i pojazdów**
Name in English: **Dynamics of working machines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042138**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10	20	
Number of hours of total student workload (CNPS)	90		30	60	
Form of crediting	Crediting with grade		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	3		1	2	
including number of ECTS points for practical (P) classes			1	2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of analytical mechanics, linear algebra and differential equations confirmed by completion of relevant courses at university level
2. Has basic knowledge of drive systems for machinery and vehicles
3. Has basic knowledge of the theory of vehicle movement

SUBJECT OBJECTIVES

C1. Consolidate and increase knowledge of the dynamic phenomena occurring in the working machines and vehicles
C2. Acquire skills to solve engineering problems related to the dynamics of working machines and vehicles
C3. To gain the habit of caring about the aesthetics of the work, including projects and reports, and consolidate the awareness of second-degree graduate, as a future leader

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - has consolidated and expanded knowledge of dynamics of systems with one degree of freedom, many degrees of freedom and continuous

PEK_W02 - has expanded and consolidated knowledge of ways to minimize vibrations and the dynamics of working machines

PEK_W03 - has expanded and consolidated knowledge of vehicle dynamics

II. Relating to skills:

PEK_U01 - is able to apply the appropriate computational methods and appropriate computer programs for vibration analysis and dynamic phenomena in mechanical devices

PEK_U02 - is able to shape and modify the dynamic properties of working machines and vehicles according to the needs

PEK_U03 - is able to plan and carry out experiments for identifying some dynamic properties of various working machines and vehicles

III. Relating to social competences:

PEK_K01 - has expanded the competence in care about the aesthetics of the work, including projects and reports

PEK_K02 - has consolidated the awareness of second-degree graduate, as a future leader

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Dynamics of mechanical linear systems with one degree of freedom	2
Lec2	Dynamics of mechanical linear systems with finite amount of degrees of freedom. Reduction of continuous systems to systems with few degrees of freedom.	2
Lec3	Classical and operational modal analysis	2
Lec4	Nonlinear dynamics - selected issues	1
Lec5	Classical methods of vibration isolation. Tuned mass damper	2
Lec6	Stochastic description of road surfaces irregularities	1
Lec7	Vertical dynamics of vehicles	2
Lec8	Longitudinal vehicle dynamics	2
Lec9	Dynamics and vibration in powertrain systems of vehicles and working machines	2
Lec10	Mitigation and damping of noxious vehicle movements	2
Lec11	Selected problems the dynamics of cranes	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Experimental determination of the moments of inertia of machines and their components	2
Lab2	Identification of the dynamic model of crane girder with use of classical experimental modal analysis	2

Lab3	Testing of dynamic effects in the steering system of industrial vehicle	2
Lab4	Testing of a dynamic properties of pneumatic nonlinear vibroisolation system	2
Lab5	Testing of a effectiveness load sway damping system for overhead crane	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Analysis of the work of a given crane and familiarization with a norms refer to dynamic calculations of this type of machines	2
Proj2	Building a simple mathematical model that allows approximate analysis of selected dynamic phenomena occurring during the operation of a given crane	2
Proj3	Building a crane simulation model that takes into account, inter alia, rope flexibility and stiffness of the rail-wheel contact	2
Proj4	Simulation studies of selected dynamic phenomena occurring during crane operation. Interpretation of the results with respect to current standards	2
Proj5	Simulation studies of the impact of applied solutions on dynamics of virtual crane	2
Proj6	Analysis of construction and operating conditions of given industrial wheeled vehicle. Familiarization with selected standards referring to the dynamics of this type of machines	2
Proj7	Building a simple mathematical model that allows approximate analysis of selected dynamic phenomena occurring during the operation given industrial vehicle	2
Proj8	Building the simulation model of given industrial wheeled vehicle	2
Proj9	Simulation studies of selected phenomena and dynamic characteristics of an object such as: snaking, angular oscillations and dynamic stability	2
Proj10	Simulation studies the impact on the dynamics of the test vehicle different structural changes	2
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

P = F1

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02÷PEK_U03, PEK_K01÷PEK_K02	rating developed models and reports from the undertaken calculations and analysis
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bereś W.: Dynamika pojazdów i maszyn roboczych ciężkich. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1983r.[2] Giergiel J.: Drgania Mechaniczne. Wydawnictwo AGH, Kraków 2000r.

SECONDARY LITERATURE

[1] Uhl T.: Komputerowo wspomagana identyfikacja modeli konstrukcji mechanicznych. WNT, Warszawa 1997r. [2] Kaliski S.: Drgania i fale. PWN, Warszawa 1986r.[3] Randall R. B., Tech B.: Frequency Analysis. Brüel and Kjær 1987r.[4] Dudek D.: Elementy dynamiki maszyn górnictwa odkrywkowego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1994r.[5] Dudziński Piotr: „Lenksysteme für Nutzfahrzeuge - Theorie und Praxis”, Springer 2005r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dynamics of working machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W02	C1	Lec1÷Lec4	4, 5
PEK_W02	K2MBM_KE_W02	C1	Lec5, Lec9, Lec11	4, 5
PEK_W03	K2MBM_KE_W02	C1	Lec6÷Lec10	4, 5
PEK_U01	K2MBM_KE_U01	C2	Pr1÷Pr10	2, 5
PEK_U02	K2MBM_KE_U01	C2	Pr5, Pr10	2, 5
PEK_U03	K2MBM_KE_U01	C2	La1÷La5	1, 3, 5
PEK_K01	K2MBM_K03	C3	La1÷La5, Pr1÷Pr10	5
PEK_K02	K2MBM_K07	C3	Pr1÷Pr10	2, 5

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Niezawodność i bezpieczeństwo maszyn**
Name in English: **Reliability and safety of machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042139**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of engineering statistics.

SUBJECT OBJECTIVES

C1. To acquaint the student with the decision problems occurring during the operation of a technical object
C2. Acquisition of modeling processes in the operation phase of object
C3. Learning methods of conducting field tests aimed at collecting, processing and statistical inference from the data.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - To know the basic methods for solving decision problems that occur during the operation of a technical object.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - To explain the causes and effects occurring and the potential damage / disaster / hazard

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic concepts and definitions. Relationship between teaching supplies.	2
Lec2	The model of irreparable component reliability	2
Lec3	The reliability structure of unrecoverable system. Reserving	2
Lec4	Reliability model of repairable element.	2
Lec5	Reliability model of repairable system. Markov process. Stationary solution	2
Lec6	Maintenace strategies. Optimization of maintenance of facilities.	2
Lec7	Maintenace strategies. Reliability Centered Maintenance.	2
Lec8	Safety of installations and technical systems. The notion of risk	2
Lec9	Risk analysis methods: FMEA / FMECA, FTA / ETA	2
Lec10	Fundamentals of risk management methods: PHA, PSA, HAZOP.	2
		Total hours: 20

TEACHING TOOLS USED

N1. 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_K01	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Zio Enrico, An introduction to the basics of reliability and risk analysis. Singapore [etc.] : World Scientific, 2010.

SECONDARY LITERATURE

Birolini, Alessandro, Reliability engineering. Berlin [etc.] : Springer, cop. 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Reliability and safety of machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W06	C1	Lec. 1 - Lec. 10	N1
PEK_K01	K2MBM_K09	C1	Lec. 1 - Lec. 10	N1

SUBJECT SUPERVISOR

Prof. dr hab. inż. Tomasz Nowakowski tel.: 71 320-35-11 email: Tomasz.Nowakowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Problemy smarowania i zużywania maszyn**
Name in English: **Lubrication and wear problems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042140**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a structured understanding of the physical and physicochemical processes occurring in the tribological nodes .2. It has a basic knowledge of the mechanics of continuous media, including the basics of fluid mechanics and flow issues.
2. Skills: 1 It has the ability to apply fundamental fluid mechanics for the fluid flow and its use in art.
3. Social competence: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineering, including its impact on the environment and the associated responsibility for their decyzje.2.Potrafi think in an entrepreneurial manner.

SUBJECT OBJECTIVES

C1. Acquire advanced theoretical knowledge of tribological wear and its type.
C2. Detailed understanding of the types of lubricants, their tribological properties and rheology.
C3. Gaining an ability to select the type and amount of lubricant to lubrication friction and knowledge of the fundamentals of circuit design and environmental aspects of lubrication lubrication assemblies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has detailed knowledge of the tribological wear of materials used in the nodes of friction.
PEK_W02 - He has detailed knowledge of lubricants, their tribological properties and rheology.
PEK_W03 - He has detailed knowledge of the ways of lubricating oils and greases plastic and basic knowledge on lubrication system design.

II. Relating to skills:
PEK_U01 - He can select materials for friction nodes.
PEK_U02 - He can choose the type and amount of lubricant to friction nodes.
PEK_U03 - He can design a simple installation lubrication and define the basic parameters that will determine its reliable functioning.

III. Relating to social competences:
PEK_K01 - He can think and act creatively.
PEK_K02 - It can objectively evaluate the arguments rationally explain and justify their own point of view, using the knowledge gained during lectures and laboratory exercises.
PEK_K03 - It can work, search for information and critically analyze them, both individually and collectively.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Terms and organization of classes, framework programs, the terms of credit. Introduction to lubrication and wear in the construction and operation of machinery. Terms: adhesion of the surface layer, the surface free energy. Work of adhesion.	2
Lec2	Types and characteristics of lubricants. Properties and application of lubricants. The testing of lubricants (including lubricity, mechanical stability, service life and thermal stability).	2
Lec3	Basic rheology of lubricants. Capillary and rotational rheometry. Rheological greases steady flow conditions and with the use of methods for dynamic oscillation. Linear viscoelasticity.	2
Lec4	Methods of lubrication. Selection of the type and amount of lubricant for the lubrication of friction. Process automation lubrication. Construction of central lubrication systems. Examples of applications for central lubrication systems in various industries. Basic design of lubrication.	2
Lec5	Final test.	2
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Measurement of density and viscosity of lubricating oils. Determination of the viscosity index of lubricating oils.	2
Lab2	Lubrication of slioding bearings. Determination of the frictional characteristics of the cross slide bearing. Evaluation of the impact of oil viscosity on the process of hydrodynamic lubrication.	2

Lab3	Measuring the degree of penetration of lubricating greases and study the rheological properties of lubricating greases (compilation flow curves, determination of yield stress).	2
Lab4	Studies on impact of length, diameter and shape of circular pipe pressure drop in lubricants arts.	2
Lab5	Research on the influence of the wall material for the formation of a boundary layer greases in the lubricant.	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_K01 - PEK_K03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Krawiec S. Kompozycje smarów plastycznych i stałych w procesie tarcia stalowych węzłów maszyn. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011. [2] Płaza S., Fizykochemia procesów tribologicznych. Wydawnictwo Uniwersytetu Łódzkiego, Łódz 1997. [3] Bartz W., J., Schmierfette, Renningen-Malmsheim, expert-Verlag, 2000. [4] Bartz W., J.,Getriebe-schmierung. Ehningen bei Bóblingen, expert-Verlag 1989. [5] Czarny R., Smary plastyczne. Wydawnictwo Naukowo-Techniczne, Warszawa 2004. [6] Czarny R., Systemy centralnego smarowania maszyn i urządzeń. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000. [7] Wysocki M., Systemy smarownicze w przemyśle ciężkim. Wydawnictwo Śląsk, Katowice 1971. [8] Laboratory manuals available on the website of the Department PKMiT.

SECONDARY LITERATURE

[1] Froischteter G. B, Trilisky K. K., Ishchuk Yu. L., Stupak P. M., Rheological and thermophysical properties of greases. Gordon & Breach Science Publishers, Londyn 1989. [2] Ishchuk Yu. L., Lubricating grease manufacturing technology. New Age International Limited Publishers, New Delhi 2005. [3] Ferguson J., Kembłowski R., Reologia stosowana płynów. Wydawnictwo Marcus, Łódź 1995. [4] Matras Z., Transport reologicznie złożonych cieczy nienewtonowskich w przewodach. Wydawnictwo Politechniki Krakowskiej, Kraków 2001. [5] Garkunov D. N., Tribotechnika. Masinostroenie, Moskva 1985. [6] Kosteckij B. I., Trenie, smazka i iznos w masinach. Izdatelstvo Technika, Kiev 1970. [7] Lawrowski Z., Tribologia - tarcie, zużywanie i smarowanie. Wydawnictwo Naukowe PWN, Warszawa 1993. [8] Płaza S., Margielewski L., Celichowski G., Wstęp do tribologii i tribochemia. Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Lubrication and wear problems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W03, K2MBM_W05, K2MBM_W08	C1	Lec1	N1, N2, N3
PEK_W02	K2MBM_KE_W03, K2MBM_W05	C2	Lec2, Lec3	N1, N2, N3
PEK_W03	K2MBM_KE_W03, K2MBM_KE_W06, K2MBM_W05	C3	Lec4	N1, N2, N3
PEK_U01 - PEK_U03	K2MBM_KE_U03, K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C1, C2, C3	Lab1 - Lab5	N3, N4, N5
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K07, K2MBM_K10	C1, C2, C3	Lab1 - Lab5, Lec1 - Lec5	N1 - N5

SUBJECT SUPERVISOR

dr hab. inż. Maciej Paszkowski tel.: 71 320-31-12 email: Maciej.Paszkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Synteza układów mechanicznych**
Name in English: **SYNTHESIS OF MECHANICAL SYSTEMS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042141**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	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	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of forms of mechanisms' structure notation.
PEK_W02 - Knowledge of fundamental methods of type synthesis of kinematic systems.
PEK_W03 - Knowledge of fundamental methods of gepmetrical synthesis of kinematic systems.

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

III. Relating to social competences:
PEK_K01 - Purchasing care about the aesthetics of the work, including projects and reports.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Forms of mechanisms' structure notation.	1
Lec2	Methods of type synthesis, set of possible solutions creation.	3
Lec3	Criteria and selection of optimal structure solution.	2
Lec4	Methods of dimensional synthesis of linkages mechanisms.	2
Lec5	Synthesis of mechanisms with higher pairs.	2
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Methods of notation of topology (test and project).	2
Proj2	Type synthesis. Making of possible sets of the solutions (test).	2
Proj3	Type synthesis cont. Selection for optimal solution (project).	2
Proj4	Dimensional synthesis of linkages mechanisms (test and project).	2
Proj5	Synthesis of mechanisms with higher pairs.	2
		Total hours: 10

TEACHING TOOLS USED

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
SYNTHESIS OF MECHANICAL SYSTEMS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_KE_W04	C1-C2	L1-L5	N1-N2
PEK_U01- PEK_U03	K2MBM_KE_U04	C1-C2	Pr1-Pr5	N3-N4
PEK_K01	K2MBM_K03	C1-C2	L1-L5, Pr1-Pr5	N1-N4

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Aspekty bezpieczeństwa w modelowaniu obciążeń pojazdów**
Name in English: **Numerical Simulations of Vehicle Construction loads in aspect safety**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042142.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Crediting with grade			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	1.2			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		2
Lec2		4
Lec3		2
Lec4		4
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		2
		Total hours: 10

TEACHING TOOLS USED
N1. multimedia presentation N2. N3. self study - preparation for project class N4. report preparation

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical Simulations of Vehicle Construction loads in aspect safety
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W08, K2MBM_W01	C1		N1
PEK_W02	K2MBM_KE_W08	C2		N1
PEK_U01	K2MBM_U01	C1		N2, N3
PEK_U02	K2MBM_U05	C1, C2		N2, N3, N4
PEK_U03	K2MBM_U05	C1, C2		N2, N3, N4
PEK_ K01	K2MBM_K10	C2		N1, N2
PEK_K02	K2MBM_K09	C2		N1, N2

SUBJECT SUPERVISOR

dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka i sterowanie silnikiem spalinowym**
Name in English: **Diagnostics and controling engine I.C.**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042143.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		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	Basic engine I.C. parameters	2
Lec2	Indicator chart, calculation of charecteristics	2
Lec3	Timing system, diagnostic	2
Lec4	Piston-crank system, diagnostic	2
Lec5	Crank system, diagnostic	2
Lec6	Power system diagnostic	2
Lec7	Control system construction	2
Lec8	Diagnostic control system	2
Lec9	Diagnostic lubrication system	2
Lec10	Diagnostic cooling system	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Endoscopic engine I.C. diagnostic	2
Lab2	Measurements of piston - cylinder components	2
Lab3	Measurements of piston-crank system	2
Lab4	Measurements of block cylinder	2
Lab5	Measurements of the timing systems components	2
		Total hours: 10

TEACHING TOOLS USED

N1. self study - self studies and preparation for examination
N2. multimedia presentation
N3. problem discussion
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	
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_K02 PEK_K03	
P = F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diagnostics and controling engine I.C.
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_KE_W08, K2MBM_KE_W09	C2		N1,N2
PEK_U01-PEK_U03	K2MBM_KE_U01, K2MBM_KE_U06	C1		N1,N2,N4

PEK_K01-PEK_K03	K2MBM_K08, K2MBM_K10	C1,C3		N1,N2,N4

SUBJECT SUPERVISOR

dr inż. Krzysztof Miksiewicz tel.: 71 347-79-18 email: Krzysztof.Miksiewicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia silników spalinowych i pojazdów**
Name in English: **Ecology of internal combustion engines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042144**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of internal combustion engines and vehicle construction compatible with, respectively, Engine and Diesel engines implemented at the 1st stage of the MiBM of the Faculty of Mechanical Engineering at the Wrocław University of Technology
2. ability to independently perform laboratory exercises, especially in the aspect of independent development of laboratory test results
3. awareness of the need for group work and the ability to implement it with the adoption of different roles in the group

SUBJECT OBJECTIVES

C1. based on laws of thermodynamics, understanding and understanding the formation of toxic substances as a result of combustion processes as the main source of their emission in motor vehicles
C2. deepening knowledge of the construction of the internal combustion engine systems in the ecological aspect of preventing excessive emission of toxic compounds to the environment of the vehicle
C3. mastering knowledge in the selection of the source of propulsion for the vehicle, including the issue of reducing the displacement of internal combustion engines (so-called downsizing) to reduce the emission of carbon dioxide into the atmosphere

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - describes the energy consumption of vehicle traffic, related fuel consumption and explains the concept of the ecological balance of a vehicle
PEK_W02 - it defines and describes individual systems of an internal combustion engine and a vehicle, the appropriate construction of which makes it possible to reduce the emission of toxic substances to the environment
PEK_W03 - knows and lists ways to reduce the displacement of engines (so-called downsizing), which aim is to reduce the emission of carbon dioxide to the atmosphere while maintaining the appropriate traction properties of vehicles

II. Relating to skills:
PEK_U01 - can perform tests of selected systems of the internal combustion engine in the aspect of the content of toxic exhaust components in the exhaust gas
PEK_U02 - analyzes the results of tests carried out as part of laboratory classes
PEK_U03 - calculates and correctly interpreates the results of laboratory tests, in particular the emission of toxic exhaust components

III. Relating to social competences:
PEK_K01 - understands the need and knows the possibilities of continuous training, especially raising their knowledge of the ecology of internal combustion engines and vehicles (third degree studies, postgraduate studies, courses)
PEK_K02 - is aware of the importance, responsibility and impact of the engineer's activity in the field of mechanics and machine construction in the aspect of responsibility for the state of the natural environment, resulting from the proper use of vehicles
PEK_K03 - appreciates the need to raise professional, personal and social competences, including issues related to the ecology of vehicles and internal combustion engines, especially in the aspect of managing human beings

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Energy consumption of vehicle movement. Fuel consumption and toxic components emissions by modern motor vehicles. Ecological balance of a motor vehicle	2
Lec2	Ecological aspect of the construction of pistons and piston pins of modern internal combustion engines. De-piston pin stop to reduce lubricant oil consumption	2

Lec3	Ecological aspect of constructing piston rings of modern internal combustion engines. Lubricating oil consumption and its combustion	2
Lec4	Ecological aspect of the connecting rod and the crankshaft construction of modern internal combustion engines. Selection of manufacturing technology in the aspect of reducing carbon dioxide emissions during their production	2
Lec5	The ecological fuel storage and refueling system of the fuel tank in a modern car	2
Lec6	Constructing power systems for spark-ignition engines to reduce carbon dioxide emissions from motor vehicles	2
Lec7	Constructing power systems for self-ignition engines to reduce carbon dioxide emissions from motor vehicles	2
Lec8	An ecological aspect of constructing timing systems of modern internal combustion engines in order to minimize the emission of carbon dioxide	2
Lec9	An ecological aspect of the design of cooling and lubrication systems for modern internal combustion engines in order to minimize the use of cooling liquids as a result of reducing the capacity of indirect cooling systems	2
Lec10	Recharging combustion engines and, as a result, reducing their displacement volume while maintaining appropriate traction properties of internal combustion engines and using for this purpose the technologies of the discussed internal combustion engine and vehicle systems	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Execution of load and external characteristics of the internal combustion engine	2
Lab2	Preparing a universal characteristic based on laboratory exercises number 1 with the determination of carbon dioxide emission to the atmosphere	2
Lab3	Tests of the filling factor of the internal combustion engine	2
Lab4	Calculation of cylinder filling factor based on laboratory exercise number 3 with the calculation of the fuel-air mixture composition in the aspect of determining the composition of exhaust gases; poor, rich mix	2
Lab5	Examination of the content of unburned hydrocarbons, nitrogen oxides, carbon dioxide and oxide, as well as smoke opacity of the internal combustion engine during the implementation of the chosen load curves	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F2	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F3	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F4	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
P = (F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Kaźmierczak A. i inni, Silniki pojazdów samochodowych, wydawnictwo: REA Warszawa, rok: 2010.
2. Sitnik L., Ekopaliwa silnikowe, Oficyna Wydawnicza PWr, Wrocław 2004
3. Kowalewicz A., Wybrane zagadnienia samochodowych silników spalinowych, wydawnictwo: WSI Radom, rok: 2000.
4. Drozd Cz., Sroka Z.J. Silniki spalinowe laboratorium. Oficyna wydawnicza PWr, skrypt PWr. Wrocław 1996.

SECONDARY LITERATURE

1. Kowalewicz A., Podstawy procesów spalania, wydawnictwo: WNT Warszawa, rok: 2000.
2. Kozaczewski W., Konstrukcja grupy tłokowo - cylindrowej silników spalinowych, wydawnictwo: WKŁ Warszawa, rok: 2004.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology of internal combustion engines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

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

PEK_W01	K2MBM_KE_W08, K2MBM_W05	C1	Lec1 Lec2 Lec3	N1. N5.
PEK_W02	K2MBM_KE_W08, K2MBM_W06	C2	Lec4 Lec5 Lec6 Lec7 Lec8	N1. N5.
PEK_W03	K2MBM_KE_W08	C3	Lec9 Lec10	N1. N5.
PEK_U01	K2MBM_KE_U06	C1	La1 La3	N2. N3. N4.
PEK_U02	K2MBM_KE_U06	C1 C2	La2 La4	N2. N3. N4.
PEK_U03	K2MBM_KE_U06	C3	La5	N2. N3. N4.
PEK_K01	K2MBM_K06, K2MBM_K08	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N1. N5.
PEK_K02	K2MBM_K06, K2MBM_K08	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8	N1. N5.
PEK_K03	K2MBM_K08, K2MBM_K09	C1 C2 C3	Lec1 Lec2 Lec3 Lec4	N1. N5.

SUBJECT SUPERVISOR

Prof. dr hab. inż. Andrzej Kaźmierczak tel.: 71 347-79-18 email: Andrzej.Kazmierczak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria napraw silników spalinowych i pojazdów**
Name in English: **Engineering repair of internal combustion engines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042145**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of the principles of operation of technical facilities and the operation of internal combustion engines
2. the ability to select an internal combustion engine for driving a vehicle
3. teamwork skills, in particular, managing a team of people

SUBJECT OBJECTIVES

C1. learning about the principles of vehicle service including in particular internal combustion engines
C2. understanding the rules of moving a vehicle from the state of use to a serviceable state
C3. learning the methods of operating vehicles, in particular repairs of internal combustion engines and their systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - recognizes the condition of the vehicle when deciding to change its status from use to operating status
PEK_W02 - defines damage and defines vehicle assemblies, including the internal combustion engine in which they occurred
PEK_W03 - indicates the methods of repair and determines the time for the drive system to regain its state of use

II. Relating to skills:
PEK_U01 - analyzes the criteria for reaching the limit state by the vehicle
PEK_U02 - organizes and plans vehicle repairs, including internal combustion engines
PEK_U03 - verifies the correctness of service and repair of vehicles, including repairs of the main internal combustion engines

III. Relating to social competences:
PEK_K01 - understands the need and knows the possibilities of continuous training, especially increasing their knowledge of vehicle operation, including repair engineering (third degree studies, postgraduate studies, courses)
PEK_K02 - is aware of the importance, responsibility and impact of the engineer's activity in the field of mechanics and machine construction in terms of responsibility for the state of the environment, resulting from the proper use of vehicles, in particular properly performed service and repair, which are a significant threat to the natural environment
PEK_K03 - appreciates the need to raise professional, personal and social competences, especially in the aspect of managing human beings, including the service facilities of vehicles and internal combustion engines

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, introduction to the lecture, program, requirements. Operation of technical facilities in systemic approach	2
Lec2	Service facilities, including service, service facilities. Types of maintenance activities including types of repairs	2
Lec3	Principles of disassembly and maintenance of vehicle components, including internal combustion engines	2
Lec4	Service, damage and repair of the fuselage and cylinder head	2
Lec5	Operation of the components of the engine's timing system including their wear and repair	2
Lec6	Operation of crank and reciprocating engines of internal combustion engines including wear and technology of repairs of pistons, piston rings, connecting rods and crankshafts	2
Lec7	Operation of the lubrication and cooling system of the internal combustion engine and wear and repair of their components	2
Lec8	Operation of the recharging system and wear and repair of its components, including compressor, free and dynamic charge systems	2
Lec9	Exploitation of diesel and spark ignition fuel system components, including repair of their components and assemblies	2
Lec10	Operation of vehicle transmission systems, including repair of its components and systems	2

		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Search for damage and deformation of the cylinder head and block and selection of repair technology	2
Lab2	Measurements of timing system components wear and selection of repair technology	2
Lab3	Measurements of piston and connecting rod consumption as well as piston rings and selection of repair technology	2
Lab4	Measurements and methods of repairing engine fuel system components with ZS and ZI	2
Lab5	Measurements and ways to repair elements of vehicle transmission systems	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. report preparation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F2	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F3	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F4	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises

F5	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
P = (F1+F2+F3+F4+F5)/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Kaźmierczak A. i inni, Silniki pojazdów samochodowych, Wydanictwo REA, Warszawa 2010
2. Bernhardt M., "Silniki samochodowe", WKiŁ, Warszawa 1988
3. Hebda M., Janicki D., "Trwałość i niezawodność samochodów w eksploatacji", WKiŁ, Warszawa 1977
4. Kozaczewski W., "Konstrukcja złożeń tłok-cylinder silników spalinowych", WkiŁ, Warszawa 1987
5. Hebda M., Elementy teorii eksploatacji systemów technicznych, Wydawnictwo MCNEMT, Radom 1990.

SECONDARY LITERATURE

1. Mańczak K., Technika planowania eksperymentu, WNT, Warszawa 1976
2. Niewczas A., Modelowanie procesu zużycia, WSI Radom 1989
3. Pytko S., Podstawy tribologii i techniki smarowniczej, AGH Kraków 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering repair of internal combustion engines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W08	C1	Lec1 Lec2 Lec3	N1. N4.
PEK_W02	K2MBM_KE_W08	C2 C3	Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10	N1. N4.
PEK_W03	K2MBM_KE_W08	C3	Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10	N1. N4.
PEK_U01	K2MBM_KE_U06	C1 C2	La1 La2	N2. N3.
PEK_U02	K2MBM_KE_U06	C3	La3	N2. N3.
PEK_U03	K2MBM_KE_U06	C3		N2. N3.
PEK_K01	K2MBM_K07	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10	N1. N2. N3. N4.
PEK_K02	K2MBM_K05, K2MBM_K08	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10	N1. N2. N3. N4.

PEK_K03	K2MBM_K09	C1 C2 C3	Lec1 Lec2 Lec3	N1. N2. N3. N4.

SUBJECT SUPERVISOR

Prof. dr hab. inż. Andrzej Kaźmierczak tel.: 71 347-79-18 email: Andrzej.Kazmierczak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza stanów ustalonych i nieustalonych układów hydraulicznych**
Name in English: **Analysis stable and transient states of hydraulic systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042146**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics. Basic knowledge of the construction of hydrostatic and pneumatic power systems, knowledge about relations present in this type of power systems.
2. Knowledge of the principle of operation, construction, basic parameters and the role the individual components in hydrostatic or pneumatic power system.
3. Ability to formulate conclusions based on its observations and laboratory tests. Willingness extend knowledge of a more complete description of the phenomena occurring in hydraulic and pneumatic systems.

SUBJECT OBJECTIVES

C1. To acquaint students with extended and more complete mathematical description of systems taking into account the dynamic phenomenas occurring in the hydraulic and pneumatic power systems. Provide students with the mathematical description and the real waveforms of the basic parameters of power systems, demonstrate the convergence of the results obtained from the presented mathematical models with the results recorded during the test of real systems.
C2. To acquaint students with extended descriptions of individual components of hydraulic and pneumatic systems. Presentation of the dynamic characteristics of selected system components. Pointed the corelation and description of the interaction between system components together with an indication characteristic dynamic correlations of those connections. Indication of the risks and benefits of presence of the dynamic phenomena in the hydrostatic and pneumatic power systems as well as the acquisition of skills of preventing the occurrence of adverse dynamic effects.
C3. Exercise team working skills and to formulate written conclusions based on laboratory experiment. Identify the phenomenas based on selected and measured characteristic values of hydraulic and pneumatic systems or components.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student can describe the dynamic interactions in hydraulic and pneumatic systems. Can describe the impact of dynamic phenomena in these systems. Student be able to list, identify the cause and source of the differences in the operation of systems working in steady and unsteady conditions. Student be able to define the benefits and risks of dynamic interactions occurring during work in the unsteady conditions.
PEK_W02 - The student can describe the dynamic interactions in hydraulic and pneumatic systems. Can describe the impact of dynamic phenomena in these systems. Student be able to list, identify the cause and source of the differences in the operation of systems working in steady and unsteady conditions. Student be able to define the benefits and risks of dynamic interactions occurring during work in the unsteady conditions.
PEK_W03 - The student can described by mathematical models of the hydraulic and pneumatic systems working in steady and unsteady state. The student on the design stage uses mathematical models mentioned above to identify the risks resulting from dynamic interactions in the system.

II. Relating to skills:
PEK_U01 - The student analyzes the performance, characteristics, and the impact of the different components of hydraulic and pneumatic systems on the character of the work of the whole system. The student performs laboratory testing of individual components, which results are the part of the written reports.
PEK_U02 - The student analyzes the character of the work of the example hydraulic and pneumatic systems. The student independently identifies the state of the system and determines the extent to which the volatility of the selected parameter this state persists. Student, based on the results of the experiment, independently draws conclusions.
PEK_U03 - Student analizuje, na podstawie teoretycznej wiedzy zdobytej na wykładach, rodzaju i charakteru zjawisk zachodzących w elementach i całych systemów hydraulicznych i pneumatycznych, które są badane w laboratorium. Na podstawie wyników doświadczalnych sprawdzenia wiedzy teoretycznej, formułując wnioski w pisemnym sprawozdaniu.

III. Relating to social competences:
PEK_K01 - A student takes part in the work of the group of students, the goal of which is the joint planning and proper perform of a laboratory experiment.
PEK_K02 - Students practice skills to present the results of their work in writing and orally.
PEK_K03 - The student independently makes the selection and compiled the acquired theoretical knowledge with the results of a laboratory experiment.

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Introduction, presentation of the lecture content, requirements and forms of the completion. Pulsation flow and pressure - the sources , the reduction of the pressure pulsation amplitudes.	2
Lec2	The methods of calculation and modeling of unsteady flow in the hydraulic lines.	2
Lec3	Basic concepts describing the condition of the elements and the whole hydraulic system. The principle of models construction for lumped and distributed parameters.	2
Lec4	The steady operating status of hydraulic components (pumps, motors, valves) - ideal and real characteristics.	2
Lec5	Indicators describing the dynamic quality of the component of the hydraulic system.	2
Lec6	The steady operating status of the hydrostatic transmission - the ideal and the real characteristics.	2
Lec7	The dynamic models of the hydraulic valves.	2
Lec8	Analysis of the simplifying assumptions impact on the accuracy of the representation actual object by the model.	2
Lec9	Methods of shaping hydraulic transient processes. Methods to prevent the adverse effects caused by transition phases in the machine with hydrostatic power system.	2
Lec10	Completion of the course.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab3	Experimental identification of the pressure pulsation components in the hydraulic system.	2
Lab4	Experimental identification of the pressure pulsation components in the hydraulic system.	2
Lab5	Mitigation method of the start phase of the hydrostatic system using the proportional valve.	2
		Total hours: 10

TEACHING TOOLS USED

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Tomasiak E.,The drives and controls systems of the hydraulic and pneumatic, Wydawnictwo Polit. Slaskiej, Gliwice 2001, (in Polish)
2.Tomczyk J.,The dynamic models of components and systems of the hydrostatic drives, Wydawnictwa Naukowo-Techniczne, Warszawa 1999, (in Polish)
3. Palczak E., The dynamic of the hydraulic components and systems, Wydawnictwo Ossolineum, Wrocław 1999, (in Polish)
4. Stryczek S., Hydrostatic drive, Wydawnictwa Naukowo-Techniczne, Warszawa 1992, (in Polish)

SECONDARY LITERATURE

1. Pizon A.,Hydraulic and electro-hydraulic control and regulation systems, Wydawnictwa Naukowo-Techniczne, Warszawa 1987, (in Polish)
2. Kollek W., Basics of the designing hydraulic drives and controls, Oficyna Wydawnicza Polit. Wrocławskiej, Wrocław 2004, (in Polish)
3. Osiecki A., The hydrostatic drive of machines, Wydawnictwa Naukowo-Techniczne, Warszawa 2004, (in Polish)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analysis stable and transient states of hydraulic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_KE_W02, K2MBM_KE_W07	C1, C2	Lec1÷Lec9	N1, N2
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_KE_U02	C3	Lab1÷Lab5	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-45-99 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metodologia projektowania maszyn i urządzeń hydraulicznych**
Name in English: **Methodology of designing hydraulic machines and devices**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042147**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses				X	
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	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of machine design.
2. Student has expertise in manufacturing techniques
3. Student has basic knowledge in management and modeling

SUBJECT OBJECTIVES

C1. To acquaint students with the basic techniques of modern machine design
C2. The ability to search concept
C3. To acquaint students with contemporary design strategies

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has in-depth knowledge of design methodology
PEK_W02 - Student has the ability to choose the best design solution due to accepted assessment criteria.
PEK_W03 - Student knows contemporary concepts and strategies of the design process

II. Relating to skills:
PEK_U01 - The student should skillfully formulate a design task
PEK_U02 - Uses various methods of searching for solutions for a project task
PEK_U03 - He can evaluate and choose a solution that meets the design task

III. Relating to social competences:
PEK_K01 - He can interact and work in a group, taking on different roles

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Technical processes and their modeling. Motoda, methodology and design methodology. The structure of the design process.	2
Lec2	Marketing product concept and implications for the design process	1
Lec3	Formulating a design problem. Problem analysis, its structure and elements	1
Lec4	Methods of searching for solutions - an overview of isystematic heuristic methods: abstracting, brainstorming, synektics, 635, exploration matrix, morphology, ARIZ-71, playing with words. The choice of the method of writing.	3
Lec5	Issues of evaluation and selection of solutions (variants). Assessment criteria and limitations. Selected methods of selection and evaluation of solution variants: T, Delphic cards, forced decisions, weighted characteristics of useful value. The problem of selecting the assessment method. decision making process in the technical design process - competence levels	2
Lec6	Morphological method of generating structure of systems, functions of hydraulic systems.	1
Lec7	Ways of implementing the functions of hydraulic systems	6
Lec8	Basic calculations and rules for the selection of basic (catalog) elements of the system: actuators and motors, pumps and compressors, distributors, pressure and flow valves.	2
Lec9	Static characteristics of hydraulic systems, thermal balance of the hydraulic system.	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		2

Proj5		2
		Total hours: 10

TEACHING TOOLS USED

N1. problem lecture
N2. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03,	Defense project
P = 0,3*Fw+0,7F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methodology of designing hydraulic machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_KE_W04	C1, C2, C3		N1
PEK_U01, PEK_U02, PEK_U03,	K2MBM_U09	C1, C2, C3		N2
PEK_K01	K2MBM_K04	C1, C2, C3		N2

SUBJECT SUPERVISOR

dr inż. Waldemar Sradomski tel.: 71 320-26-67 email: Waldemar.Sradomski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie hydraulicznych układów napędowych**
Name in English: **Hydraulic drive systems control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042148**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student possess basic knowledge of classic mechanics and fluid mechanics.
2. Student possess basic knowledge of hydraulic components of drive systems: pumps, motors, cylinders, valves.
3. Student possess basic knowledge of construction and design of simple hydraulic systems.

SUBJECT OBJECTIVES

C1. Acquaint students with proportional technique - its applications, properties and limitations.
C2. Acquaint students with control and regulations methods selected parameters of hydraulic systems.
C3. Acquaint students with advanced hydrostatic systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - In the result of lesson student has extended knowledge of description of more advanced hydraulic components like proportional valves and servovalves.

PEK_W02 - In the result of lesson student has extended knowledge of explanation advanced control and regulation methods of selected hydraulic systems parameters.

PEK_W03 - In the result of lesson student has extended knowledge of description of advanced hydraulic and electrohydraulic systems.

II. Relating to skills:

PEK_U01 - In the result of lesson student is able to bulid hydraulic and electrohydraulic systems and analyse its working principle.

PEK_U02 - In the result of lesson student is able to preper to work hydraulic device or electrohydraulic and plan and execute measurements of selected parameters. On the basis of measurements results student is able to formulate appropriate conclusions.

PEK_U03 - In the result of lesson student is able to design device with hydraulic or electrohydraulic system according to specified requirements.

III. Relating to social competences:

PEK_K01 - Student can cooperate in group during hydraulic and electrohydraulic system building and report preparation.

PEK_K02 - Student can plan measurements during laboratory and report preparate.

PEK_K03 - Student correctly identyfi and solve problems with hydraulic and electrohydraulic system building. Student formulate appropriate conclusions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements.	1
Lec2	Control and regulation methods in hydrostatic systems.	2
Lec3	Technique of hydraulic proportional control.	1
Lec4	Working principle and characteristics of directional control valves with proportional control.	1
Lec5	Working principle and characteristics of flow regulators and pressure valves with proportional control.	1
Lec6	Logic valves in proportional technique.	1
Lec7	Electrohydraulic servovalves.	1
Lec8	Hydrostatic systems of position regulation.	2
Lec9	Hydrostatic systems of force or torque regulation.	2
Lec10	Load-sensing systems in machines with hydrostatic drive.	1
Lec11	Load-sensing systems with fixed displacement pump.	1
Lec12	Load-sensing systems with variable displacement pump.	1
Lec13	Controllers in hydraulic systems.	2
Lec14	Volumetric control and regulation.	2
Lec15	Pump capacity regulation for Q = const., p = const., N = const.	1

		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory range presentation, check form, requirements.	1
Lab2	Throttle-serial regulation of hydraulic actuator speed.	2
Lab3	Throttle-parallel regulation of hydraulic actuator speed.	1
Lab4	Control and regulation throttle methods comparison.	2
Lab5	Application of proportional reliefe valve.	1
Lab6	Experimental test for critical frequency for system with proportional directional control valve.	1
Lab7	Tests of position regulation system with electrohydraulic servovalve.	1
Lab8	Check.	1
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	oral response for practical veryfication of design and buliding of systems.
F2	PEK_U02	report
F3	PEK_U01 PEK_U03	student's activity note

P = (2F1+F2+F3)/4

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Tomasiak E.: Hydraulic and pneumatic drives and control (in polish). Wydawnictwo Polit. Slaskiej, Gliwice, 2001
Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.
Norvelle F. D.: Electrohydraulic control systems. Prentice-Hall INC, New Jersey 2000.

SECONDARY LITERATURE

Palczak E.: Dynamics of hydraulic components and systems (in polish). Wydawnictwo Ossolineum, Wrocław,1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydraulic drive systems control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W05, K2MBM_KE_W07	C1 C2	Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9	N1
PEK_W02	K2MBM_KE_W05, K2MBM_KE_W07	C1 C2 C3	Lec2 Lec5 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N1
PEK_W03	K2MBM_KE_W05, K2MBM_KE_W07	C3	Wy8 Wy9 Wy10Wy11 Wy12 Wy14Wy15	N1
PEK_U01	K2MBM_U13	C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6	N3 N4
PEK_U02	K2MBM_U05, K2MBM_U11	C1 C2 C3	Lab2 Lab3 Lab4 Lab6 Lab7	N2 N3 N4
PEK_U03	K2MBM_U14	C3	Lab2 Lab3 Lab5	N3 N4
PEK_K01	K2MBM_K04, K2MBM_K05, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6	N3 N4
PEK_K02	K2MBM_K03, K2MBM_K05, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab6 Lab7	N2 N3 N4
PEK_K03	K2MBM_K06, K2MBM_K10	C1 C2 C3	Lab2 Lab3 Lab4 Lab5Lab6 Lab7	N2 N3 N4

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-45-99 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Uszczelnienia i techniki uszczelniania**
Name in English: **Seals and sealing technique**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042149**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge in areas related to the basics of the machine design.
2. The knowledge of the principles of operation and basic design of hydraulic and pneumatic systems.
3. Basic knowledge of plastics materials.

SUBJECT OBJECTIVES

C1. Acquainting students with the present sealing technology level, mode of action, construction of various types of technical seals. Presentation the directions of development.
C2. Presentation of the problems that occur during the design, installation and exploatation of technical sealings. Presentation of the example seals selection process of the various types of seals. Preparing students to make knowingly and proper selection and exploatation of technical seals.
C3. Acquiring skills for the identification and description of phenomenas occurring in the seals, doing an independent determination of the seal condition based on the description of external appearance and selected parameters of the seal and making the determination of suitability for further exploitation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student is able to define the characteristics of the seals used in the technique and describe their mode of use.

PEK_W02 - The student defines the basic parameters and the use of standard technical seals, also can make differentiation and identification of the seals.

PEK_W03 - The student is able to select the the correct type of seal to the requirements of a particular application while explaining and describing the working conditions of selected seal.

II. Relating to skills:

PEK_U01 - The student is able analyze the phenomenon occurring during the seal exploitation, so that acquires the ability to control and describe the condition of the seal.

PEK_U02 - The student is able to prepare and conduct a laboratory experiment indicates the technical condition of the seal.

PEK_U03 - The student has the ability to decide on authorization to exploitation or exchange the seal on the basis of analysis of the seal technical condition.

III. Relating to social competences:

PEK_K01 - The student taking part in the work of a team of students which aim is to interpret the laboratory results based on theoretical knowledge.

PEK_K02 - Students gain the ability to link theoretical knowledge with the results of the experiment, and the formulation of a coherent conclusions.

PEK_K03 - Student presents conclusions formulated on the basis of their knowledge and the results of the laboratory tests and provide their justification of the group with teacher.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	To acquaint students with the scope of the lecture, the terms of credit, and subject literature. The function of seals in the machine design.	2
Lec2	Presentation of the basic requirements for technical seals. Classification of the technical seals. Leak testing.	2
Lec3	Fundamentals of correct sealing selection, process analysis, examples of correct application.	2
Lec4	Static seals, description, principle of operation, classification, materials, applications.	2
Lec5	Seals of the rotational movement, description, principle of operation, classification, the basic parameters, materials, applications.	2
Lec6	Examples of the selection processes of rotational movement seals. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec7	Seals of the reciprocating movement, description, principle of operation, classification, parameters, materials, applications.	2
Lec8	Examples of the seals selection process of the piston rod and piston in the pneumatic actuator. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2

Lec9	Presentation of the directions of development of the seals. New trends in sealing technology.	2
Lec10	Completion of the course.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	Examination of the impact the gap width on the flow rate and pressure difference.	2
Lab3	Examination of the impact the direction of movement the piston rod on the forces measure on the seal contact area.	2
Lab4	Examination of the impact of pressure difference on the frictional force occurring in the packing set seals of the piston rod.	2
Lab5	Examination of the impact moving speed on the frictional force measure on the seal contact area.	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01÷PEK_W03	oral response, participation in problems discussions
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

F1	PEK_U01÷PEK_U03 PEK_K01÷PEK_K03	laboratory reports, oral response, participation in problems discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. L. A. Kondakow: The hydraulic seals, WNT 1975, (in Polish)
2. E. Mayer: The face seals, WNT 1970, (in Polish)
3. Seals and sealing thenbook, 2nd Edition, Trade and Technical Press Ltd., 1985 Anglia,
4. Poradnik: The thematic inserts about seals in the journal "Hydraulics and Pneumatics", (in Polish)

SECONDARY LITERATURE

1. Proceedings of the Conference "Seals and Sealing Technology", SIMP Wroclaw
magazine "Pneumatics and Hydraulics", (in Polish)
2. H. Ebertshäuser: Dichtungen in der Fluidtechnik Resch Verlag, München 1987,
3. F.W. Reuter: Dichtungen in der Verfahrenstechnik Resch Verlag, München 1987.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Seals and sealing technique
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W07	C1	Lec1÷Lec3, Lec9	N2, N4
PEK_W02, PEK_W03	K2MBM_KE_W07	C2	Lec4÷Lec8	N2, N4
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K09, K2MBM_KE_U06	C3	Lab1÷Lab5	N1, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wibroakustyczne diagnozowanie maszyn i urządzeń**
Name in English: **Vibroacoustics diagnosis of machinery and equipment**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042150**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of mathematical analysis.
2. The student has a basic knowledge of classical mechanics.
3. The student is able to solve ordinary differential equations.

SUBJECT OBJECTIVES

C1. Mastering the basic issues of applied vibroacustic.
C2. Get acquainted with the methodology of measurement of parameters of vibroacustics and the acquisition of skills for the interpretation of the results obtained.
C3. Knowledge of methods of identifying sources of vibrations and noise.
C4. To become acquainted with the methods of reducing vibration and noise generated by working machines and equipment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic issues of the scope of used vibroacoustics
PEK_W02 - The student is able to apply the common technical solutions to reduce the negative impact of vibrations and noise.
PEK_W03 - The student has a basic knowledge of the theoretical scope of the building acoustics.

II. Relating to skills:
PEK_U01 - Participant knows how to handle the test apparatus.
PEK_U02 - The student is able to analyze and interpret the results of the research complex vibroacoustics processes.
PEK_U03 - The listener is able to determine the cause of the formation of vibration and noise in machinery and equipment.

III. Relating to social competences:
PEK_K01 - The student become aware that the ability to analyze information with different levels of complexity.
PEK_K02 - Student gets knowledge objective judging, reasoning, rational and justify their own point of view, using knowledge of vibroacoustics area.
PEK_K03 - The student develops ability to respect the Customs and rules in academia.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction	1
Lec2	Propagation of sound, sound level and vibration	2
Lec3	Acoustic units	1
Lec4	The source of vibrations and noise	2
Lec5	Criteria for the assessment of noise	2
Lec6	Minimize vibrations and noise	2
Lec7	Lec9 Reduction of noise in machines and devices	4
Lec8	Building acoustics	2
Lec9	Energy methods in the diagnosis of acoustic condition of machinery and equipment	2
Lec10	Exam	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory.	1
Lab2	3 Acoustics psychofizjological, perception of sound.	2
Lab3	Sound power measurements in rooms with acoustic adaptation.	2
Lab4	Measurement of noise in the workplace.	2
Lab5	The use of probes and acoustic holography diagnose acoustic status of machinery and equipment.	2
Lab6	Passing of the course	1

	Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Cempel Cz.: Used vibroacoustic, Publishe: PWN 1989.
2. Puzyna C.: Vibration and noise, Publishe: CRZZ 1967.
3. Osiński Z.: Damping mechanical vibration, Publishe: PWN 1997.
4. Engel Z.: Protection of the environment against vibrations and nois. Publishe PWN 2001.
5. Goliński A.: Vibration isolation of machines and equipment. Publishe WNT 2000.

SECONDARY LITERATURE

6. Renowski J.: Noise indicators and assessment criteria. Publishe OWPWr 1998.
7. Ozimek E.: Sound and its perception. Aspects of physical and psychoacoustical, Publishe PWN 2002.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Vibroacoustics diagnosis of machinery and equipment
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W02	C1	Wy1 - Wy5	N1,N2
PEK_W02, PEK_W03	K2MBM_KE_W02	C4	Wy6, Wy7, Wy8,Wy9	N1,N2
PEK_U01	K2MBM_U05, K2MBM_U11, K2MBM_U12	C2	La1, La2	N3,N4,N5
PEK_U02	K2MBM_KE_U01, K2MBM_KE_U06	C2, C4	La3, La4	N3,N4,N5
PEK_U03	K2MBM_KE_U05, K2MBM_KE_U06	C3	La5	N3,N4,N5
PEK_K01-PEK_K03	K2MBM_K08, K2MBM_K10	C2-C4	La1-La5	N3,N4,N5

SUBJECT SUPERVISOR

dr hab. inż. Piotr Osiński tel.: 71 320-45-98 email: Piotr.Osinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA I, II**
Name in English:
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042151, MMM042152.**
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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U	K2MBM_U02, K2MBM_U05, K2MBM_U17, K2MBM_U20			
PEK_K	K2MBM_K01, K2MBM_K03, K2MBM_K05, K2MBM_K10			

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria urządzeń transportu przemysłowego**
Name in English: **Engineering of industrial transport devices**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042152**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Crediting with grade			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	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of solid mechanics, machine design basics, and theory of mechanisms and propulsion systems
2. Ability to read drawings and diagrams in the technical documentation for machinery and industrial transport systems, and the ability to sketch diagrams presenting schemes of simple load-carrying structures and mechanisms of machines
3. The ability to use a spreadsheet program and make 2D drawings using CAD

SUBJECT OBJECTIVES

C1. Gain basic knowledge about the structure, function, and code-based principles behind calculations for industrial transport systems. C1.1. Knowledge of basic forms and construction features of load-carrying structures, as well as propulsion mechanisms for industrial transport systems of cyclic (cranes), and continuous (conveyors) operations, respectively. C1.2. Knowledge of the code parameters governing the conditions of use of cranes and their connection with the relevant technical requirements to ensure that operating characteristics are met.
C2. C2 Gain basic knowledge and skill in the analytical description and calculation of code-based exploitation parameters as wel as technical and operating parameters of industrial transport equipment. C2.1. Creating schemes for load-carrying structures and mechanisms of devices for industrial transportation and their load systems, appropriate for their given conditions of use. C2.2. Ability to carry out calculations of basic parameters to satisfy assumed technical and operating conditions for cranes and conveyors. C2.3. Skill in calculation and selection of typical parts and components of cranes and conveyors
C3. Awareness of the inter-relationship between types of structures, design features and technical parameters of industrial transport equipment and conditions for use of these devices

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic structure and design features of load-carrying structures and propulsion systems for industrial transport equipment with cyclic (cranes) and continuous (conveyors) operations, respectively.
PEK_W02 - Has knowledge of the code parameters governing the use of cranes and the relationship to the relevant technical parameters to ensure the required operating characteristics for these devices are met.

II. Relating to skills:
PEK_U01 - Can create diagrams of load-carrying structures and mechanisms in industrial handling equipment, together with their load systems appropriate to the given conditions of their use.
PEK_U02 - Can calculate basic technical and operating parameters for cranes and conveyors, appropriate to the given conditions for their use

III. Relating to social competences:
PEK_K01 - Is aware of the interconnections between the types of structures, design features and technical parameters of industrial transport equipment and conditions for use of these devices
PEK_K02 - Recognizes the linkages adequate knowledge of mathematics, mechanics, electrical engineering and electronics engineering used in the industrial transport devices

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic structural and operational features of a cyclic (cranes) and continuous (conveyors) operating industrial transport devices i.t.d., review of their structures, major parts and components, examples of design solutions	2
Lec2	Basic technical and operational parameters of the i.t.d., principles of standardization and evaluation criteria for intensive use, the duty exploitation groups of cranes	2

Lec3	Principles of calculation and classification of the code-based operating conditions for cranes	2
Lec4	Rules for the selection of the form and the structural development of the major nodes in load-carrying structures and mechanisms of cranes	2
Lec5	Rules for load calculation and strength checks for load-carrying structures and mechanisms of cranes, according to European standards	2
Lec6	Rules for selection of structure type and structural development of major carrying joints and mechanisms-drive nodes of conveyors	2
Lec7	Rules for loads and proof calculations of major load-carrying joints and mechanisms-drive nodes of conveyors	2
Lec8	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with flat horizontal movement	2
Lec9	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with flat vertical movement	2
Lec10	Methods and systems of control for cranes and conveyors	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Analysis of the operating conditions for a given crane and calculation of its code-based classification parameters, determination of crane technical parameters to ensure meeting its required operating characteristics	2
Proj2	Determination of the load-carrying structure and propulsion system for a given crane, development of computational schemes for indicated superstructure subassembly and propulsion system, code-based loads calculations for specified components of the crane	2
Proj3	For a selected crane, determination of the most important nodes for safety of the load-carrying structure and propulsion system, initial selection of typical elements of the specified subassembly of the crane propulsion system, design sketches of the selected nodes in the load-carrying structure and propulsion system.	2
Proj4	The calculation of the maximum overload for the selected elements of a given crane propulsion system subassembly in its transient periods of work, and validation of the typical elements selection	2
Proj5	Analysis of conveyor operational conditions and initial calculation of technical parameters to satisfy these conditions, determination of the structure of the conveyor drive system, initial selection of typical elements of the conveyor drive subassembly, execution of a design sketch of a selected node of this subassembly	2
		Total hours: 10

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02 PEK_K	Answers during design presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Piątkiewicz A., Sobolski R. – Cranes. WNT Warsow 1977
[2] Goździecki M., Świątkiewicz H. – Conveyors. WNT Warsow 1978

SECONDARY LITERATURE

[1] Vershoof J. - Cranes. Design, Practice and Maintenance. Professional Engineering Publishing Limited, London &Bury St. Edmonds 2000r.
[2] Gładysiewicz L. – Belt conveyors. Theory and calculations. Publ. Wroclaw University of Technology 2003r.
[3] European Standard EN13001-1:2007 - Crane safety. General design. Part 1. General principles and requirements
[4]European Standard EN13001-2:2007 - Crane safety. General design. Part 2. Load effects.
[5] Catalogues of unified components of cranes and conveyors offered by firms: FAMAK, DEMAG, ABUS, KONE CRANES, AUMUND

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering of industrial transport devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W09	C1	Lec1	N1, N2, N3
PEK_W02	K2MBM_KE_W09	C1	Lec2 to Lec10	N1, N2, N3, N4
PEK_U01	K2MBM_U01, K2MBM_U07	C2	Proj2	N2, N3, N4
PEK_U02	K2MBM_U01, K2MBM_U07	C2	Proj1, Proj3, Proj4, Proj5	N2, N3, N4
PEK_K01, PEK_K02	K2MBM_K06	C3	Lec1 to Lec10, Proj1 to Proj5	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Robert Czabanowski tel.: 71 320-28-37 email: robert.czabanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy hybrydowe w pojazdach i maszynach roboczych**
Name in English: **Hybrid drives in working machines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042153**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses	X				
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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a knowledge in a frame of earth working machines and vehicles driving systems. Student is aware of solved putted into use on environmental. Student has an advanced knowledge in a frame of mathematics and phisics.
2. It has an advanced knowledge of the design of control algorithms. He knows the proper terminology. It has a basic knowledge of the principles of operation of electronic components.
3. Can use measuring devices and measuring devices. Able to work in groups in various roles, and to develop and formulate conclusions.

SUBJECT OBJECTIVES

C1. The aim of the course is to expand knowledge of the design and operating principles powertrains including hybrids. The student is able to design control systems for hybrid systems working machines, known traction characteristics of selected vehicles.
C2. The course aims to raise awareness of the range of dynamic phenomena, experimental research. It can acquire, also with foreign literature and materials to use them.
C3. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has extended knowledge of the terminology associated with the operation of propulsion systems including hybrid
machines and work vehicles;
PEK_W02 - has the knowledge necessary to carry out a proper selection of individual elements in hybrid drive systems and to formulate and solve related problems;
PEK_W03 - explains the mechanism of energy loss during the transformation and transmission of energy and chooses the control algorithm of the hybrid system.

II. Relating to skills:
PEK_U01 - able to develop a simple plan of experimental research, carry the experiment, and to formulate conclusions
PEK_U02 - able to design a propulsion system so as to obtain its brief foredesing action
PEK_U03 - be able to specify a path for power and estimate the power flow dissipation in the proposed drive system

III. Relating to social competences:
PEK_K01 - know the range of having own knowledge and own skills and understands the need for continuous training and professional development;
PEK_K02 - indevidually initiates and takes a simple research tasks;
PEK_K03 - can indyvidually search the literature and also in foreign languages.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of the propulsion system, hybrid types and propulsion systems, single and multi-source power systems.	2
Lec2	Primary and secondary sources of energy: electrical, mechanical, hydraulical, fue -calorific value. Fuel cells. The efficiency of energy processed. Power converters for AC and DC operated from vehicles.	2
Lec3	A detailed overview of the energy storage. The problems and limitations associated with it. Resistance and power consumption while moving.	2
Lec4	Structure parallel hybrid powertrain. The choice of elements and calculations.	2

Lec5	The structure of serial hybrid drive systems. The choice of elements and calculations.	2
Lec6	Structures mixed hybrid propulsion systems. The choice of elements and calculations	2
Lec7	Propulsion systems of "mild", selection of components and calculations. Non-conventional propulsion systems equipment and vehicles.	2
Lec8	Computational method for selecting the individual components of hybrid powertrains. Problems associated with the delivery of energy recovered to the source. The amount and efficiency of energy recuperation based on the cycle of the vehicle.	2
Lec9	The recuperative braking wheeled vehicles. Problems with receiving energy and preserving the direction of motion. Construction of hybrid brakes.	2
Lec10	Modeling of hybrid drive systems for wheeled vehicles. Modeling of sources and receivers of energy.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Performance testing of the propulsion system overhead traveling crane.	2
Lab2	Study the possibility of accumulation of energy in the hydrostatic drive system loader excavated arm bucket.	2
Lab3	Accumulation and recuperation of energy in the inertial propulsion system.	2
Lab4	Energy efficiency of the bucket filling process of earth working vehicle.	2
Lab5	Hydrostatic driving system experimental test.	2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03 PEK_K01,02	final test
P = kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03 PEK_K03	report on laboratory exercises, short tests
P = średnia ocen pozytywnych ze sprawozdań i kartkówek z ćwiczeń laboratoryjnych		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1 "Electric and hybrid vehicles Design Fundamentals", Husain, I., CRC PRESS, 2011
2 "Fundamentals of hybrid vehicle drives," Szumanowski A Warsaw-Radom, 2000
3 "Hybrid Electric Vehicles Design", Szumanowski A., Institute for Sustainable Technologies NRI / 2006
4 "The accumulation of energy in vehicles", Szumanowski A., optics, 1984
5 "Motor vehicles with electric and hybrid", K. Michalowski, Ocioszyński J., optics, Warsaw 1989
6 "Alternative fuels and vehicle propulsion systems", J. Diaper Merkisz I., Publisher University of Technology, Poznan, 2006
7 "Electric vehicles", Poplawski E. optics, Warsaw, 1994
8 "Energy efficient powertrains working machines", Ocioszyński J., Publishing House of Warsaw University of Technology, Warsaw, 1994
9 "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Second Edition", M. Ehsani, Y. Gao, CRC PRESS, 2009
10th "Propulsion systems for hybrid vehicles," Miller JM, The Institution of Electrical Engineers, 2003
11th "Electric Vehicle Technology Explained", Larminie J., Lowry, J., Wiley, 2003
12th "The rationalization of labor power system of a passenger car using fuzzy logic", PhD thesis Korniak J., supervisor: prof. Assoc. Mr Rojek.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hybrid drives in working machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W01, K2MBM_KE_W04, K2MBM_KE_W09	C1	Le1-Le7	N1, N3
PEK_W02	K2MBM_KE_W01, K2MBM_KE_W04	C2	Le8-Le10	N1, N3

PEK_W03	K2MBM_KE_W09	C1, C2	La1-La5	N1, N3
PEK_U01	K2MBM_KE_U01	C3	Le1-Le10	N1, N3
PEK_U02	K2MBM_KE_U06	C3	La1-La5	N2
PEK_U03	K2MBM_U01, K2MBM_U05	C3	La1-La5	N2
PEK_K01	K2MBM_K10	C1, C2, C3	Le1-Le10	N1, N3
PEK_K02	K2MBM_K02, K2MBM_K09	C1, C2, C3	Le1-Le10	Wy1-Wy10
PEK_K03	K2MBM_K04, K2MBM_K05	C3	La1-La5	N2

SUBJECT SUPERVISOR

dr inż. Aleksander Skurjat tel.: 71 320-23-46 email: Aleksander.Skurjat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy mechatroniczne w pojazdach i maszynach roboczych**
Name in English: **Mechatronics systems in industrial vehicles and machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042154**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of automation confirmed by completion of relevant course at university level
2. Has basic knowledge of the theory of machines and mechanisms

SUBJECT OBJECTIVES

C1. To gain knowledge of the structure, programming and operation of mechatronic systems working machines and vehicles
C2. To gain skills of experimental research and diagnostics of mechatronic systems of working machines and vehicles
C3. To gain and consolidate awareness of links between knowledge of mechanics, electronics and computer science and awareness of the responsibility for the work

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of sensors used in working machines and vehicles
PEK_W02 - has basic knowledge of controllers and communication standards used in working machines and industrial vehicles
PEK_W03 - has knowledge of structure and principles of operation of the typical mechatronic systems used in working machines and industrial vehicles

II. Relating to skills:
PEK_U01 - is able to carry out experimental research and diagnostics of a typical industrial vehicle mechatronic system
PEK_U02 - is able carry out experimental research and diagnostics of a typical mechatronic system of crane

III. Relating to social competences:
PEK_K01 - is aware of and understanding the relationship between knowledge of mechanics, electronics and computer science
PEK_K02 - is aware of the responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Sensors in mechatronic systems of working machines and vehicles. Temperature sensors. Proximity transducers	2
Lec2	Sensors in mechatronic systems of working machines and vehicles. Sensors of linear and angular displacement. Speed and acceleration sensors	2
Lec3	Sensors in mechatronic systems of working machines and vehicles. Sensors for measurement of forces, moments, pressures and flows	2
Lec4	Controllers and operator panels in mechatronic systems of working machines and vehicles and their programming	2
Lec5	Typical communication standards used in control systems of vehicles and working machines	2
Lec6	Navigation systems used in industrial vehicles	2
Lec7	Automatic systems for excavating and loading of crushed material	2
Lec8	Advanced automation systems supporting the process of positioning of manipulators of earthmoving machines	2
Lec9	Automation of storage and transhipment processes	2
Lec10	Overview of automation systems used in cranes	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Selection of elements and programming of the control system of working machine manipulator	2
Lab2	Examination of jib crane monitoring system	2
Lab3	The investigation of the new generation's mechatronic steering system for articulated vehicle	2

Lab4	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab5	Experimental studies of a robot used for ropeway's rope diagnostics	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Szlagowski J.: Automatyzacja pracy maszyn roboczych. Metodyka i zastosowania. WKiŁ, 2010r.[2] Dudziński P.: Lenksysteme für Nutzfahrzeuge - Theorie und Praxis. Springer, 2005r.[3] Czabanowski R.: Sensory i systemy pomiarowe. Oficyna Wydawnicza Politechniki Wrocławskiej, 2010r.

SECONDARY LITERATURE

[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki iMagazynowania, 1998r.[2] Zimmermann W., Schmidgall R.: Magistrale danych w pojazdach. WKiŁ, 2008[3] PLUS+1 GUIDE - User Manual. Sauer-Danfoss 2012r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronics systems in industrial vehicles and machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec1÷Lec3	2, 5
PEK_W02	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec4÷Lec5	2, 5
PEK_W03	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec6÷Lec10	2, 5
PEK_U01	K2MBM_KE_U06	C2	La1, La3, La5	1, 2, 3, 4
PEK_U02	K2MBM_KE_U06	C2	La2, La4	1, 2, 3, 4
PEK_K01	K2MBM_K06	C3	Lec1÷Lec10, La1÷La5	1, 2, 3, 4, 5
PEK_K02	K2MBM_K05	C3	La1÷La5	1

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wirtualne prototypowanie pojazdów i maszyn roboczych**
Name in English: **Virtual prototyping of vehicles and working machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042155**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Crediting with grade			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	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He knows the issues related to the use of tools of CAD / CAM in the field of design and manufacturing.
2. Be able to work design and construction of simple assemblies; knows the methodological tools and algorithmic used in the design; can be used in the practice known computer programs aided engineering.
3. He can build models, solve the basic issues of static, dynamic and thermal loads in machines, equipment and vehicles, using the finite element method.

SUBJECT OBJECTIVES

C1. Gaining knowledge about the design of industrial vehicles and machines.
C2. Acquiring the ability to use modern methods and tools for the design of industrial vehicles and machines.
C3. Consolidation of ability to work in a group.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It has an extended knowledge in the field of optimal selection of engineering materials based on the mechanical, physical, and operational and technological, utility and economical criteria.
PEK_W02 - It has an extended knowledge in modern techniques of design and construction of machinery and equipment; He is knowledgeable about the latest strategies of design.
PEK_W03 - It has a detailed and well-established theoretical knowledge about design, industrial vehicles and machines.

II. Relating to skills:

PEK_U01 - can make collections of conceptual solutions kinematic systems of machines and equipment, to make a selection; is able to use modern strategies and techniques in the design of components and units of machines and vehicles, including, calculate statics and dynamics in the field of linear and non-linear using CAD tools
PEK_U02 - able to carry out the selection of the material or to develop a conceptual design based on databases and assumptions concerning the operational requirements components or assemblies konstrukcyjnychmaszyn and equipment
PEK_U03 - is able to acquire and use information from the literature, databases, and other available sources to the activities of engineering in the design, operation of machines and manufacturing techniques

III. Relating to social competences:

PEK_K01 - Acquires care about the aesthetics of the work, including projects and reports.
PEK_K02 - Can properly determine priorities for implementation specified by yourself or other tasks.
PEK_K03 - Able to work in a group, taking on different roles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Definitions. The role of virtual prototyping in contemporary art. Areas of application.	2
Lec2	Virtual Prototyping as a combination of 3D modeling, process simulation of manufacturing and numerical study of the properties of strength, functional (kinematic, dynamic), ergonomic (maintenance, service).	2
Lec3	Solid modeling in modern CAD systems: possibilities and limitations. Elements unified in CAD systems. Library of standard parts. Managing a complex project in CAD systems. Group work in CAD systems.	2
Lec4	Numerical (FEA, MBS) using tools implemented in CAD systems. The possibilities and limitations. Computational tools to support the work of designer integrated into CAD systems. Calculation of typical machine elements (eg .: shaft).	2
Lec5	Tools (programs) to the numerical investigations (simulation) designed objects: strength analysis: static and dynamic (FEA: Abaqus, Nastran), analysis of kinematics and dynamics (MBS Adams, Matlab + Simulink, etc.). Conversion and adaptation of data (numerical models) between different CAD / FEA / MBS. Standard formats.	2

Lec6	Strength analysis: construction of a computational model (import and adaptation of a solid model to the needs of the finite element analysis, the definition of materials and computational models, the choice of type and size of elements, discretization, the definition of loads and boundary conditions - and their variants).	2
Lec7	Strength analysis: choice of numerical solution methods, presentation of the results of calculation, evaluation of their correctness, estimation errors, optimizing computational model. Nonlinearity in the calculation models (geometric and material), computational models of the nonlinear issues - method of solving.	2
Lec8	Analysis of kinematics and dynamics of the object as a system wielomasowego (MBS): Defining the parameters of components and connections between them. Models and submodel component products (eg .: wheel tire), defining the interaction of elements of the proposed facility, with each other and with the environment (eg .: the ground).	2
Lec9	Analysis MBS: Defining the boundary conditions. The choice of method and specify simulation parameters and their impact on the correctness obtained wyników.Sposoby presentation of simulation results (animations, diagrams, etc.), evaluation of the results of numerical calculations, estimation errors and their possible limitation. Modeling of hydraulic systems and their cooperation with the mechanical systems.	2
Lec10	Exchange of data (and results of calculations) between MBS and FEA systems. Modeling and numerical studies of complex objects: industrial vehicles and machines and their drive systems and working. Hydraulic and pneumatic these objects in combination with the mechanics.	2
		Total hours: 20
Form of classes – Project		Number of hours
Proj1	Object selection and development of the concept. Defining the proposed facility and determine the system of construction - features, dimensions, load and speed of movement.	1
Proj2	The construction of a 3D model of the proposed facility.	2
Proj3	Modeling: mass properties, kinematic connections, the drive system facility and external extortion. Numerical optimization of dynamic properties of the object and determine the load for strength calculations.	3
Proj4	Construction of numerical model (FEM) designed components. The choice of method of numerical analysis (FEA) due to a possible geometric nonlinearity and material nonlinearity. Identify and analyze the required load combinations. Numerical calculations. Verification and analysis of the results of calculations.	3
Proj5	Optimization of the object, taking into account the criteria adopted, the necessary modifications to the geometry and kinematic and dynamic analysis of the modified object.	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. self study - preparation for project class
N4. project presentation
N5. tutorials

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K03	completion of the project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Virtual prototyping of vehicles and working machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

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

PEK_W01	K2MBM_W05	C1	Lec6-Lec8	N1, N2
PEK_W02	K2MBM_W06	C1	Lec1-Lec10	N1, N2
PEK_W03	K2MBM_KE_W07	C1	Lec10	N1, N2
PEK_U01	K2MBM_U09	C2	Proj1-Proj5	N3-N5
PEK_U02	K2MBM_U07	C2	Proj1-Proj5	N3-N5
PEK_U03	K2MBM_U01	C2	Proj1-Proj5	N3-N5
PEK_K01	K2MBM_K03	C2	Proj1-Proj5	N3, N4
PEK_K02	K2MBM_K10	C2	Proj1-Proj5	N3, N4
PEK_K03	K2MBM_K10	C3	Proj1-Proj5	N3, N4

SUBJECT SUPERVISOR

dr inż. Robert Czabanowski tel.: 71 320-28-37 email: robert.czabanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przebieg i organizacja montażu**
Name in English: **The course and organization of the assembly**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042203**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10			10	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of description and analysis processes. He knows the rules of process engineering design and construction and operation of basic components, assemblies and systems machine. It has a basic knowledge of methods of design and analysis of the various mechanisms found in machine and plant construction. It has a basic knowledge of the organization of production processes, regulations, labor law and health and safety factors, harmful and dangerous in the workplace, knows the basic ergonomic issues.
2. It has the skills writing design and creation of technical documentation of mechanical structures and to read it. Can measure the specific machine parts, quantities characterizing the quality of the surface and estimate the errors of measurements and develop measurement results. He can use the manufacturing technologies in order to shape the form, structure and properties of the products.
3. He is aware of the responsibility for own work and a willingness to comply with the principles of teamwork and responsibility for jointly implemented tasks.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the methods and organization of the assembly.
C2. Acquiring the ability to choose the appropriate assessment tools, methods, standardization of assembly and the basic principles of the organization of the assembly process.
C3. Acquiring skills: design process assembly, organization, process, and evaluation process uncomplicated installation team

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has ordered expertise in defining, identifying and describing the design and production processes.
PEK_W02 - The student knows the methods and techniques of organization of processes and evaluation assembly processes.
PEK_W03 - The student is able to suggest methods, techniques and tools for the reorganization and optimization of technological processes of assembly.

II. Relating to skills:
PEK_U01 - The student has the ability to develop writing and reading documentation of technological and organizational assembly of mechanical structures.
PEK_U02 - The student is able to analyze the organizational process for assembly and apply the methodology and analysis of the standardization of working time.
PEK_U03 - Student can design a technological process of installation and assess and reorganization in terms of its effectiveness.

III. Relating to social competences:
PEK_K01 - search for information and its critical analysis
PEK_K02 - team cooperation on improving the methods for the selection of strategy and organization of work aimed at solving the optimal production processes
PEK_K03 - an objective assessment of arguments, rational explanations and justifications own point of view, using the knowledge of the organization of work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Place the assembly in the manufacturing process. The components in the design of assembly processes.	2
Lec2	Producibility machines due to assembly.	3
Lec3	Methodology for product design assessment due to the installation of DFA.	2
Lec4	Standardization methods the time of assembly operations.	3
		Total hours: 10
Form of classes – Project		Number of hours
Proj1	Analysis of the requirements and conditions of technical and technological	2

Proj2	Analysis of the input data and the structure of the unit to be mounted	2
Proj3	The choice of assembly methods and the development schemes and plans for installation, operation and control of auxiliary Establishing order and content of operations and assembly operations selection time standards preparing technical documentation assembly.	2
Proj4	Assembly sequence planning and content of operations and assembly operations selection time standards preparing technical documentation assembly.	2
Proj5	Analysis of assembly operations using a variety of methods for standardization of working time.	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK-K03	evaluation of the final project
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Kwartalnik Technologia i automatyzacja montażu
[2] Jerzy Łunarski, Wiktor Szabajkowicz: Automatyzacja procesów technologicznych montażu maszyn, WNT Warszawa 1993
[3] Tadeusz Kowalski, Grzegorz Lis, Wiesław Szenajch Technologia i Automatyzacja montażu maszyn Pol.Warsz. 2000
[4] T. Sawik, „ Planowanie i sterowanie produkcji w elastycznych systemach montażowych” . WNT Warszawa 1993

SECONDARY LITERATURE

[1] Kwartalnik Technologia i automatyzacja montażuBruno Lotter: Wirtschaftlische Montage, VDI Verlag 1992
[2] P. Konold, „Flexible Montagesysteme” Springer-Verlag Berli 1995

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The course and organization of the assembly
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_PMS_W03, K2MBM_PMS_W05	C1	Wy1, Wy2, Wy3	N1, N3,
PEK_W02, PEK_W03	K2MBM_PMS_W05, K2MBM_PMS_W06	C1, C2	Wy4-Wy5	N1,N3
PEK_U01, PEK_U02	K2MBM_PMS_U02, K2MBM_PMS_U03	C2	Pr1,Pr2	N2, N3
PEK_U02, PEL_U03	K2MBM_PMS_U04, K2MBM_PMS_U05	C2, C3	Pr1-Pr5	N1-N3
PEK_K01, PEK_K02	K2MBM_K05, K2MBM_K07, K2MBM_K09, K2MBM_K10	C3	pr1-Pr5	N2,N3
PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K07	C3	Wy1-Wy5, Pr1-Pr5	N3

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elastyczne systemy produkcyjne**
Name in English: **Flexible production systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042212**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					10
Number of hours of total student workload (CNPS)					30
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					1
including number of ECTS points for practical (P) classes					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 a basic knowledge of the design - construction process, operation and exploitation of the main components and units of machine tools, and the principles of of their selection and design.
2. The student has an established knowledge in the field of machine tools structure and their technological capabilities.
3. The student has an established knowledge of solutions applied in the flexible automated manufacturing.

SUBJECT OBJECTIVES

C1. Getting to know structural details of machine components in flexible manufacturing systems.
C2. Practical skills to select the components of flexible manufacturing systems (in particular sensorics) and to critically evaluate different solutions.
C3. Ability to independently searching for information in a foreign language, making their interpretation and using of the designed technical solutions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student is able to analyze and evaluate the configuration and machine components of the flexible manufacturing system in terms of its functionality.
PEK_U02 - The student is able to select the components of flexible manufacturing systems (especially sensors) and critically evaluate different solutions.
PEK_U03 - The student can independently search for information in a foreign language, make its interpretation and use it in the designed technical solutions.

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 - he 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 – Seminar		Number of hours
Sem1	Introduction to flexible manufacturing systems (FMS); providing students with issues to develop a presentations.	2
Sem2	Presentations on systems for handling, transport and storage facilities used in FMS.	2
Sem3	Presentations on the tool management subsystem and supervision of the machining system in FMS.	2
Sem4	Presentations on measuring systems used for supervision of tools, workpieces and machining process.	2
Sem5	Presentations on the systems used for deburring and removing and processing chips in FMS.	2
		Total hours: 10

TEACHING TOOLS USED

N1. problem presentations
N2. self-study - preparing a thematic presentation
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Bishop R.H.: Mechatronic Systems, Sensors, and Actuators. Fundamentals and Modeling. CRC Press. Boca Raton, London, New York 2008
2. Fraden J.: Handbook of modern sensors. Physics, designs and applications. Springer Science + Business Media. New York 2004
3. Honczarenko J.: Elastyczna automatyzacja wytwarzania. WNT, Warszawa 2000
4. Honczarenko J.: Obrabiarki sterowane numerycznie. WNT. Warszawa 2008
5. Jemielniak K.: Automatyczna diagnostyka stanu narzędzia i procesu skrawania. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2002
6. Krzyżanowski J.: Wprowadzenie do elastycznych systemów wytwórczych. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005
7. Tönshoff H.K., Inasaki I.: Sensors in Manufacturing. Wiley-VCH Verlag. Weinheim - New York - Chichester - Brisbane - Singapore - Toronto 2001

SECONDARY LITERATURE

1. Czabanowski R.: Sensory i systemy pomiarowe. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2010
2. Luggen W.W.: Flexible manufacturing cells and systems, Prentice-Hall, Inc. Engelwood Cliffs, NJ, 1991
3. Nawrocki W.: Sensory i systemy pomiarowe. Wydawnictwo Politechniki Poznańskiej. Poznań 2001
4. Soloman S.: Sensors and Control Systems in Manufacturing, Second Edition, McGraw-Hill Professional, New York, Chicago, San Francisco, 2010
5. Turkowski M.: Przemysłowe sensory i przetworniki pomiarowe. Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Flexible production systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K2MBM_PMS_U05, K2MBM_U10, K2MBM_U18, K2MBM_U20	C1-C3	Sem1 - Sem5	N1, N2, N3
PEK_K01 - PEK_K03	K2MBM_K09, K2MBM_K10	C1-C3	Sem1 - Sem5	N1, N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Wacław Skoczyński tel.: 26-39 email: waclaw.skoczynski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Konstrukcja i eksploatacja obrabiarek**
Name in English: **Design and Exploitation of Machine Tools**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042213**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has an established expertise in the use of and communicate using language engineering
2. It has a basic knowledge of design and manufacturing systems

SUBJECT OBJECTIVES

C1. Learn the basic function structures of manufacturing systems and methods and techniques machine tools building
C2. Learning functional subsystem of machine tools
C3. Knowledge of machine tools selection and their operating parameters for different type of workpieces

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows the structure of the machine and able to characterize its basic components
PEK_W02 - Student knows the technical capabilities of machine tools and is able to offer their proper use
PEK_W03 - Student understands the need for consideration in the processing properties of static, dynamic and thermal machine tools.

II. Relating to skills:
PEK_U01 - Is able to analyze a problem technical or organizational and design in terms of functional configuration of the machine.
PEK_U02 - He can build a prototype of system machining thermal error compensation
PEK_U03 - s able to ensure high product quality by taking into account properties of static, dynamic and thermal machine behaviour

III. Relating to social competences:
PEK_K01 - Understands the need for lifelong learning in the field of activity of an engineer specializing in "Machine design engineering" and improving professional and social competence
PEK_K02 - He can think and critically analyze the functioning of systems built to improve its efficiency
PEK_K03 - Is aware of the responsibility for their own work and its impact on the functioning of the company

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	General characteristics of machines for material removal (machine tools): definitions, destiny and basic concepts. Spindle units including spindle designs, bearing units, lubrication and cooling systems.	2
Lec2	Carrier systems including machine bodys and slides connections. Main drives, drives of feed motion with measuring systems.	2
Lec3	Main drives, drives of feed motion with measuring systems.	2
Lec4	Auxiliary machine tool modules: tool heads, tool magazines, tool changers, chip conveyors, cooling systems.	2
Lec5	Control of machine tools, systems monitoring and diagnostics.	1
Lec6	Final test.	1
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Compensation of machining thermal erro	2
Lab2	-model CAD and FEM machine tools for determining the thermal deformation	2
Lab3	-Simulation machining error the selected operating conditions	2
Lab4	develop error correction for the control system	2
Lab5	-evaluation of quality results obtained.	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01,PEK_W02	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	prepare reports
F2	PEK_U01,PEK_U02,PEK_U03	evaluation reports
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design and Exploitation of Machine Tools
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_PMS_W01, K2MBM_W06, K2MBM_W07	C1		N1, N4
PEK_W02	K2MBM_PMS_W01, K2MBM_W06, K2MBM_W07	C2		N1, N4, N5
PEK_U01, PEK_U02, PEK_U03	K2MBM_PMS_U05	C3		N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K05	C3		N1, N3, N4

SUBJECT SUPERVISOR

dr inż. Andrzej Roszkowski tel.: (71) 320 2781 email: andrzej.roszkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja procesów produkcyjnych**
Name in English: **Automation of production processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042217**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		20		
Number of hours of total student workload (CNPS)	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	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: Fundamentals of Automatic Control

SUBJECT OBJECTIVES

C1. Explain building automation systems
C2. Explain the operation of control systems
C3. Explain the rules for the application of automation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the construction of automation components
PEK_W02 - Can explain the operation of control systems
PEK_W03 - Can choose the components for the automation of the production process

II. Relating to skills:
PEK_U01 - Can apply automation components for process automation
PEK_U02 - Can program the selected control elements
PEK_U03 - Is able to operate automated manufacturing processes

III. Relating to social competences:
PEK_K01 - Recognizes the importance of team collaboration.
PEK_K02 - Can search for information regarding the various fields of technology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic concepts, building automation systems and their classification.	1
Lec2	The mathematical description of automation.	1
Lec3	Industrial control system. PLCs	1
Lec4	Aspects of safety.	1
Lec5	Network communication systems	1
Lec6	Electric drives	1
Lec7	Industrial robots	1
Lec8	Vision Systems	1
Lec9	HMI and SCADA systems	1
Lec10	Test	1
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Industrial control system.	2
Lab2	Programmanle logic controllers	2
Lab3	Electric servo drives	2
Lab4	Electric servo drives	2
Lab5	Industrial robots	2
Lab6	Vision Systems	2
Lab7	Industrial networks	2
Lab8	HMI and SCADA	2
Lab9	Automating the process of treatment process	2
Lab10	Automating the process of transport	2

	Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03,	Test
F2	PEK_U01, PEK_U02, PEK_U03,	REPORT OF LABORATORY PRACTICE
P = ŚREDNIA Z WSZYSTKICH OCEN		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legierski T., Wyrwał J., Kasprzyk J., Hajda J., tytuł: Programowanie sterownikówPLC,Kosmol J., tytuł: Automatyzacja obrabiarek i obróbki skrawaniem, WNT, rok: 2000Jakuszewski R.: Programowanie systemów SCADA. WPK J. Skalmierskiego, Gliwice 2002 Solnik W. ; Zajda Z.:Komputerowe sieci przemysłowe Profibus DP i MPI, Oficyna WydawniczaPolitechniki Wrocławskiej, Wrocław 2005

SECONDARY LITERATURE

Barczyk J., Automatyzacja procesów dyskretnych, WPW 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Automation of production processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W04	c1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_W02	K2MBM_W04	c2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_W03	K2MBM_W04	c3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_U01	K2MBM_U13	c3	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9, LA10	N2,N3, N5
PEK_U02	K2MBM_U13	c3	LA2, LA4, LA5, LA8, LA9, LA10	N2,N3, N5
PEK_U03	K2MBM_U13	c2	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9, LA10	N2,N3, N5
PEK_K01	K2MBM_K09	C1,C2,C3	LA1-LA15	N1-N5
PEK_K02	K2MBM_K06	C1,C2,C3	Lec1-Lec10	N1-N5

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metalurgia i fizyka procesów spawalniczych**
Name in English: **Welding processes metallurgy and physics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042218**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of metallurgy of steel and non-ferrous metals, metallurgy and heat treatment of steel, copper and aluminum. Knowledge about joining methods.

SUBJECT OBJECTIVES

C1. Understanding the basics of bonding materials
C2. Understanding metallurgical processes and changes in the heat affected zone of materials

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to characterize the physicochemical basis of bonding materials
PEK_W02 - Student is able to describe metallurgical processes in bonding processes
PEK_W03 - The student knows and can explain the changes taking place in the heat affected zone

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Linking knowledge from chemistry, physics, and metal science.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Physico-chemical basis for joining engineering materials. Thermodynamic and metallurgical foundations of bonding processes	2
Lec2	Metallurgy for welding construction steels	2
Lec3	Metallurgy welding of alloy steels and high-alloy steels	2
Lec4	Metallurgy of copper and aluminum bonding	2
Lec5	Unlike connections	1
Lec6	Final test	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Welding processes metallurgy and physics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_PMS_W06	C1		N1
PEK_W02 - PEK_W03	K2MBM_PMS_W06	C2, C3		N1
PEK_W01 - PEK_W03	K2MBM_K06	C1 - C3		N1

SUBJECT SUPERVISOR

Prof. dr hab. inż. Andrzej Ambroziak tel.: 21-48 email: andrzej.ambroziak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane technologie wytwarzania**
Name in English: **Advanced production technics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042219.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	120				
Form of crediting	Examination				
Group of courses					
Number of ECTS points	4				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	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
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced production technics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K2MBM_PMS_W06, K2MBM_PMS_W07, K2MBM_W07, K2MBM_W10	C1-C4		N1-N4
PEK_K01-PEK_K02	K2MBM_K01	C1-C4		N1-N4

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: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042220**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				180	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				6	
including number of ECTS points for practical (P) classes				6	
including number of ECTS points for direct teacher-student contact (BK) classes				2.8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of production methods of using various techniques: casting, welding, plastic forming, machining.
2. Has a basic knowledge of the principles of machines selection, equipment and tools for the implementation to various manufacturing processes.
3. Has a knowledge of the basics of the process designing.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge and skills of a critical analysis for selection the planning technology and methods to manufacture the products.
C2. Acquisition of knowledge and skills to choice suitable machines, tools and equipment of technological tooling, process parameters for the selected method of product manufacturing.
C3. Acquire the execution skills to the project of the products manufacturing process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can select and plan the manufacturing technology of the products.
PEK_U02 - Can correctly evaluate the conditions and parameters of the products manufacturing technology.
PEK_U03 - Can develop and carry out the project of products manufacturing technology.

III. Relating to social competences:

PEK_K01 - Acquires the ability to care about the aesthetics of the work and the responsibility for its implementation.
PEK_K02 - Can think and act in a creative way.
PEK_K03 - Acquires a teamwork skills.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Presentation of the course. The scope and discuss how to implement and the pass the pre-final project. Edition proposals and discussion of topics of technological projects. Entering literature list.	3
Proj2	Analysis of possibilities and ways to accomplish the product depending of its construction, required performance and production volume. Presentation and discussion about the final concept of manufacturing technology.	6
Proj3	Development of technological assumptions, selection of the performance parameters, perform the necessary calculations for the selected method of manufacturing.	6
Proj4	Selection of machines, tools and equipment for realization of the agreed manufacturing process.	3
Proj5	Execution the structure of technological process, with detailed plan of selected operations, the order of basic and additional treatments, time standards, technological brochures, etc.	6
Proj6	Development of the project design documentation (assembly drawing and executive drawings). Presentation with the project defense.	6
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of the project preparation
F2	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Project defense.
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Pre-final project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K2MBM_PMS_U04, K2MBM_PMS_U05, K2MBM_U08, K2MBM_U10	C1 - C3	Pr3 - Pr6	N1 - N3
PEK_K01 - PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K05, K2MBM_K10	C1 - C3	Pr1 - Pr6	N1 - N3

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania nieniszczące wyrobów**
Name in English: **Non Destructive Testing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042221**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the basic mechanical properties of engineering materials, ordered knowledge about the types of metallic materials engineering - their construction, properties, applications and selection rules.
2. Abilities to read and interpret drawings and diagrams used in the technical documentation, abilities to do the technical documentation.

SUBJECT OBJECTIVES

C1. Getting knowledge of non-destructive testing methods used in modern technology.
C2. Getting to know the different methods of NDT: visual, liquid penetrant, magnetic-particle, ultrasonic, radiographic, etc..

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student can explain the advantages and limitations of selected methods of non-destructive testing.
PEK_W02 - Student is able to propose a method for non-destructive testing for a structural component or means of transportation(eg car, crane, container extraction, welded, pressure vessels, etc.).
PEK_W03 - Student is able to identify and assess potential risks of detected flaws.

II. Relating to skills:
PEK_U01 - Applying non-destructive testing methods in welding structures, castings and finished products during the operation.
PEK_U02 - Ability to prepare the protocol of non-destructive examinations.
PEK_U03 - Ability to do selected non-destructive testing and asses its results.

III. Relating to social competences:
PEK_K01 - Ability to explain the results of research and assess them critically.
PEK_K02 - Student can objectively evaluate arguments rationally explain them and justify his point of view using the knowledge of non-destructive testing.
PEK_K03 - Knowing the rules of team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Principles of assessment. Visual examination. Liquid penetrant testing Magnetic-particle testing Radiographic testing Ultrasonic testing of welding joints , part 1 Ultrasonic testing, part II. Assessment the size of flaw by ultrasonic testing. Ultrasonic testing of spot welds using 2D arrays. Test grade.	10
		Total hours: 10
Form of classes – Laboratory		Number of hours

Lab1	Introduction. Principles of assessment. Visual examination. Liquid penetrant testing Magnetic-particle testing Radiographic testing Ultrasonic testing of welding joints , part 1 Ultrasonic testing, part II. Assessment the size of flaw by ultrasonic testing. Ultrasonic testing of spot welds using 2D arrays. Test grade.	10
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	short test
F2	PEK_U01-PEK_U03	oral answers, laboratory report,
F3	PEK_K01-PEK_K03	participation in discussion
P = (F1+ F2+F3) /3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Lewińska-Romicka A. , Badania nieniszczące-podstawy defektoskopii, WNT Warszawa 2001

SECONDARY LITERATURE

Poradnik Inżyniera - Spawalnictwo T1., pod red. J. Pilarczyka, WNT Warszawa 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Non Destructive Testing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_PMS_W06, K2MBM_W05	C1, C2	Lec	N1
PEK_U01-PEK_U03	K2MBM_U11, K2MBM_U12	C1, C2	Lab	N2, N3
PEK_K01-PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K08	C1, C2	Lec, Lab	N2, N3, N4

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Organizacja procesów produkcyjnych**
Name in English: **The organization of production processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042222.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Crediting with grade			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	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowladge in area of organization management and manufacturing processes.
2. Knowledge of methods of analysis and improvement of production processes.

SUBJECT OBJECTIVES

C1. The aim of the course is to familiarize with the different areas of organization and design of production processes, taking into account the specificity of the flow of technological information, its structure and its relation to the production company.
C2. The aim of the course is to master the skills of organization, planning, design and process management in a manufacturing company.
C3. The aim of the course is to acquire practical skills in modeling and simulating basic organizational functions and production processes (manufacturing, supply, logistics, stock).
C4. The aim of the courses is to familiarize with modern methods and systems supporting production companies management.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows how to plan, prepare and analyze production systems.
PEK_W02 - Knows and is able to effectively use techniques and tools to optimize production systems.
PEK_W03 - It provides information on the latest trends in the management of a manufacturing company.

II. Relating to skills:

PEK_U01 - He can model part of the manufacturing system.
PEK_U02 - Can improve the operation of the manufacturing system.
PEK_U03 - Can create new, reorganized variants of the manufacturing system.

III. Relating to social competences:

PEK_K01 - Think and act in a logical way.
PEK_K02 - Can draw logical conclusions and in an orderly way solve the problem.
PEK_K03 - Can appropriately determine the priorities for accomplishing specific tasks.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction.	2
Lec2	Process organization of production systems – workflow.	2
Lec3	Process Simulation - Objectives and Tools.	2
Lec4	Product Development Management - PDM and PLM systems.	2
Lec5	Reorganization of processes in the manufacturing company.	2
Lec6	New methods of managing a manufacturing company.	2
Lec7	Elements of the concept of sustainable development in the organization of production processes.	2
Lec8	Summary and verification of acquired knowledge.	2
		Total hours: 16
Form of classes – Project		Number of hours
Proj1	Implementation of the fragment model of the manufacturing system.	4
Proj2	Conducting experiments - simulation of the manufacturing process.	3
Proj3	Development of the optimal model of the production system fragments for the given criteria.	3
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for project class
N4. multimedia presentation
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_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_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	project defense
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Autor: Chlebus Edward, tytuł: Techniki komputerowe CAx w inżynierii produkcji,
Autor: Klemens J. Wróblewski, tytuł: Podstawy sterowania przepływem produkcji,

SECONDARY LITERATURE

Autor: 1.Chlebus Edward, Cholewa Mariusz, Czajka Jacek, tytuł: Systemy PLM w rozproszonym projektowaniu i wytwarzaniu.
Autor: 2.Chlebus Edward, Burduk Anna, Cholewa Mariusz, Chrobot Jarosław, Kowalski Arkadiusz, Susz Sławomir, tytuł: Symulacja komputerowa w procesowym zarzadzaniu produkcja.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The organization of production processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_W10	C1, C2	Wy1- Wy8	N1, N2, N4
PEK_U01 - PEK_U03	K2MBM_U14	C3	Pr1 - Pr3	N2 - N5
PEK_K01 - PEK_K03	K2MBM_K09, K2MBM_K10	C2, C3	Wy1- Wy8 Pr1 - Pr3	N3, N5

SUBJECT SUPERVISOR

dr inż. Małgorzata Rusińska tel.: 713202056 email: malgorzata.rusinska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Procesy obróbki skrawaniem**
Name in English: **MACHINING PROCESSES**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042223.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		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		2
Lec3		2
Lec4		3
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. self study - self studies and preparation for examination
N5. 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; ;	
F2	PEK_U01-PEK_U03	
F3	PEK_K01-PEK_K03	

P = (F1+F2+F3)/3

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	
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
MACHINING PROCESSES
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03;	K2MBM_PMS_W07	C1-C3		N1; N2; N3;N4; N5
PEK_U01-PEK_U03;	K2MBM_PMS_U05	C1-C3		N1; N2; N3;N4; N5
PEK_K01-PEK_K03;	K2MBM_K10	C1-C3		N1; N2; N3;N4; N5

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: **Specjalne metody łączenia**
Name in English: **Special methods of joining**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042224**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student has basic knowledge of welding processes (characteristics of methods, health and safety rules, parameters, equipment, joining technology, documentation, application);
A student has knowledge of basic mechanical properties of engineering materials - their structure, properties, applications and principles of selection;
A student has basic knowledge of thermal processes/heat treatment;
2. A student is able to distinguish basic methods of bonding;
A student is able to perform basic tests and inspections of engineering materials;
3. Students shows the ability to improve team work on strategy selection methods, aimed at optimal solving of assigned problems

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about special joining techniques by welding methods and related
C2. Acquiring an ability to choose the right joining technology and basic parameters of the process
C3. Acquiring the ability to design the bonding process of the product

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - A student knows the definitions and characteristics of special joining methods

PEK_W02 - A student knows the bonded materials obtained by using special joining methods and their typical applications

PEK_W03 - A student knows the methods of inspection/test of joints made by special bonding methods

II. Relating to skills:

PEK_U01 - A student is able to choose the right method of special joining group and define the basic parameters of the process

PEK_U02 - A student is able to propose the right joining technology for a particular product

PEK_U03 - A student is able to perform basic joints with different special methods

III. Relating to social competences:

PEK_K01 - A student shows ability to search for information and its critical analysis

PEK_K02 - A student shows the ability to team work on improving methods of strategy selection aimed to optimal solving of assigned problems

PEK_K03 - The student shows the ability of an objective evaluation of arguments, rational explanations and justifications of own position using knowledge of welding

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Application of laser technology in welding	2
Lec2	Application of electron beam in bonding, cutting, overlapping the layers and materials heat treatment	2
Lec3	Application of plasma in welding, cutting, spraying and surfacing	2
Lec4	Special methods of soldering and brazing of advanced materials	2
Lec5	Special methods of resistance welding	2
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Modern applications of friction welding	2
Lab2	Plasma welding and cutting	2
Lab3	Underwater welding	2
Lab4	Termite welding, explosion welding	2
Lab5	Modern applications of adhesive technology	2
		Total hours: 10

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	short test, laboratory report
F2	PEK_K01 - PEK_K03	participation in problems discussions
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

PILARCZYK J.: Procesy spajania, Poradnik Inżyniera Spawalnika, tom I i II, WNT, Warszawa 2003 i 2005.
FERENC K.: Spawalnictwo, WNT Warszawa, 2007.
NOWACKI J., CHUDZIŃSKI M., ZMITROWICZ P.: Lutowanie w budowie maszyn, WNT, Warszawa 2007.
KLIMPEL A.: Spawanie zgrzewanie i cięcie metali. Technologie, WNT, Warszawa 1999.

SECONDARY LITERATURE

BUKAT K., HACKIEWICZ H.: Lutowanie bezołowiowe, Wyd. BTC, 2007.
PAPKAŁA h.: Zgrzewanie oporowe metali, Wyd. KaBe, 2003.
BRANDENBURG A.: Kleben metallischer Werkstoffe, DVS-Verlag GmbH, Düsseldorf 2001.
GODZIMIRSKI J.: Wytrzymałość doraźna konstrukcyjnych połączeń klejowych, WNT, Warszawa 2002.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Special methods of joining
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_PMS_W06	C1 - C3	lec1-7	N1, N4
PEK_U01 - PEK_U03	K2MBM_PMS_U04	C1 - C3	lab1-7	N2, N3
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K05, K2MBM_K10	C3	lab1-7	N2, N3

SUBJECT SUPERVISOR

dr inż. Tomasz Piwowarczyk tel.: 4255 email: tomasz.piwowarczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytwarzanie kompozytów metodami odlewniczymi**
Name in English: **Manufacturing of composite materials by casting methods**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042226**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of manufacture and casting methods.
2. Basic knowledge of physical metallurgy.

SUBJECT OBJECTIVES

C1. Getting knowledge of the basic information about manufacturing methods, composite materials properties and their applications.
C2. Getting knowledge about the casting methods to produce metal matrix composite.
C3. Getting knowledge about the property test examinations included strength and wear tests.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Basic knowledge about production and application of composite materials. Knowledge of matrix types and strengthening mechanisms.

PEK_W02 - Basic knowledge about production and application of composite materials. Can select composite components for proper application.

PEK_W03 - Basic knowledge about strength and wear investigations of composite materials. Can define wear mechanism and metallographic observations.

II. Relating to skills:

PEK_U01 - Can use terminology related to composite materials, their manufacturing, and investigation of properties.

PEK_U02 - Can characterize selected composite materials. Can apply proper process parameters.

PEK_U03 - Can select and prepare composite components to achieve good reinforcing effect.

III. Relating to social competences:

PEK_K01 - Can think and act in a creative way.

PEK_K02 - Follows the rules and customs prevailing in academia.

PEK_K03 - Can correlate the effects of industry activity with the impact on the environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Composite materials- basic terms, groups.	2
Lec2	Strengthening mechanisms. Types of matrix-reinforcement interface.	2
Lec3	Surface phenomena, wetting of reinforcement by liquid metal, capillary phenomena, chemical reactions between composite components.	2
Lec4	Producing methods of composite materials, in-situ and ex-situ composites.	2
Lec5	Squeeze casting, stir casting. Exam	2
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	Manufacturing of porous ceramic performs to reinforce composite materials	2
Lab2	Pressure infiltration of ceramic preforms.	2
Lab3	Production of hybrid composite materials	2
Lab4	Preparation of composite suspensions by stir casting.	2
Lab5	Centrifugal casting gradient materials. Credit	2
		Total hours: 10

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Jerzy Sobczak, Kompozyty metalowe, 2001; Józef Śleziona, Podstawy technologii kompozytów, 1998; Izabela Hyla, Józef Śleziona, Kompozyty. Elementy mechaniki i projektowania, 2004; Ochelski Stanisław, Metody doświadczalne mechaniki kompozytów konstrukcyjnych

SECONDARY LITERATURE

Janusz Braszczyńsk, KRYSTALIZACJA ODLEWÓW; Zbigniew Konopka, METALOWE KOMPOZYTY ODLEWANE, 2011

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing of composite materials by casting methods
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03 PEK_K01 - PEK_K03	K2MBM_PMS_W04, K2MBM_PMS_W06	C1,C2	Lec1-Lec5	N1, N2, N3
PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	K2MBM_K10, K2MBM_PMS_U02	C2, C3	Lab1-Lab5	N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Krzysztof Naplocha tel.: 27-22 email: krzysztof.naplocha@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane metody kształtowania plastycznego**
Name in English: **Advanced methods of metal forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042227**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20			10	
Number of hours of total student workload (CNPS)	90			30	
Form of crediting	Crediting with grade			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	1.2			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Able to design a typical process of metal forming
2. Possess a knowledge on modern engineering materials
3. Able to use of analysis methods and optimization of metal forming processes

SUBJECT OBJECTIVES

C1. Application of modern engineering materials for processes efficiency improvement
C2. Cognition of unconventional metal forming methods
C3. Application of analysis methods and optimization of metal forming processes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Possess a knowledge on modern metal forming methods and their analysis

PEK_W02 - Know relations between material properties, metal forming process parameters and strain and load distributions

PEK_W03 - Able to indicate of directions of process modification with respect to efficiency

II. Relating to skills:

PEK_U01 - Able to design a modern process of metal forming, to analyze of limit conditions, to optimize of a process

PEK_U02 - Able to design tools, to choose of materials, machines and process automation methods

PEK_U03 - Able to calculate of necessary efforts of materials and tools

III. Relating to social competences:

PEK_K01 - Has awareness of the effect of method selection on environment

PEK_K02 - Able to use different information sources for decision making

PEK_K03 - Able to organize of teem working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview of limitations in metal forming processes	1
Lec2	Definition of advanced metal forming methods as e way of limits elimination	1
Lec3	Trends of metal forming process development, accuracy of parts, efficiency of processes, improvement of the process flexibility, forming of hard deformed materials, shortening of production preparation time, preservation of environment	1
Lec4	Development of materials for metal forming, automobile industry, light materials, special materials	2
Lec5	Modern tool materials	2
Lec6	Progressive and transfer methods in sheet metal forming processes	1
Lec7	Application of powder metallurgy for manufacturing materials and parts on specific properties	2
Lec8	Unconventional metal forming methods	2
Lec9	Enhancement of metal forming methods flexibility	1
Lec10	Numerical methods in analyze, designing and optimization of metal forming processes	2
Lec11	Engineering, dedicated FEM programs	1
Lec12	Modern machines for metal forming	2
Lec13	Control methods of metal forming processes	2
		Total hours: 20
Form of classes – Project		Number of hours

Proj1	Evaluation of significance and placement of risk of fracture, wrinkling and part accuracy on the base of literature	1
Proj2	Elaboration of assumptions to the process project, number of operations, conception of intermediate shapes, preliminary selection of parameters, assessment of necessary machines availability	2
Proj3	Elaboration of 3D CAD model and geometry transfer to FEM program	2
Proj4	Metal forming process modeling by engineering FEM program	2
Proj5	Metal forming tools design	2
Proj6	Assessment of process efficiency in relation to typical metal forming methods	1
		Total hours: 10

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. self study - preparation for project class
N4. tutorials
N5. self study, preparation for lecture class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K03,	Assessment of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Richert J., Innovative methods of metal forming. AGH publishing, Krakow, 2010.
Gronostajski Z., Applied research in advanced metal forming processes. Editorial Office of Wroclaw university of Technology, Wroclaw, 2003.
Dyja H., Rheology of plastically deformed metals. Polytechnic of Czestochowa publishing.

SECONDARY LITERATURE

Boljanovic V., Sheet metal forming processes and die design New York : Industrial Press, cop. 2005.
Walsh R. A., McGraw-Hill Machining and metalworking handbook, McGraw-Hill, 2006
Rao S. S., Engineering optimization theory and practice . John Wiley & Sons. 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced methods of metal forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_PMS_W02	C1, C3	Lec1 - Lec3, Lec10,	N1, N2, N5
PEK_W02	K2MBM_PMS_W02, K2MBM_PMS_W06	C1, C3	Lec4, Lec5, Lec7, Lec13,	N1, N2, N5
PEK_W03	K2MBM_W05, K2MBM_W06, K2MBM_W07, K2MBM_W10	C1 - C3	Lec3 - Lec12	N1, N2, N4, N5
PEK_U1 - PEK_U3	K2MBM_PMS_U01, K2MBM_U01, K2MBM_U02, K2MBM_U10, K2MBM_U20	C1 -C3	Proj1 - Proj6	N1 -N5
PEK_K01 - PEK_K03	K2MBM_K07, K2MBM_K08, K2MBM_K09	C1, C3	Lec1 - Lec13, Proj1 - Proj6	N1 - N5

SUBJECT SUPERVISOR

dr inż. Adam Niechajowicz tel.: 40-49 email: adam.niechajowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Narzędzia do przeróbki plastycznej**
Name in English: **Tools for metal forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042228**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10				
Number of hours of total student workload (CNPS)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	0.6				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic concepts to metal and plastic processing.
2. Fundamentals of materials science. Materials used in the construction of machinery and equipment in plastic forming.
3. Basis of design processes in the processing of plastic.

SUBJECT OBJECTIVES

C1. To acquaint the participants with the basic construction of the equipment used in the processing of plastic.
C2. Gaining knowledge of the materials used in the construction of tools for cold and hot forming.
C3. To acquaint the participants with the typical design solutions used in the construction of working tools.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge of the foundations of the theory of plasticity, analytical methods development processes, application of mathematical modeling methods for the analysis of metal forming processes
PEK_W02 - He has ordered knowledge of methods and techniques of organization of installation of equipment and machines

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Acquires the ability to take responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification of basic technologies shaping by plastic forming. Development of cold and hot. Construction equipment for plastic processing.	2
Lec2	Cold forming. The types of treatment used tool. Classification of materials used in cold forming.	2
Lec3	Forged in the heat. The types of treatment used tool. Classification of materials used in the treatment of hot forming.	2
Lec4	Design solutions for the construction working tools. Heat treatment of materials used in construction working tools.	2
Lec5	Analysis of the sample preparation process in the forming of the workpiece. Solutions will design, material and technology for tools.	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. BOLJANOVIC V.: Sheet metal forming processes and die design, Industrial Press, New York 2004.
2. MARCINIAK Z.: Konstrukcja tłoczników, WNT, Warszawa 2002.
3. ZIMNIAK Z.: System wspomagania projektowania, zapewnienia jakości i diagnozowania tłoczenia blach, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005
4. Ćwiczenia laboratoryjne z budowy maszyn część II Obróbka Plastyczna pod redakcją Henryka Ziemby, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1981.
5. MAZURKIEWICZ A., KOCUR L.: Obróbka plastyczna laboratorium , Politechnika Radomska, Radom 1997.

SECONDARY LITERATURE

[1] H.J. Kleemola, M.T. Pelkkikangas, Effect of predeformation and strain path on the forming limits of steel copper and brass, Sheet Met. Ind. 63 (2) (1997) 591–599.
[2] R. Arrieux, C. Bedrin, M. Boivin, Determination of an intrinsic forming limit stress diagram for isotropic metal sheets, in: Proceedings of the 12th Biennial Congress IDDRG, 1982.
[3] A.K. Ghosh, J.V. Laukonis, The influence of strain-path changes on the formability of sheet steel, in: Proceedings of the Ninth Biennial Congress of the International Deep Drawing Research Group, Sheet Metal Forming and Energy Conservation, ASM Publication, New York, 1976.
[4] T.B. Stoughton, A general forming limit criterion for sheet metal forming, Int. J. Mech. Sci. 42 (1) (2000) 1–27.
[5] A.F. Graf,W.F. Hosford, Calculations of forming limit diagram for changing strain paths, Metall. Trans. A 24 (3) (1993) 2497–2501.
[6] A. Graf, W.F. Horsford, Effects of changing strain paths on forming limit diagrams of Al 2008–T4, Metall. Trans. A 24 (3) (1993) 2503–2512.
[7] R. Arrieux, Determination and use of the forming limit stress diagrams, J. Mater. Process. Technol. 53 (3) (1995) 47–56.
[8] R. Hill, Math. Proc. Camb. Philos. Soc. 85 (4) (1979) 179–185.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Tools for metal forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2MBM_PMS_W02, K2MBM_PMS_W06, K2MBM_PMS_W07	C1, C2, C3	W1-W5	N1,N2,N3
PEK_K01	K2MBM_K05	C1, C2, C3	W1-W5	N1,N2,N3

SUBJECT SUPERVISOR

dr inż. Maciej Zwierzchowski tel.: 21-74 email: maciej.zwierzchowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042229**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					20
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Cross-sectional knowledge on the problems taught in the I and II degree of the studies.

SUBJECT OBJECTIVES

C1. To acquire the skill of presenting the diploma work.
C2. To acquire the skill of discussing the fundamental problems learnt in the I and II degree of the studies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student is supposed to be have the skill of discussing the problems presented in their diploma work as well as the fundamental problems learnt in the I and II degree of the studies.

III. Relating to social competences:

PEK_K01 - The student understands the need for continuing their education process and knows the educational possibilities

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, discussion of the structure and the way of editing the diploma work.	2
Sem2	Introductory discussion on the diploma works.	2
Sem3	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the fundamental areas.	2
Sem4	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the design area.	2
Sem5	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the technology area.	2
Sem6	Presentation of the students' work effects.	8
Sem7	Summary.	2
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

F1	PEK_U01, PEK, K01	Problem discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U, PEK_K	K2MBM_K09, K2MBM_U17	C1, C2		N1

SUBJECT SUPERVISOR

Prof. dr hab. inż. Zbigniew Gronostajski tel.: 21-73 email: zbigniew.gronostajski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA I, II**
Name in English: **MASTER THESIS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042251, MMM042252**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of manufacturing techniques and production systems documented by positive marks in all subjects of the first and second semesters in within the specialty Processes Machines and Manufacturing Systems
2. Can apply their knowledge. Carry out experimental research, seek an information from the literature. Speak a foreign language at the level which let to express self-opinions and write master's thesis in the field of production techniques and production systems. Can analyze the results of the research and specify the conclusions.
3. Is aware of the importance of non-technical aspects and impacts of engineering, to respect the principles of ethics and social role of technical college graduate.

SUBJECT OBJECTIVES

C1. Based on the acquired knowledge while studying, preparation of master thesis by the solution of research problem in the field of the specialty Processes Machines and Manufacturing Systems.
C2. Writing a master thesis and presentation of its achievements in relation to current information in literature.
C3. Acquisition and consolidation of independent work skills, determination of the priorities to tackle the task and awareness of responsibility for own work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can critically analyze and evaluate existing manufacturing processes, production systems and technological machines. Can work independently to realize the degree of master's thesis, using research techniques and methods known during studies.

PEK_U02 - Can acquire concrete information from the literature also in foreign languages. Can to interpret and critically evaluate the research results.

PEK_U03 - Knows how to edit a master's thesis complying with prevailing requirements of method and style of writing. Can present it orally to a wider audience using multimedia capabilities, including the occurrence to the diploma committee.

III. Relating to social competences:

PEK_K01 - As a graduate student is aware of being the next leader, who knows how to organize the work and determine the self-priorities for the others, can manage a team of people as well as work together in the group taking the different roles.

PEK_K02 - Is gaining characteristics of a person working alone, according to the principles of ethics with an awareness of the responsibility for their own work.

PEK_K03 - Acquires attention to style and form of expression of own views in native and a foreign languages, especially in English, understands the need of continuing education and developing professional skills throughout their live.

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. case study
N2. self study - self studies and preparation for examination
N3. multimedia presentation
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Working in the semester, preparing master's thesis as a work.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Literature of the master's thesis topic agreed with the promoter.

SECONDARY LITERATURE

1. Kozłowski R.: Praktyczny sposób pisania prac dyplomowych; Wolters Kluwer Polska sp. z o.o. 2009;
2. Kalita C.: Zasady pisania licencjackich i magisterskich prac badawczych; Poradnik dla studentów; Wyd. ARTE 2011
3. Kevine J. S.; Writing and presenting your thesis or dissertation; Michigan 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MASTER THESIS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K2MBM_U03, K2MBM_U17, K2MBM_U20	C1, C2		N1 - N4
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K03, K2MBM_K10	C1 - C3		N1 - N4

SUBJECT SUPERVISOR

dr inż. Mateusz Stachowicz tel.: 713204235 email: mateusz.stachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria materiałowa**
Name in English: **Materials Science**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042302**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge of basics of physics and chemistry of solids.
2. The knowledge in the field of materials science in the reference engineering materials groups and their overall characteristics.

SUBJECT OBJECTIVES

C1. Students acknowledgements with the basic and methods of material engineering.
C2. The familiarization with problems and methods of choosing and design of engineering materials.
C3. Basing on already gained knowledge (materials science), presentation of new and perspective material groups.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows the clasification of engineering materials, knows their overall characteristics and fields of applications.

PEK_W02 - Knows the issue and complexicity of knowledge elements which are part of material science.

PEK_W03 - Has the knowledge about modern and future materials.

II. Relating to skills:

III. Relating to social competences:

PEK_K01 - Broads the knowledge about the role of materials in the civilization development

PEK_K02 - Knows the methodology of system analysys, useful not only for the materials problems resolving.

PEK_K03 - Will be the propagator of new materials introduction to the common usage.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The base and methods of materials science.	2
Lec2	The role and meaning of materials in the civilization development.	2
Lec3	The overview of engineering materials (metals alloys, polymers, ceramics, composites).	2
Lec4	The basics of system analysis with the example of its usage in the materials choosing.	4
Lec5	Stuctural, strength and corrosive aspects of materials degradation.	2
Lec6	Bionic , biomimetic and 'smart' materials.	2
Lec7	Modern low-alloed martensitic steels.	2
Lec8	Modern materials, used in higher and lowered temperatures.	2
Lec9	Test.	2
		Total hours: 20

TEACHING TOOLS USED

N1. problem lecture

N2. problem discussion

N3. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK - W01 - PEK - W03	Test
P = f1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Grabski.M.W, Kozubowski.J.A, Inżynieria materiałowa - geneza, istota, perspektywy,Wyd.PW,2002
[2]Ashby.M.F, Jones.D.R, Materiały inżynierskie, WNT,1995

SECONDARY LITERATURE

[3] Pękalski.G, Materiały dydaktyczne dla IPS, praca niepublikowana, 2012

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK - W01	K2MBM_IMK_W01, K2MBM_IMK_W02, K2MBM_IMK_W03, K2MBM_IMK_W05	C1	Lec1,2	N1, N2
PEK - W02	K2MBM_IMK_W01, K2MBM_IMK_W03	C1,C2	Lec3	N1,N2
PEK - W03	K2MBM_IMK_W02, K2MBM_IMK_W03	C3	Lec5-9	N1 - N3

SUBJECT SUPERVISOR

dr inż. Łukasz Konat email: lukasz.konat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wibroakustyczne diagnozowanie maszyn i urządzeń**
Name in English: **Vibroacoustics diagnosis of machinery and equipment**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042321**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			20		
Number of hours of total student workload (CNPS)			60		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes			1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of mathematical analysis.
2. The student has a basic knowledge of classical mechanics.
3. The student is able to solve ordinary differential equations.

SUBJECT OBJECTIVES

C1. Mastering the basic issues of applied vibroacoustic
C2. Get acquainted with the methodology of measuring the size of the acoustic.
C3. Get acquainted with the methodology of measuring vibration.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - As a result of the carried out activities the student should be able to operate the measurement devices
PEK_U02 - As a result of the carried out activities the student should be able to analyze and interpret the results of the research complex processes vibroacoustics
PEK_U03 - As a result of the carried out activities the student should be able to apply the common technical solutions to reduce the negative impact of vibrations and noise.

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 the capacity for objective evaluation, arguments, rational and justify their own point of view, using knowledge of vibroacoustic.
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 – Laboratory		Number of hours
Lab1	Introduction to laboratory	2
Lab2	Propagation of sound, sound level and vibration	2
Lab3	Acoustic unit	2
Lab4	The source of vibrations and noise	2
Lab5	Selected noise of machinery and equipment	2
Lab6	Criteria for the assessment of noise	2
Lab7	Methods of noise reduction	2
Lab8	Construction and selection of acoustic filters	2
Lab9	Holography and acoustic probe	2
Lab10	Passing of the course	2
		Total hours: 20

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 (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Quiz, the report, paper, oral response
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Cempel Cz.: Used vibroacoustic, Publishe: PWN 1989.
2. Puzyna C.: Vibration and noise, Publishe: CRZZ 1967.
3. Osiński Z.: Damping mechanical vibration, Publishe: PWN 1997.
4. Engel Z.: Protection of the environment against vibrations and nois. Publishe PWN 2001.
5. Goliński A.: Vibration isolation of machines and equipment. Publishe WNT 2000.

SECONDARY LITERATURE

6. Renowski J.: Noise indicators and assessment criteria. Publishe OWPWr 1998.
7. Ozimek E.: Sound and its perception. Aspects of physical and psychoacoustical, Publishe PWN 2002.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Vibroacoustics diagnosis of machinery and equipment
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_U01, K2MBM_U05, K2MBM_U11	C2, C3	La3-La9	N1-N5
PEK_U02	K2MBM_U01, K2MBM_U12	C1	La1-La10	N1-N5
PEK_U03	K2MBM_U01, K2MBM_U02	C1	La5, La7, La8	N1-N5
PEK_K01-PEK_K03	K2MBM_K05			

SUBJECT SUPERVISOR

dr hab. inż. Piotr Osiński tel.: 71 320-45-98 email: Piotr.Osinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika materiałów "Smart"**
Name in English: **Mechanics of Smart materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042322**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10	10			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the courses: Technical Mechanics, Calculus I,
Algebra and Analytic Geometry, Physics.
2. Strength of Materials I and II
3. Student has fundamental knowledge of materials science and plastics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the structure, properties, investigation and modelling methods of selected group of Smart materials.
C2. Acquisition of skills related to constitutive equations and their identification with reference to Smart materials, particularly in the area of mechanical constructions.
C3. Acquisition of skills related to physical fundamentals and methodology of experimental investigations aimed at determining the properties of Smart materials.
C4. Acquisition and strengthening of the social competence including emotional intelligence that is based on the ability to cooperate in a group of students, which is aimed at effective problem solving.
Responsibility, honesty and diligence in one's code of conduct; obeying the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the structure and properties of selected Smart materials
PEK_W02 - Student knows how to describe properties of Smart materials using constitutive models
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods essential to determine the properties of Smart materials.

II. Relating to skills:
PEK_U01 - Student can select a material from the Smart materials group on the basis of knowledge of its properties and application in mechanical constructions
PEK_U02 - Student can apply a body model to describe properties of a Smart material,
PEK_U03 - Student can apply experimental verification methods to selected Smart materials.

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information,
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the strength of materials,
PEK_K03 - Student adheres to the customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Cross effects; classification, structure, manufacture, application of Smart materials.	2
Lec2	Magnetorheological fluids and ferrofluids and composites based on these fluids; magnetorheological elastomers. Structure, properties and application possibilities.	2
Lec3	Magnetostrictive materials and composites based on these materials. Design of dampers, actuators and measurement systems.	2
Lec4	Magnetocaloric and electrocaloric materials and effects. Cooling systems utilizing Smart materials.	1

Lec5	Smart magnetic materials in the design of NDT measurement systems. Magnetovision and its applications.	1
Lec6	Energy Harvesting. Methods of energy acquisition from vibrations and waste heat using Smart materials.	1
Lec7	Methods of description of Smart materials. Overview of constitutive models. Elastic, pseudoelastic and magnetoelastic materials etc.	1
		Total hours: 10
Form of classes – Classes		Number of hours
Cl1	Investigation of properties of the magnetorheological damper with a magnetorheological fluid and a magnetorheological composite.	2
Cl2	Determination of damping in a magnetorheological elastomer.	2
Cl3	Testing of the actuator with the "giant magnetostriction" core in the acoustic band; the so-called "playing table"	2
Cl4	Testing of the harvester which acquires electrical energy from vibrations.	1
Cl5	Determination of the properties of the harvester device which acquires electrical energy from waste heat.	1
Cl6	Use of magnetovision in experimental mechanics.	1
Cl7	"Magnetic refrigerator" demonstrator utilizing Smart materials. Testing.	1
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

Author's own publications (for each topic).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics of Smart materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K2MBM_IMK_W03	C1	Lec1-Lec7	N1,N2,N4
PEK_U01-PEK_U03, PEK_K01-PEK_K03	K2MBM_IMK_U03, K2MBM_K01, K2MBM_K03	C2,C3,C4	Cl1-Cl7	N1,N2, N3,N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe cząstkowe**
Name in English: **Partial Differential Equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042323**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10	10			
Number of hours of total student workload (CNPS)	30	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	1	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the elements of calculus and linear algebra
2. Knowledge of the elements of ordinary differential equations
3. Ability to perform calculations and analysis of the results

SUBJECT OBJECTIVES

C1. Ability to solve the equations of physics
C2. Ability to analyze the course of the physical processes
C3. The ability to search for information and its analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge about the different types of partial differential equations and methods of solving them.
PEK_W02 - Knowledge of the physical problems described by partial differential equations
PEK_W03 - Knowledge allows to analyze the results

II. Relating to skills:
PEK_U01 - Ability to identify and describe the problem
PEK_U02 - Ability to analyze the equations obtained and the use of appropriate methods of solution
PEK_U03 - Ability to analyze the results

III. Relating to social competences:
PEK_K01 - Ability to work independently with the use of literature
PEK_K02 - Ability to work systematically and, in particular, the consulting
PEK_K03 - Collective ability to solve problems in the classroom

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	1. Linear partial differential equations of first order and second.	2
Lec2	2. Equation of string	2
Lec3	3. Wave equation	2
Lec4	5. Laplace equation.	2
Lec5	Test.	2
		Total hours: 10
Form of classes – Classes		Number of hours
Cl1	1. Equation of string.	2
Cl2	2. Wavw equation.	2
Cl3	3. Laplace equation.	2
Cl4	4. The equation for beam bending vibration	2
Cl5	5. Solving these equations using the equations discussed during the course.	2
		Total hours: 10

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials
N3. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEKU01+PEKU02+PEKU03	test
P = ocena z kolokwium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U2+PEK_U3	test
P = ocena z kolokwium przeprowadzonego na wykładzie		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
W. Żakowski, W. Leksiński, Mathematic, part IV

SECONDARY LITERATURE
N. Matwiejew, Methods integration of ordinary differential equations

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Partial Differential Equations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

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

PEK_W01+PEK_W2+PEK_W3	K2MBM_IMK_W01	C1+C2+C3	Lec1=Lec5	N3
PEK_K01+PEK_K2+PEK_K3+PEK_U01+PEK_U2+PEK_U3	K2MBM_IMK_U02	C1+C2+C3	Cl1-Cl5	N1 i N2

SUBJECT SUPERVISOR

dr inż. Grażyna Ziętek tel.: 320-21-18 email: grazyna.zietek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy teorii sprężystości i plastyczności**
Name in English: **Elements of Theory Elasticity and Plasticity**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042326**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20	20			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Crediting with grade	Crediting with grade			
Group of courses					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.2	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowlege of elements of the mathematical analysis and the lineal algebra.
2. The knowlege of elements of the strenght of materials, and particularly of the knowledge concerning of the stress and strain state.
3. The skill of the calculations and analyses of received results in the area of the strenght of materials.

SUBJECT OBJECTIVES

C1. The achivement of the knowledge from the area of the theory of the elasticity and the purchase, in this range, the skill of the problem solving for complex stress states.
C2. The achivementt of the knowledge from the area of the theory of the plasticity and the purchase, in this range, the skill of the problem solving for complex stress states.
C3. The achivement of skills of formulating of equations describing the mechanical state of elements of construction.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The orderly knowledge from the theory of the elasticity, particularly in the area of the plane stress state .

PEK_W02 - The orderly knowledge from the theory of the plasticity, particularly in the area of the plane stress state

PEK_W03 - The orderly knowledge conserning of constitutive equations applied to description of structural materials

II. Relating to skills:

PEK_U01 - The skill of finding of stress and strain in complex states in the different kind constructions.

PEK_U02 - The skill of formulating of problems in area of the mechanics os structural material.

PEK_U03 - The skill of analyzing of obtained results.

III. Relating to social competences:

PEK_K01 - The skill of the individual works with the utilization of the literature.

PEK_K02 - The skill of the systematical works, and particularly the participation in consultations.

PEK_K03 - The skill of the collective problem solving during lecture.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Stress state	2
Lec2	Strain state	2
Lec3	Transformation of of stress and strain state elements.	2
Lec4	Equations of equilibrium and strain compatibility conditions.	2
Lec5	The plate state of stress and strain for elastic medium	2
Lec6	Criteria for initial yield.	2
Lec7	Kinematic, isotropic and mixed hardening.	4
Lec8	Elasto-plastic torsion of prismatic bar.	2
Lec9	Elasto-plastic banding of prismatic bar.	2
		Total hours: 20
Form of classes – Classes		Number of hours
Cl1	Determining of stress and strain tensors in the case of differently loaded of elements of construction.	2
Cl2	Determining of principal stress and strain.	2
Cl3	The analysis of the different kind of the hardening. Determining of the dependence between the stress and strain in the case of the uni-axial compression and the tension.	4
Cl4	Determining of the permissible stress using different yield criteria.	2
Cl5	Elasto-plastic torsion of prismatic bars, determining the state of stress and strain.	4

Cl6	Elasto-plastic bending of prismatic bars, determining the state of stress and strain.	4
Cl7	Test.	2
		Total hours: 20

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials
N3. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01+PEK_W2+PEK_W3	test
P = Ocena z kolokwium na ćwiczeniach		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U2+PEK_U3	test
P = ocena z kolokwium		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Walczak, The strength of materials and the foundations of the theory of elasticity and plasticity

SECONDARY LITERATURE
J. Skrzypek, Plasticity and creep.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Elements of Theory Elasticity and Plasticity
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Te n
PEK_W01+PEK_W2+PEK_W3	K2MBM_IMK_W03	C1+C2+C3	Lec1-Lec9	
PEK_K01+PEk_K02+PEK_K03+PEK_U01+PEK_U02+PEK_U03	K2MBM_IMK_U04, K2MBM_K06	C1+C2+C3	Cl1-Cl7	N

SUBJECT SUPERVISOR

dr inż. Grażyna Ziętek tel.: 320-21-18 email: grazyna.zietek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Obróbka cieplna**
Name in English: **Heat treatment**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042327**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of physics, chemistry and mathematics at the high school level
2. Has knowledge of terminology related to engineering of metallic construction materials, selection of methods for shaping the structure and properties of materials for technical applications, as well as selection of engineering materials for applications in various products. Able to compare the basic mechanical, technological and operational properties of materials.
3. He can use technical information. Has the ability to assess the economic and operational conditions of using various engineering materials

SUBJECT OBJECTIVES

C1. Expanding knowledge in the field of engineering of metallic construction materials and methods of shaping the structure and properties of materials for technical applications by heat treatment.
C2. Expanding knowledge of the use of technical information for the selection of heat treatment parameters of metallic materials and the correct terminology in the field of heat treatment
C3. The acquisition of practical skills in the selection of heat treatment parameters, as well as the impact of these parameters on the structure and properties of metallic materials.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to characterize the influence of heat treatment on the structure and properties of metallic construction materials. He can determine the mutual relationship between these elements
PEK_W02 - He knows and defines advanced terminology in the field of heat treatment of metallic materials. Understands the phenomena occurring in metallic materials during heat treatment.
PEK_W03 - Has the ability of rational selection of materials for structural elements and machine parts, and knowledge allowing to shape the structure and properties of these materials in technological processes, in particular through heat treatment

II. Relating to skills:
PEK_U01 - Student is able to choose the parameters and technology of heat treatment depending on the chemical composition of metallic materials and expected mechanical properties
PEK_U02 - The student is able to use technical information and analyze the scientific literature on heat treatment. The student is able to use the acquired knowledge to plan the heat treatment course for basic metallic materials
PEK_U03 - The student has a preparation for work supporting material design, as well as for handling specialized computer software and for cooperation with users of engineering materials, constructors and other specialists in the field of designing, manufacturing, processing and application of engineering materials

III. Relating to social competences:
PEK_K01 - The student knows the range of knowledge and skills. Understands the need for continuous training and professional development.
PEK_K02 - The student has the ability to use a specialist language, which allows to achieve communication skills in industry and small and medium-sized enterprises associated with the production and processing of engineering materials
PEK_K03 - The student is able to plan a simple research experiment and evaluate the obtained experimental results. Can independently search for information in literature, including foreign language. Has the ability to independently justify the selection of heat treatment parameters

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	General classification of thermal treatments. Own stresses and defects arising in the heat treatment process	1
Lec2	Transformations in steel occurring during heating	2
Lec3	Transformations in steel occurring during cooling	2

Lec4	Graphs of austenite transformation supercooled during isothermal and continuous cooling	1
Lec5	Transformations in steel during tempering	2
Lec6	Technology of ordinary heat treatment of steel	2
Lec7	Heat treatment of structural, special and tool steel	3
Lec8	Surface hardening of steel	1
Lec9	Theoretical basics of thermo-chemical and thermo-plastic treatment of steel	3
Lec10	Steel hardenability	1
Lec11	Heat treatment of non-ferrous alloys	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Selection of heat treatment parameters of steel based on Fe-Fe3C graph and hardenability criterion.	2
Lab2	The influence of heat treatment treatments on the microstructure and properties of steel	2
Lab3	Hardening and tempering of steel in practice. Own metallographic analysis.	6
Lab4	Microstructures of tool and special steels after heat treatment	2
Lab5	Steel microstructure after thermo-chemical treatment	2
Lab6	Heat treatment of welded joints	2
Lab7	Heat treatment of non-ferrous alloys	2
Lab8	Passing the laboratory	2
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem exercises
N3. calculation exercises
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_U01 - PEK_U03 PEK_K01 - PEK_K03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	report on laboratory exercises
F2	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	quiz
F3	PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	participation in problem discussions
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. R. Haimann: Metaloznawstwo. Wydawnictwo Politechniki Wrocławskiej, Wrocław 1980, 2000.
2. W. Dudziński, K. Widanka: Ćwiczenia laboratoryjne z materiałoznawstwa. Wydanictwo Politechniki Wrocławskiej, Wrocław 2005, 2009.
3. W. Dudziński: Materiały konstrukcyjne w budowie maszyn. Wydawnictwo Politechniki Wrocławskiej, Wrocław 1994.
4. K. Przybyłowicz: Metaloznawstwo, WNT, Warszawa 1992, 2007.
5. L. A. Dobrzański: Metaloznawstwo i obróbka cieplna stopów metali, Wydawnictwo Politechniki Śląskiej, Gliwice 1993.

SECONDARY LITERATURE

1. Blicharski M.: Inżynieria materiałowa, Stal. WNT, Warszawa 2004.
2. Blicharski M.: Wstęp do inżynierii materiałowej. WNT, Warszawa 2003.
3. Adamczyk J.: Inżynieria materiałów metalowych. Wydawnictwo Politechniki Śląskiej, Gliwice 2004.
4. Adamczyk J.: Inżynieria wyrobów stalowych. Wydawnictwo Politechniki Śląskiej, Gliwice 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Heat treatment
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

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

PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	K2MBM_IMK_W02, K2MBM_W05	C1, C2, C3	Lec1-lec11	N1
PEK_W01 - PEK_W03 PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	K2MBM_IMK_U02, K2MBM_K03, K2MBM_K04, K2MBM_K05	C1, C2, C3	Lab1-Lab8	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Łukasz Konat email: lukasz.konat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza wymiarowa w projektowaniu eksperymentu**
Name in English: **Dimensional Analysis in Experiment Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042329**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis, linear algebra.

SUBJECT OBJECTIVES

C1. Knowledge of dimensional analysisas a tool for theory of identification and experiment planning.
C2. Skill of construction of empirical mathematical models.
C3. Acqurement and consolidation of social competences contaiining emotional intelligence based on skills of co-operation in a student group in order to efficiently solve the problems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of dimensional analysis in Drobot's formulation.
PEK_W02 - Knowledge of rudiments of parametrical identification.
PEK_W03 - Knowledge of rules of model similarity.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Definition of dimensional space according to Drobot.	1
Lec2	Relations between elements of dimensional space & images described in classical theory of measurement.	1
Lec3	Postulates of obiectivision & synonymity.	1
Lec4	Elements of measurement theory.	1
Lec5	Dimensional homogenity & invariability.	1
Lec6	Construction of empirical mathematical models .	1
Lec7	Dimensional transformation - so called Π-theorem.	2
Lec8	Dimensional analysisas vs theory of identification and experiment planning.	2
Lec9	Dimensional complex function.	1
Lec10	Multistage identification.	1
Lec11	Rule of correspodence.	1
Lec12	Theory of model similarity.	2
Lec13	Change of dimensional basis. Experiment planning.	2
Lec14	Testing of completeness of similarity invariants set.	1
Lec15	Presentation & disscusion of control works, Crediting.	2
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03,	Homeworks evaluation.
P = f1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.W. Kasprzak, B. Lysik, M. Rybaczuk, Measurements, Dimensions, Invariant Models and Fractals, Wrocław-Lwów 2004,
2.W. Kasprzak, B. Lysik, M. Rybaczuk, Dimensional Analysis in the Identification of Mathematical Models. World Scientific Singapore, 1990,
3.Pr. zb. pod red. W. Myszki, Komputerowy system obsługi eksperymentu, WNT Warszawa 1991,
4.M. Szata, Opis rozwoju zmęczeniowego pękania w ujęciu energetycznym, Oficyna Wydawnicza PWr, Wrocław 2002.

SECONDARY LITERATURE

W. Kasprzak, B. Lysik, Analiza wymiarowa. Algorytmiczne procedury obsługi eksperymentu, WNT Warszawa 1988.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dimensional Analysis in Experiment Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03.	K2MBM_IMK_W03	C1	Lec1 - Lec15	1,2,3

SUBJECT SUPERVISOR

dr inż. Grzegorz Lesiuk tel.: 713203919 email: grzegorz.lesiuk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fizyka i chemia ciała stałego**
Name in English: **Solid State Chemistry and Physics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042330**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	120				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	4				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. first degree studies level of chemistry and physics

SUBJECT OBJECTIVES

C1. Acquainting students with aspects of the solid state chemistry and physics
C2. Acquainting students with modern physico-chemical techniques for investigations of constructional materials.
C3. Acquired skills of learning through bringing together knowledge from different fields of science, with particular reference to chemistry, physics, material science.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student should have basic chemical and physical knowledge associated with structure and properties of solid state of matter.

PEK_W02 - The student should have basic knowledge associated with the quantum-mechanical interatomic interactions.

PEK_W03 - The student should have basic knowledge associated with modern physicochemical measurements,

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, Solid state of matter, properties.	2
Lec2	Defects in Crystals.	2
Lec3	Techniques for physicochemical characterization of solids.	2
Lec4	Quantum mechanical aspects of chemical bonds. Physical interactions.	2
Lec5	Electron spectroscopy of solids, absorption, emission, photon upconversion	2
Lec6	Syntheses of solids, photonic effect.	2
Lec7	Magnetic properties of solids.	2
Lec8	Basic electrochemistry - electrolysis, electrolytic cells, corrosion.	2
Lec9	Basic nanotechnology - nanometerials, synthesis, application, properties.	2
Lec10	Qualifying class –test	2
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (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
Charles Kittel , Introduction to Solid State Physics, 8th Edition

SECONDARY LITERATURE
reliable websites, notes from the lectures

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Solid State Chemistry and Physics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 , PEK_W02, PEK_W03	K2MBM_IMK_W01, K2MBM_IMK_W02, K2MBM_IMK_W05, K2MBM_IMK_W06	C1, C2, C3	Lec1-Lec9	1,2,3

SUBJECT SUPERVISOR

dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042331**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				180	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				6	
including number of ECTS points for practical (P) classes				6	
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Positive credit of courses Materials Science I and II
2. Basic knowledge concerning manufacturing technics and selection rules of materials for construction elements of machines and devices

SUBJECT OBJECTIVES

C1. Obtaining the skills in self conducting of basic metallographic examinations
C2. Obtaining the skills in self selection of materials for chosen structural elements
C3. Obtaining the skills in self analyse of influence of material structure on its performance properties

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Able to plan correctly the basic procedure of metallographic examinations
PEK_U02 - Able to select correctly the material for chosen structural elements
PEK_U03 - Able to assess the correctness of used processing and heat treatment on the basis of the structure and final properties of material

III. Relating to social competences:

PEK_K01 - Obtain the skills in care of aesthetic of project and bearing responsibility for its execution
PEK_K02 - Able to think and work in creative way.
PEK_K03 - Obtain the skill of team work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction the goal and scope of pre-final project, discussion about the procedure and credit conditions of project. Serving the proposals of subjects and discussion about them. Suggestions of literature resources.	2
Proj2	Analysis of opportunities and the methods of task execution. Introduction and discussion about the final project strategy	3
Proj3	Conceptual design of experiment, selection of experimental methods and process parameters	5
Proj4	Literature review. Preparation of samples and test stand for examinations	4
Proj5	Execution of basic metallographic examinations as well as additional necessary studies	8
Proj6	Formulation of project documentation. Presentation and defence of pre-final project	8
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03,PEK_K01-PEK_K03	evaluation of project preparation
F2	PEK_U01-PEK_U03,PEK_K01-PEK_K03	defence of project
P = (F1 +F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Leader suggestions

SECONDARY LITERATURE
Leader suggestions

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Pre-final project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03,	K2MBM_IMK_U04	C1-C3	Pr3-Pr6	N1- N3
PEK_K01-PEK_K03	K2MBM_K03, K2MBM_K05	C1-C3	Pr1-Pr6	N1- N3

SUBJECT SUPERVISOR

dr inż. Krzysztof Widanka tel.: 320-37-00 email: krzysztof.widanka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania strukturalne materiałów**
Name in English: **Structural investigations of materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042332**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of physics and chemistry at the high school level
2. Positive credits of Materials Science I and II courses

SUBJECT OBJECTIVES

C1. Knowledge of methods of structural investigations using X-ray and electron diffraction.
C2. Konwledge of transmission and scanning electron microscopy - microscope construction. operation, applications, methods of specimen preparation.
C3. Knowledge of spectroscopic methods using X-rays and electrons - X-ray microanalysis, electron energy loss spectroscopy, Auger electron spectroscopy, photoelectron spectroscopy.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows methods of structural investigations using X-ray and electron diffraction.
PEK_W02 - Knows construction, operation and applications of transmission and scanning electron microscopes. Knows methods of specimen preparation for electron microscopy investigations.
PEK_W03 - Knows spectroscopic methods using X-rays and electrons - X-ray microanalysis, electron energy loss spectroscopy, Auger electron spectroscopy, photoelectron spectroscopy.

II. Relating to skills:

PEK_U01 - Is able to identify an aim and a scope of structural investigations of materials.
PEK_U02 - Is able to interpret micrographs obtained with the use of scanning and transmission electron microscopes and results of X-ray microanalysis.
PEK_U03 - Is able to interpret X-ray and electron diffractograms and to index electron diffractograms of selected metals.

III. Relating to social competences:

PEK_K01 - Search of information and their critical analysis.
PEK_K02 - To follow customs and rules compulsory in an academic society.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to structure investigations. Reciprcal lattice. Diffraction of waves on a crystal lattice.	2
Lec2	X-ray diffractometer. Construction, working principle, applications.	2
Lec3	Electron optics basics. Electron guns, electron lenses. Vacuum pumps and gauges.	2
Lec4	Scanning electron microscope - construction, working principle, applications.	2
Lec5	X-ray microanalysis. X-ray spectrometers, methods of analysis, applications.	2
Lec6	Transmission electron microscope - construction, working principle. Methods of specimen preparation for transmission electron microscopy.	2
Lec7	Scattering and phase contrasts in a transmission electron microscope and their applications.	2
Lec8	Electron diffraction in a transmission electron microscope. Geometry of diffraction, interpretation of electron diffractograms.	2
Lec9	Dynamical theory of electron diffraction. Diffraction contrast and its applications. High resolution transmission electron microscopy. Electron energy loss spectroscopy. Lorentz microscopy.	2
Lec10	Methods of surface analysis (Auger electron spectroscopy, secondary ion mass spectroscopy, photoelectron spectroscopy).	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Introduction to structure investigations. Explanation of exercises schedule.	2
Lab2	Interpretation of X-ray diffractograms.	2

Lab3	Scanning electron microscope and X-ray microanalysis - demonstration + interpretation of micrographs and results of analysis..	2
Lab4	Interpretation and indexing of electron diffractograms.	2
Lab5	Transmission electron microscope - demonstration + interpretation of micrographs.	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.V.K. Pecharsky, P.Y. Zavalij. Fundamentals of Powder Diffraction and Structural Characterization of Materials. Springer 2009
2.D.B. Williams, C.B. Carter. Transmission electron microscopy. Vol. 1-4. Plenum Press, New York 1996
3.L. Reimer. Scanning electron microscopy. Springer, 1998
4.L. Reimer, H. Kohl. Transmission electron microscopy. Springer 2008
5.J.I. Goldstein, D.E. Newburry, P. Echlin, D.C. Joy, C. Fiori, E. Lifshin. Scanning electron microscopy and X-ray microanalysis. Plenum Press, New York 1981

SECONDARY LITERATURE

1.R.F. Egerton. Physical principles of electron microscopy. Springer 2005
2.D.J. O'Connor, B.A. Sexton, R.St.C. Smart (Eds.). Surface analysis methods in material science. Springer 2003
3.N. Yao, Z.L. Wang. (Eds.) Handbook of microscopy for nanotechnology. Kluwer Academic Publishers 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Structural investigations of materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_IMK_W05	C1 - C3	Lec1 - Lec10	N1 - N2
PEK_U01 - PEK_U03	K2MBM_IMK_U01	C1 - C3	Lab1 - Lab5	N3 - N4

SUBJECT SUPERVISOR

dr hab. inż. Jan Hejna tel.: 320-28-79 email: jan.hejna@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria niezawodności**
Name in English: **Reliability Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042333**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20				
Number of hours of total student workload (CNPS)	120				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	4				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in operation, statistics, engineering design

SUBJECT OBJECTIVES

C1. Acquaint students with problems dealing with analysis and assessment of mechanical object reliability.
C2. Ability of rational management in machine operation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student knows relations and dependecies among processes observed in operation as well as failing process

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Data sources about reliability and safety of machines	2
Lec2	Methodology of data statistical processing. Instructions to reliability testing program.	2
Lec3	Informatic systems aided reliability testing. Analysis and interpretation of test results.	2
Lec4	Application of test results in operation management.	2
Lec5	Structure reliability. Design with probabilistic characteristics.	2
Lec6	Basics in structural reliability modelling using simulation	2
Lec7	Analitical methods in reliability: block diagrams (complex systems)	2
Lec8	Analitical methods in reliability: FTA	2
Lec9	Analitical methods in reliability: FMEA	2
Lec10	Analitical methods in reliability: FMEA	2
Lec11	Multistate systems: Markov processes	2
Lec12	Basics in simulation of reliability assessment. Variable generating of given probability dsitribution.	2
Lec13	Basics in simulation of reliability assessment. Algorithms of simple programs. Programming (Basics),	2
Lec14	Basics in simulation of reliability assessment. Results analysis and conclusions.	2
Lec15	Testing of simulation applications	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Poradnik niezawodności. Podstawy matematyczne. Red. Migdalski J. Wydawnictwo WEMA, Warszawa 1982.
Inżynieria niezawodności. Poradnik. Red. Migdalski J. Akademia Techniczno- Rolnicza, Ośrodek Badania Jakości Wyrobów „ZETOM". Bydgoszcz, Warszawa 1992.
The Reliability of Mechanical Systems. Red. Davidson J. Mechanical Engineering Publications Limited for The Institution of Mechanical Engineers. London 1994.

SECONDARY LITERATURE

Polska Norma PN-93/N-050191. Słownik terminologiczny elektryki. Niezawodność, jakość usługi.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Reliability Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_IMK_W04	C1	Lec1-Lec15	N1

SUBJECT SUPERVISOR

dr hab. inż. Marek Młyńczak tel.: 71 320 38 17 email: marek.mlynczak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Korozja i ochrona przeciwkorozyjna**
Name in English: **Corrosion and anticorrosion protectoin**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042334**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		30		
Form of crediting	Crediting with grade		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge of phycis and chemistry of solids and electrchemistry.
2. The knowledge of kinds, characteristics and aplications of engineering materials.

SUBJECT OBJECTIVES

C1. The acquaintenance of students with corrosion and it economical results.
C2. Familiariation with the basics of electrochemical and gas corrosion
C3. Familirization with the methods of anticorrosion protection (passive and active).
C4. The presentation of problems of materials choosing due to their high corrosion resistance in the specified enviroment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can respect the range of corrosion and its technical and economical results for the inductry
PEK_W02 - Knows types of corrosive processes, types of corrosion and characteristic types of corrosive changes.
PEK_W03 - Knows ways of anticorrosive protection in the reference to type of material and enviroment agresivity.

II. Relating to skills:
PEK_U01 - Can anlyse and take into account corrosive processes in the reference to complex issue of materials degradation.
PEK_U02 - Can take into account corrosive processes and methods of protection during constructions design and their renovation.
PEK_U03 - Can specify the influence of chemical content of material, state of heat treatmens, methods of protection in the reference to behaviour of materials in corrosive enviroment

III. Relating to social competences:
PEK_K01 - Can respect, propagate and indicate need of taking into account corrosion, during constuction design
PEK_K02 - Through gained knowledge limit the economic results of corrosion

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Historical background, Technical and economical meaning of corrosion	2
Lec2	Types of corrosion processes, clasifiaction and cahracteristics of corrosive damages	2
Lec3	Theoretical background of electrochemical corrosion.	2
Lec4	Voltage series of metals and alloys, galvanic series of metals and alloys.	2
Lec5	Polarization processes, passivation and depassivation	2
Lec6	Mechanism of high-temperature corrosion	2
Lec7	Classifiaction and characteristic of anti-corrosion protection methods	2
Lec8	Corrosion of non-metallic materials	2
Lec9	The influence of construction solution and materials microstructure on corrosion process	2
Lec10	Test	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	The overview of methods of corrosion investigations	2
Lab2	Macroscopis corrosion tests	2
Lab3	Microscopic corrosion tests	2
Lab4	Protective surfaces corrosion tests	2
Lab5	Analysis of examples of corrosion expertises	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK - W01 - PEK - W03, PEK_K01, PEK_K02	Test
P = F		

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,	The report from laboratory courses, introduction test
P = F		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Pękalski. G, Materiały dydaktyczne z korozji i ochrony przeciwkorozyjnej, praca niepublikowana,2012
[2] Praca zbiorowa, Ochrona przed korozją, Wyd. KOmunikacji i Łączności, 1986
[3] Aschby.M.F, Jones.D.R.H, Materiały inżynierskie, WNT,1995

SECONDARY LITERATURE

[4] Dobrzański. I.A, Podstawy nauki o materiałach i metaloznawstwo, WNT,2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Corrosion and anticorrosion protectoin
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK - W01	K2MBM_IMK_W06	C1		N1
PEK - W02	K2MBM_IMK_W02, K2MBM_IMK_W06	C2		N1
PEK - W03	K2MBM_IMK_W01, K2MBM_IMK_W02, K2MBM_IMK_W06	C3, C4		N1, N2
PEK - U01	K2MBM_IMK_U02, K2MBM_IMK_U03, K2MBM_IMK_U04, K2MBM_IMK_U05	C3		N3, N5
PEK - U02	K2MBM_IMK_U03, K2MBM_IMK_U04, K2MBM_IMK_U05	C3		N3, N5
PEK - U03	K2MBM_IMK_U04, K2MBM_IMK_U05	C3		N3, N5
PEK - K01	K2MBM_K10	C1, C3		N1, N4
PEK - K02	K2MBM_K06	C1		N1, N4

SUBJECT SUPERVISOR

dr inż. Marzena Lachowicz tel.: 320-27-64 email: marzena.lachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiały konstrukcyjne**
Name in English: **Metallic Construction Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042335**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completing the Materials Science course

SUBJECT OBJECTIVES

C1. Understanding of phase transformations and metal strengthening mechanisms to a sufficient extent selection of materials in the construction and development of product technologies.
C2. Understanding the relationship between the structure, the manufacturing process and the properties of steel.
C3. Acquiring knowledge about the characteristics of basic groups of metallic construction materials - iron alloys and non-ferrous alloys.
C4. Acquiring information search skills and critical analysis.
C5. Acquisition and consolidation of social competences including group cooperation skills student's goal of effective problem solving. Responsibility, honesty, reliability, adherence to customs binding in the academic environment and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - knows the mechanisms of crystallization and phase changes during heating and solidification of metals and
alloys and methods of shaping their basic mechanical properties,
PEK_W02 - knows the basic types of heat treatment treatments and their influence on the properties of steel,
PEK_W03 - has knowledge about the classification and use of basic steel grades,

II. Relating to skills:
PEK_U01 - is able to choose the right structural material and propose a method of shaping
its property based on an adequate fortification mechanism,
PEK_U02 - can choose the appropriate method of thermal improvement and determine the basic parameters process
PEK_U03 - is able to diagnose and interpret basic errors (defects) resulting from the result
production and shaping of the basic properties of construction materials,

III. Relating to social competences:
PEK_K01 - searching for information and its critical analysis,
PEK_K02 - team cooperation and objective selection and evaluation of strategy arguments
solving problems entrusted to the group,
PEK_K03 - adherence to customs and rules in the academic environment,

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational classes. Mechanisms of crystallization, crystallization dendritic, casting structure, solidification of alloys under conditions imbalances.	2
Lec2	Metal deformation and recrystallization. Phase transitions in steel during heating.	2
Lec3	Basic types of annealing. Hardening and tempering of steel. CTP charts. Hardenability.	2
Lec4	Surface treatment of steel: surface hardening, carburizing, nitriding.	2
Lec5	The influence of alloying elements on phase transitions in steels.	2
Lec6	General classification of steel. Structure and properties of unalloyed steels.	2
Lec7	Structural alloy steels.	2
Lec8	Tool and special alloy steels.	2
Lec9	Foundry iron alloys.	2
Lec10	Copper and copper alloys. Light metals and light metal alloys.	2
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Influence of carbon content on microstructure and mechanical properties of steel.	2

Lab2	The influence of heat treatment on the structure and properties of steel.	2
Lab3	Microstructure of surface hardened elements.	2
Lab4	Microstructure and properties of tool steels.	2
Lab5	Steel microstructure with special properties.	2
Lab6	Microstructure and properties of cast irons.	2
Lab7	Microstructure and properties of copper alloys.	2
Lab8	Microstructure and properties of aluminum alloys.	2
Lab9	The influence of the manufacturing method on the microstructure and mechanical properties of steel.	2
Lab10	Quantitative metallography.	2
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	W01-W03;	Written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	U01-U03; K01-K03;	Quiz, Oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metallic Construction Materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W08	C1	Lec1-Lec2, Lec5	1, 2, 4
PEK_W02	K2MBM_W08	C2	Lec2-Lec4	1, 2, 4
PEK_W03	K2MBM_W08	C3	Lec6-Lec10	1, 2, 4
PEK_U01 PEK_U02 PEK_U03	K2MBM_U01, K2MBM_U07	C1, C2, C3	Lab1-Lab10	2, 3, 5
PEK_K01 PEK_K02 PEK_K03	K2MBM_K01, K2MBM_K02, K2MBM_K03, K2MBM_K06	C1, C2, C3	Lab1-Lab10	2, 3, 5

SUBJECT SUPERVISOR

dr inż. Łukasz Konat email: lukasz.konat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika materiałów -badania, modelowanie**
Name in English: **Mechanics of materials; testing and modeling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042336**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		10		
Number of hours of total student workload (CNPS)	90		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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the courses: Technical Mechanics, Calculus I,
Algebra and Analytic Geometry
2. Physics, Strength of Materials I and II
3. Student has fundamental knowledge of materials science and plastics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the structure, properties, investigation and modelling methods of selected group of advanced materials.
C2. Acquisition of skills related to constitutive equations and their identification with reference to advanced materials for mechanical constructions.
C3. Acquisition of skills related to physical fundamentals and methodology of experimental investigations aimed at determining the properties of advanced materials.
C4. Acquisition and strengthening of the social competence including emotional intelligence that is based on the ability to cooperate in a group of students, which is aimed at effective problem solving.
Responsibility, honesty and diligence in one's code of conduct; obeying the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the structure and properties of selected advanced materials,
PEK_W02 - Student knows how to describe properties of materials using constitutive models,
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods essential to determine the properties of advanced materials.

II. Relating to skills:
PEK_U01 - Student can select a material on the basis of knowledge of its properties and application in mechanical constructions,
PEK_U02 - Student can apply a body model to describe properties of a material,
PEK_U03 - Student can apply experimental verification methods to selected advanced materials.

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the strength of materials,
PEK_K03 - Student adheres to the customs and rules of academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Advanced materials. Thematic scope of the course. Classification of materials.	1
Lec2	Composites with continuous fibre for extremely strenuous constructions. Material, technology, exemplary applications.	2
Lec3	High pressure composite vessels for gaseous fuel storage. Design, manufacture, testing, applications.	2
Lec4	Testing methods of high pressure composite vessels for gaseous fuel storage	2
Lec5	Classification, structure, manufacture, application of Smart materials.	1
Lec6	Cross effects. Methods of experimental investigations, measuring apparatus, software for experiment handling.	2

Lec7	Properties of Smart materials stimulated by magnetic field. Examples of experimental investigations.	2
Lec8	Metallic glasses. Manufacture, properties, testing.	2
Lec9	Properties of the materials with martensitic phase transformation induced by plastic strain. Examples of experimental investigations.	2
Lec10	Body models; constitutive equations for selected advanced materials.	2
Lec11	Methods to identify constitutive models for Smart materials.	1
Lec12	Examples of application of Smart materials.	1
		Total hours: 20
Form of classes – Laboratory		Number of hours
Lab1	Cyclic tests of high pressure composite vessels for gaseous fuel storage.	2
Lab2	Use of optical fibre sensors in investigations of advanced materials.	2
Lab3	Selected methods of investigation of metallic glasses.	2
Lab4	Investigation of the properties of composites subjected to complex stress states. Investigation of martensitic phase transformation induced by plastic strain.	2
Lab5	Application of magnetomechanical effects in the investigations of construction materials. Magnetovision.	1
Lab6	Application of the Thomson effect. Thermovision in the investigations of advanced materials.	1
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K04	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics of materials; testing and modeling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_IMK_W03	c1,c2		1,3,4
PEK_U01-PEK_U03	K2MBM_IMK_U03	c2,c3		1,2
PEK_K01-PEK_K03	K2MBM_K10	c4		1,2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042337**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					20
Number of hours of total student workload (CNPS)					60
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					2
including number of ECTS points for practical (P) classes					2
including number of ECTS points for direct teacher-student contact (BK) classes					0.7

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Cross-sectional knowledge on the problems taught in the I and II degree of the studies.

SUBJECT OBJECTIVES

C1. To acquire the skill of presenting the diploma work.
C2. To acquire the skill of discussing the fundamental problems learnt in the I and II degree of the studies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student is supposed to be have the skill of discussing the problems presented in their diploma work as well as the fundamental problems learnt in the I and II degree of the studies.

III. Relating to social competences:

PEK_K01 - The student understands the need for continuing their education process and knows the educational possibilities

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, discussion of the structure and the way of editing the diploma work.	1
Sem2	Introductory discussion on the diploma works.	19
Sem3	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the fundamental areas.	2
Sem4	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the design area.	2
Sem5	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the technology area.	2
Sem6	Presentation of the students' work effects.	2
Sem7	Summary.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

F1	PEK_U01, PEK, K01	Problem discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_K01	K2MBM_K09, K2MBM_U17	C1,C2		N1, N2, N3,

SUBJECT SUPERVISOR

dr inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Problemy smarowania i zużywania maszyn**
Name in English: **Lubrication and wear problems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042338**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a structured understanding of the physical and physicochemical processes occurring in the tribological nodes .2. It has a basic knowledge of the mechanics of continuous media, including the basics of fluid mechanics and flow issues.
2. Skills: 1 It has the ability to apply fundamental fluid mechanics for the fluid flow and its use in art.
3. Social competence: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineering, including its impact on the environment and the associated responsibility for their decyzje.2.Potrafi think in an entrepreneurial manner.

SUBJECT OBJECTIVES

C1. Acquire advanced theoretical knowledge of tribological wear and its type.
C2. Detailed understanding of the types of lubricants, their tribological properties and rheology.
C3. Gaining an ability to select the type and amount of lubricant to lubrication friction and knowledge of the fundamentals of circuit design and environmental aspects of lubrication lubrication assemblies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has detailed knowledge of the tribological wear of materials used in the nodes of friction.
PEK_W02 - He has detailed knowledge of lubricants, their tribological properties and rheology.
PEK_W03 - He has detailed knowledge of the ways of lubricating oils and greases plastic and basic knowledge on lubrication system design.

II. Relating to skills:
PEK_U01 - He can select materials for friction nodes.
PEK_U02 - He can choose the type and amount of lubricant to friction nodes.
PEK_U03 - He can design a simple installation lubrication and define the basic parameters that will determine its reliable functioning.

III. Relating to social competences:
PEK_K01 - He can think and act creatively.
PEK_K02 - It can objectively evaluate the arguments rationally explain and justify their own point of view, using the knowledge gained during lectures and laboratory exercises.
PEK_K03 - It can work, search for information and critically analyze them, both individually and collectively.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Terms and organization of classes, framework programs, the terms of credit. Introduction to lubrication and wear in the construction and operation of machinery. Tribological wear. Terms: adhesion of the surface layer, the surface free energy. Work of adhesion. Types and characteristics of lubricants. Properties and application of lubricants. The testing of lubricants (including lubricity, mechanical stability, service life and thermal stability). Basic rheology of lubricants. Capillary and rotational rheometry. Rheological greases steady flow conditions and with the use of methods for dynamic oscillation. Linear viscoelasticity. Methods of lubrication. Selection of the type and amount of lubricant for the lubrication of friction. Process automation lubrication. Construction of central lubrication systems. Examples of applications for central lubrication systems in various industries. Basic design of lubrication. The environmental aspects of lubrication assemblies. Final test.	10
		Total hours: 10

Form of classes – Laboratory		Number of hours
Lab1	Test of resistance to abrasive wear of the materials used in the nodes of friction. Measurement of density and viscosity of lubricating oils. Determination of the viscosity index of lubricating oils. Lubrication of slioding bearings. Determination of the frictional characteristics of the cross slide bearing. Evaluation of the impact of oil viscosity on the process of hydrodynamic lubrication. Determining the properties of lubricating greases. Measuring the degree of penetration of lubricating greases and study the rheological properties of lubricating greases (compilation flow curves, determination of yield stress). Research on the influence of the wall material for the formation of a boundary layer greases in the lubricant. Studies on impact of length, diameter and shape of circular pipe pressure drop in lubricants arts. Completion of the course.	10
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Krawiec S. Kompozycje smarów plastycznych i stałych w procesie tarcia stalowych węzłów maszyn. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011. [2] Płaza S., Fizykochemia procesów tribologicznych. Wydawnictwo Uniwersytetu Łódzkiego, Łódz 1997. [3] Bartz W., J., Schmierfette, Renningen-Malmsheim, expert-Verlag, 2000. [4] Bartz W., J.,Getriebe-schmierung. Ehningen bei Bóblingen, expert-Verlag 1989. [5] Czarny R., Smary plastyczne. Wydawnictwo Naukowo-Techniczne, Warszawa 2004. [6] Czarny R., Systemy centralnego smarowania maszyn i urządzeń. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000. [7] Wysocki M., Systemy smarownicze w przemyśle ciężkim. Wydawnictwo Śląsk, Katowice 1971. [8] Laboratory manuals available on the website of the Department PKMiT.

SECONDARY LITERATURE

[1] Froischteter G. B, Trilisky K. K., Ishchuk Yu. L., Stupak P. M., Rheological and thermophysical properties of greases. Gordon & Breach Science Publishers, Londyn 1989. [2] Ishchuk Yu. L., Lubricating grease manufacturing technology. New Age International Limited Publishers, New Delhi 2005. [3] Ferguson J., Kembłowski R., Reologia stosowana płynów. Wydawnictwo Marcus, Łódź 1995. [4] Matras Z., Transport reologicznie złożonych cieczy nienewtonowskich w przewodach. Wydawnictwo Politechniki Krakowskiej, Kraków 2001. [5] Garkunov D. N., Tribotechnika. Masinostroenie, Moskva 1985. [6] Kosteckij B. I., Trenie, smazka i iznos w masinach. Izdatelstvo Technika, Kiev 1970. [7] Lawrowski Z., Tribologia - tarcie, zużywanie i smarowanie. Wydawnictwo Naukowe PWN, Warszawa 1993. [8] Płaza S., Margielewski L., Celichowski G., Wstęp do tribologii i tribochemia. Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Lubrication and wear problems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_IMK_W07, K2MBM_IMK_W08, K2MBM_W05, K2MBM_W08	C1-C3	Lec	N1-N3
PEK_U01-PEK_U03	K2MBM_IMK_U07, K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C1-C3	Lab	N3-N5
PEK_K01-PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K07, K2MBM_K10	C1-C3	Lec, Lab	N1-N5

SUBJECT SUPERVISOR

dr hab. inż. Maciej Paszkowski tel.: 71 320-31-12 email: Maciej.Paszkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Degradacja i recykling materiałów**
Name in English: **Degradation and recycling of materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042340**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	20		20		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	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	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge of basics of engineering materials science, ecology and enviroment management.
2. The knowledge in the field of groups, characteristics and applications of engineering materials.

SUBJECT OBJECTIVES

C1. The acquaintanance of students with the problem of degradation processes in the reference to complex technical objects.
C2. The acquaintanance of students with materials' degradation processes (microstructures degradation, corrosion, occurence and cracks development.
C3. The influence of degradation processes on mechanical and usage properties of materials.
C4. The acquaintanance of students with the problems and terms related with recycling.
C5. Condideration of recycling problems in the reference to boxes, electrical and electronic deviced and cars recycling.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can diversify degradation problems and ageing of constructions and materials.
PEK_W02 - Knows the range of reasonable needs of materials recycling.
PEK_W03 - Knows methods of prevention to the degradation processes and recycling methods.

II. Relating to skills:
PEK_U01 - Can analyse and take into account the degradation processes during design.
PEK_U02 - Can, in the overall conception of materials usage, take into account the processes of their recycling.

III. Relating to social competences:
PEK_K01 - Respect and is able to promote the need of recycling in the design and usage of devices and materials.
PEK_K02 - Through gained knowledge rationalizes and limits the results of degradation and the enviroment pollution.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The key issue of degradation theory.	2
Lec2	The basic rules in the management of thrown goods and recycling.	2
Lec3	The basic terms, law and social background.	2
Lec4	The basics and terms related with machines degradations.	2
Lec5	The meaning of materials choosing in the degradation processes.	2
Lec6	Methods of degradations rate assessment.	2
Lec7	Methods of cracking mechanism in the assessment od degradation processes	2
Lec8	Proecological design of constructions and technological processes.	2
Lec9	Electronic and electrical devices recycling.	2
Lec10	Cars recycling.	2
		Total hours: 20

Form of classes – Laboratory		Number of hours
Lab1	Research methods and diagnostics of degradation theory.	2
Lab2	The application of optical methods in degradation investigations.	2
Lab3	Thermovisive methods in the assessment of degradation state.	2
Lab4	Microscopic methods in the degradation investigations	2
Lab5	Methods of corrosive investigations - the overview, application background.	2
Lab6	The examples of expertises in the field of degratation research	2
Lab7	Evidency and segregation of thrown goods. Separation of their elements.	2
Lab8	Polymers recycling.	2
Lab9	Recycling methods of cars after usage.	2
Lab10	Test laboratory	2

	Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK - W01 - PEK - W03	Test
P = P		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK - U01 - PEK - U02, PEK_K	Introduction test, report from laboratory classes
P = P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1]Ashby.M, Shercliff.H, Cebon.D, Inżynieria materiałowa,(t1.,t.2), Wyd.Galaktyka, 2011
[2]Dudek.D, Zbiór publikacji dotyczących degradacji maszyn, dostarczany studentom
[3] Bilitewski.B, Hardtle.G, Marek.K, podręcznik gospodarki odpadami.teoria i praktyka, Wyd. Seidel- Przyewcki, 2003

SECONDARY LITERATURE

[1] Ashby.M, Jones.D, Materiały inżynierskie, WNT,1995
[2] Pękalski. G, Materiały dydaktyczne dla IPS

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Degradation and recycling of materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK-W-01 - PEK - W-03	K2MBM_IMK_W04, K2MBM_IMK_W06, K2MBM_IMK_W07	C1-C5	Lec	N1,N2,N4
PEK - U01 - PEK - U02	K2MBM_IMK_U01, K2MBM_IMK_U05, K2MBM_IMK_U06	C1 - C5	Lab	N3,N5
PEK - K01 - PEK - K02	K2MBM_K01, K2MBM_K03, K2MBM_K09	C1 - C5	Lab	N3, N5

SUBJECT SUPERVISOR

dr inż. Marzena Lachowicz tel.: 320-27-64 email: marzena.lachowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Tribologia**
Name in English: **Tribology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042341**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	10		10		
Number of hours of total student workload (CNPS)	30		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 He has ordered knowledge about the types of engineering materials - metal, ceramic, polymer and composite materials.2. It has a basic knowledge of the construction, operation and use of the main components and machine assemblies.3. It has a basic knowledge of physics, chemistry, statistics.
2. Skills: 1. It can analyze the macroscopic fractures, microstructure of materials, technological drawbacks of origin, is able to determine the characteristics of the microstructure of metallic materials.2. He can choose the material on a given machine element and can explore its basic properties.
3. Competencies: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineer.2. Is aware of the importance of behavior in a professional manner and have a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. Familiar with the processes of friction, wear and lubrication of moving nodes and methods for machine control these processes in terms of minimizing their effects (special attention will be paid to the construction and technological methods of increasing the reliability and durability of sliding pairs, as well as the problem of lubrication and lubricant selection as an effective prevention of friction and wear).
C2. Understanding the impact of selected parameters of friction vector, ie, pressure, velocity slip material cooperating associations and grease on the tribological characteristics of sliding pairs. Get to know the influence of the structure of the material to abrasion and impact bushing stiffness for load distribution in the bearing friction.
C3. Show students that they can effectively counteract the negative effects of friction in the moving solid contact with real objects illustrate some of the issues discussed theoretically in the lecture.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the processes of friction, wear and lubrication of moving nodes machine.
PEK_W02 - Know the basic types of lubricants and their applications.
PEK_W03 - He knows the design and technological methods of increasing the reliability and durability of sliding pairs.

II. Relating to skills:
PEK_U01 - It can choose materials for sliding nodes and understand relationships and dependencies between the material used and its durability.
PEK_U02 - It can perform basic tests of materials used in the nodes of friction, interpret them and implement in the final node machines.
PEK_U03 - He can use the theoretical knowledge acquired friction and lubrication of the lecture and apply it in practice.

III. Relating to social competences:
PEK_K01 - It can search for information and critically analyze them.
PEK_K02 - Properly define and resolve dilemmas, adheres to the principle of professional ethics.
PEK_K03 - Able to work independently and as a team, and properly assess their own tasks and priorities of the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program and requirements. Brief history of tribology. Elastic contact of smooth bodies. The real contact of solids. The problem of the surface layer.	2
Lec2	Friction and wear processes, their distribution and characteristics. Sliding and rolling friction. Theories of friction. Effect of pressure and sliding velocity on the friction and wear.	2
Lec3	Characteristics of materials (metal and others) on the sliding nodes and the rules for their selection. Simple and reversed pair of friction. Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2

Lec4	Grease as a construction material. Objectives lubrication. The way of obtaining o fluid friction. Distribution of lubricants. Lubricating oils and their properties. Greases, their distribution and characteristics.	2
Lec5	Final test.	2
		Total hours: 10
Form of classes – Laboratory		Number of hours
Lab1	1.Determining of properties of slide bearing materials.	2
Lab2	2.Determining of coefficient of static friction.	2
Lab3	3 Research of lubricity of greases using a four ball tester.	2
Lab4	4. Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	5. Study materials for the seizure.	2
		Total hours: 10

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_K01 - PEK_K03	test, quiz
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03PEK_K01 - PEK_K03	quiz - entrance ticket, the report of the laboratory exercises, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Lawrowski Z.; Tribologia, Tarcie, zużywanie i smarowanie. W-a, PWN, 1993.2.Garkunov D. N.; Trybotechnika. Moskva, Mašinostroenie, 1999.3.Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.4.Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990.5. Embedded detailed instructions posted on the website: www.ikem.pwr.wroc.pl/pkmit

SECONDARY LITERATURE

1.Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag, 2000.2.Lawrowski Z.; Technika smarowania. W-a, PWN, 1987.3.Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Tribology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_IMK_W01, K2MBM_IMK_W02, K2MBM_W05	C1	Lec1, Lec2	N1, N2, N5
PEK_W02	K2MBM_IMK_W07, K2MBM_W05, K2MBM_W06, K2MBM_W08	C1	Lec4	N1, N2, N5
PEK_W03	K2MBM_IMK_W03, K2MBM_IMK_W04, K2MBM_IMK_W07	C1	Lec3	N1, N2, N5
PEK_U01 - PEK_U03	K2MBM_IMK_U02, K2MBM_IMK_U04, K2MBM_IMK_U06, K2MBM_U07, K2MBM_U08	C2, C3	Lab1 - Lab5	N3, N4, N5
PEK_K01	K2MBM_K09	C1, C2	Lec1 - Lec5, Lab1 - Lab5	N1-N5
PEK_K02 - PEK_K03	K2MBM_K01, K2MBM_K03	C3	Lec1 - Lec5, Lab1 - Lab5	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium inżynierii materiałowej**
Name in English: **Materials Science - Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **MMM042342**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)					20
Number of hours of total student workload (CNPS)					90
Form of crediting					Crediting with grade
Group of courses					
Number of ECTS points					3
including number of ECTS points for practical (P) classes					3
including number of ECTS points for direct teacher-student contact (BK) classes					1.4

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has broad knowledge from the field of material science and engineering materials, acquainted during I and II level of studies (material science I, material science II, material engineering.
2. Has broaden knowledge in the field of strength of materials, technology courses and mechanics

SUBJECT OBJECTIVES

C1. The broadening and fulfillment of knowledge in the field of engineering material science.
C2. Investigations and discussion about modern and future problems of this discipline basing on investigations projects.
C3. Presentation and discussion of students works results in the field of enineering materials (thesis, publications.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can propose the research plan, tasks and metodology in the fiels of engineering materials science.
PEK_U02 - Can take into account construction issues, technological, degradation-related and economical in the dissolving of material problems.
PEK_U03 - Can propose and explain alternative materials solutions.

III. Relating to social competences:

PEK_K01 - Can organise the research team to release the specified problem.
PEK_K02 - Broads and rationalizes the knowledge about materials in the social and governemnt-related development

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	The contents and planning of experimental works	2
Sem2	Methods and identification examples of constructions and material state	4
Sem3	Development trends for maetrials and research methods	4
Sem4	Analysis of own research topics (for example 38th competition and VII programm).	2
Sem5	Planning, fields and examples of expertise works.	2
Sem6	Analysis of studies and own research work accoring to IIIrd Generation University requirements.	2
Sem7	The presentation of results of own work.	4
		Total hours: 20

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

F1	PEK - U01 - PEK U03, PEK_K01, PEK_K02	The particiaption in the problematic discussions, report.
P = F		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Indicated individaully for the participant of seminary

SECONDARY LITERATURE
Pękalski. G, Didactic materials and indicated papers

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science - Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK - U01 - PEK - U03	K2MBM_IMK_U02, K2MBM_IMK_U04	C1 - C3	Se1 - Se6	N1, N2, N4
PEK - K01 PEK -K02	K2MBM_K01, K2MBM_K04, K2MBM_K09	C1 - C3	Se5 - Se7	N2

SUBJECT SUPERVISOR

dr inż. Łukasz Konat email: lukasz.konat@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA I, II**
Name in English: **master thesis**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, part-time**
Kind of subject: **obligatory**
Subject code: **MMM042351, MMM042352.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				20	
Number of hours of total student workload (CNPS)					
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points					
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

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

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for project class
N3. self study - self studies and preparation for examination
N4. tutorials

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
master thesis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2MBM_U02, K2MBM_U05, K2MBM_U17, K2MBM_U20	C1,C2,C3		N1,N2,N3
PEK_K01, PEK_K02, PEK_K03	K2MBM_K01, K2MBM_K03, K2MBM_K05, K2MBM_K07, K2MBM_K10	C3		N1,N2,N3

SUBJECT SUPERVISOR

dr inż. Mirosław Bocian tel.: 320-27-54 email: miroslaw.bocian@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK ZAJĘCIA SPORTOWE**
Name in English: **Block of Sports Activities**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, part-time**
Kind of subject: **optional**
Subject code: **WFW010000BK.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		8			
Number of hours of total student workload (CNPS)		30			
Form of crediting		Crediting with grade			
Group of courses					
Number of ECTS points		1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Classes		Number of hours
Cl1		8
		Total hours: 8

TEACHING TOOLS USED

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	wg kart przygotowanych przez SWFiS	
P =		

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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K	xxxK2MBM	wg kart przygotowanych przez SWFiS		wg kart przygotowanych przez SWFiS