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, full-time**
Kind of subject: **optional**
Subject code: **HMH100035BK.**
Group of courses: **no**

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

TEACHING TOOLS USED
N1.

EVALUATION OF SUBJECT 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_W01, PEK_W02	K2MBM_W09, K2MBM_W11	wg kart opracowanych przez SNH		wg kart opracowanych przez SNH

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: **BLOK JĘZYK OBCY (B2+, C1+)**
Name in English:
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **JZL100709.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		15			
Number of hours of total student workload (CNPS)		30			
Form of crediting		Crediting with grade			
Group of courses					
Number of ECTS points		1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes		0.5			

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		15
		Total hours: 15

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_AE_U02, K2MBM_AE_U20	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO
PEK_K	K2MBM_AE_K02	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO

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, full-time**
Kind of subject: **optional**
Subject code: **JZL100709.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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		15
		Total hours: 15

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): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **JZL100710.**
Group of courses: **no**

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

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		45
		Total hours: 45

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_AE_U02, K2MBM_AE_U26	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO
PEK_K	K2MBM_AE_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, full-time**
Kind of subject: **optional**
Subject code: **JZL100710.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		45			
Number of hours of total student workload (CNPS)		60			
Form of crediting		Crediting with grade			
Group of courses					
Number of ECTS points		2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes		1.5			

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		45
		Total hours: 45

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_U06, 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: **Chemia i paliwa alternatywne**
Name in English: **Chemistry and Green Fuels**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMC041401**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals knowledge of the vehicle design and operation.
2. Fundamentals of chemistry.
3. Ability to exercise independent laboratory tests, supported by elemental manual dexterity. Basic knowledge of preservation of health and safety in the laboratory.

SUBJECT OBJECTIVES

C1. Understanding problems of manufacturing and using motor fuels including biofuels.
C2. Knowing the physical and chemical properties of biofuels and their production methods in the industry.
C4. Determination of biofuels using standardized analytical methods applied in the laboratory.
C5. Understanding the relationships between operation of vehicle and environmental issues.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowing the concepts of chemical and technological processes of production and use of biofuels.
Having knowledge on material and energy balances.
Recognition of the information data base of resources for production of biofuels and their products.
PEK_W02 - Being able to identify, describe and characterize the main sources of biofuel raw materials and standard fuels.
Knowing the properties of biofuels and basic rules for the selection of biofuels as fuels to supply drive systems.
Depth knowledge of the operating characteristics of fuels in vehicles.
PEK_W03 - Able to define the basic types of chemical processes used in the synthesis of biofuels.
Describing the core technology processes for the production of biofuels.
Knowing process of waste management, especially fuels and biofuels.

II. Relating to skills:
PEK_U01 - Ability to organize and carry out tests of physical and chemical properties of fuels.
Designing a technological process of biofuels as well as perform calculations of chemical balance.
Drawing conclusions from references.
Being able to make a presentation discussing key issues in manufacturing biofuels.
Providing critical substantive assessment of the technologies applied in the industry in terms of economic and environmental impacts, product quality and social factors.
Developing skills of knowledge through lifelong learning.
PEK_U02 - Able to plan and carry out a simple test for the determination of basic physical biofuels factors.
Respecting the safety rules in the laboratory.
Knowing how to calculate and interpret the tests results.
PEK_U03 - Performing basic operations in the chemical laboratory, carrying out chemical tests, recording their progress and drawing conclusions.
Using simple measurement tools.
Evaluating the quality of the energy carrier and describing its usefulness.

III. Relating to social competences:
PEK_K01 - Able to put into practice the theoretical knowledge and apply held skills.
PEK_K02 - Predicting the impacts of use of fuel for vehicles and the environment.
PEK_K03 - Understanding the need for formulating and providing the public with information and advice regarding use of biofuels.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction.	1
Lec2	Properties, classification and identification of petroleum products.	2
Lec3	Testing methods of properties of petroleum products.	3
Lec4	Properties, classification and identification of biofuels.	2
Lec5	Methods for producing biogas fuels.	2
Lec6	Natural gas and liquid fuels produced from natural gas.	2
Lec7	. Methanol, ethanol and other alcohols - properties and manufacturing.	3
Lec8	Blends of alcohol and gasoline - properties and manufacturing.	2
Lec9	Liquid fuels derived from coal processing – properties and manufacturing.	2

Lec10	Hydrogen - properties and manufacturing.	2
Lec11	Biodiesel - properties and manufacturing.	3
Lec12	Fuels other than alcohol coming from biological materials - properties and manufacturing.	2
Lec13	Properties of fuel additives.	1
Lec14	Problems of transportation, storage and distribution of green fuels.	1
Lec15	Liquefied petroleum gas (LPG) - properties and manufacturing.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Fuel sampling methodology.	1
Lab2	Gas density measurement by Schilling’s method.	2
Lab3	Determination of CNG components.	3
Lab4	Designation of fractional composition of gasoline by distillation.	2
Lab5	Determination of the density and resin content in gasoline.	2
Lab6	Designation of fractional composition diesel fuel by distillation method.	2
Lab7	Designation of density and viscosity of biofuels.	2
Lab8	Cetan number calculation for biofuels and diesel oil.	2
Lab9	Preparation of methyl ester of rapeseed oil.	2
Lab10	Determination of residue after incineration of biofuels.	3
Lab11	Determination of low-temperature properties of biofuels.	3
Lab12	Determination of the corrosion resistance of fuel B-10.	2
Lab13	Designation of fuel ignition temperature B-10 fuel.	2
Lab14	Determination of the anilin point for B-10 fuel.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. multimedia presentation
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

P = F1

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K03	written test
F2	PEK_U01-PEK_U03 PEK_K01-PEK_K03	report
P = F1 x 0,5 + F2 x 0,5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Kułażyński Marek: Green fuels, Automotive Engineering, Wrocław University of Technology; 2011, pp.103.
2. Kułażyński Marek, Sroka Zbigniew J: Green fuels laboratory, Automotive Engineering, Wrocław University of Technology, 2011. pp. 76.
3. Monagham M.L.; Future Gasoline and Diesel Engines, Fisita World, Seoul 2000
4. Pandit G.P.; Alternative Fuels for Future Vehicles, Automotive Engineering 1, 1996
5. Study material in hard copy and electronic version of Module_4 at the European Project Curriculum Development called CarEcology: "New Technological and Ecological Standards in Automotive Engineering"27876-IC-1-2005-1-BE-Erasmus-PROGUC-1, website http://project.iwt.kdg.be/cdcarecology
6. E.M. Goodgeer, Hydrocarbon Fuels, The Macmillan Press Ltd. 1995.
7. J. G. Speight The Chemistry and Technology of Petroleum Marcel Dekker Inc New York 1991

SECONDARY LITERATURE

1. UOP Laboratory Test Method for Petroleum and Its Products, Universal Oil Products Company DES Plained, Ilinois 2000
2. ASTM Standards on Petroleum Products and Lubricants , American Society for Testing Materials Philadelphia 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Chemistry and Green Fuels** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechanical Engineering and Machine Building**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K2MBM_AE_W02, K2MBM_AE_W05, K2MBM_AE_W09	C1, C2, C3, C4	Lec1 to Lec15	N1, N4, N5
PEK_W02	K2MBM_AE_W02, K2MBM_AE_W05, K2MBM_AE_W09	C1, C2, C3, C4	Lec1 to Lec15	N1, N4, N5
PEK_W03	K2MBM_AE_W02, K2MBM_AE_W05, K2MBM_AE_W09	C1, C2, C3, C4	Lec1 to Lec15	N1, N4, N5
PEK_U01	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U04, K2MBM_AE_U10	C1, C2, C3, C4	Lab1 to Lab14	N2, N3
PEK_U02	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U04, K2MBM_AE_U10	C1, C2, C3, C4	Lab1 to Lab14	N2, N3
PEK_U03	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U04, K2MBM_AE_U10	C1, C2, C3, C4	Lab1 to Lab14	N2, N3
PEK_K01	K2MBM_AE_K05, K2MBM_AE_K06, K2MBM_AE_K07, K2MBM_AE_K09	C1, C2, C3, C4	Lab1 to Lab14	N2, N3, N4, N5
PEK_K02	K2MBM_AE_K05, K2MBM_AE_K06, K2MBM_AE_K07, K2MBM_AE_K09	C1, C2, C3, C4	Lab1 to Lab14	N2, N3, N4, N5
PEK_K03	K2MBM_AE_K05, K2MBM_AE_K06, K2MBM_AE_K07, K2MBM_AE_K09	C1, C2, C3, C4	Lab1 to Lab14	N2, N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie układów wieloczłonowych**
Name in English: **Modelling of multibody systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041001**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the theory of machines and mechanisms
2. Ability to analyze the kinematics and kinetostatics of mechanisms

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

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

III. Relating to social competences:
PEK_K01 - Acquires care about the aesthetics of the work, including projects and reports
PEK_K02 - Knowledge of how to take responsibility for own work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of building a multibody models	2
Proj2	Basics of modeling mechanisms in the MD.Adams system - modeling links, kinematic pairs, kinematic excitations	3
Proj3	Basics of modeling mechanisms in the MD.Adams system - modeling loads and perform calculations and analysis of results	3
Proj4	The test of modeling multibody system	2
Proj5	Kinematic and kinetostatic analysis of linkage mechanisms - building virtual models	2
Proj6	The analysis of kinematic and dynamic properties of the linkage mechanism (project)	2
Proj7	Analysis of gears (normal, planetary and differential) - principles of construction of virtual model	2
Proj8	The analysis of kinematic and dynamic properties of the gears (project)	2
Proj9	Building models of manipulators - direct and inverse task of kinematics	2
Proj10	Simulation researches of manipulators (project)	2
Proj11	Building models of spatial mechanisms - constraints, excitations	2
Proj12	Modeling and simulations of spatial mechanisms (project)	3
Proj13	Modeling and simulations of spatial mechanisms - analysis of the results of calculations	3
		Total hours: 30

TEACHING TOOLS USED

N1. problem discussion
N2. project presentation
N3. self study - preparation for project class
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K02	building the virtual model - test
F2	PEK_U02,PEK_U03, PEK_K01,PEK_K02	report, defence of the report
P = (1/5)F1+(4/5)F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Gronowicz A. i inni: Teoria maszyn i mechanizmów. Zestaw problemów analizy i projektowania. Oficyna wydawnicza PWr. Wrocław 2000.
[2] Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna wydawnicza PWr. Wrocław 2003.
[3] Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007.

SECONDARY LITERATURE
[1]Miller S.: Teoria maszyn i mechanizmów. Analiza układów mechanicznych. Oficyna wydawnicza PWr. Wrocław 1996.
[2] Miller S.: Układy kinematyczne. Podstawy projektowania. WNT 1988.
[3] MD. Adams – Reference Manual, 2008

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_U04	C1	Pr1 to Pr4	N1
PEK_U02, PEK_U03	K2MBM_U05, K2MBM_U09	C2, C3	Pr5 to Pr13	N1, N2, N3, N4

PEK_K01, PEK_K02	K2MBM_K03, K2MBM_K05	C2, C3	Pr5 to Pr13	N1, N2, N3, N4

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania maszyn**
Name in English: **Fundamentals of Machinery Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041002**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, assessment rules and literature. Creation of models of a real problem - the process and technological ones.	2
Lec2	Utilization of methods of more detailed characterization of designing goal in widespread technical systems (e.g. brake structures, recuperative units, steering mechanisms, etc.).	2
Lec3	Practical usage of heuristic and algorithmic methods: morphological table, tree of solutions, example and own design.	2
Lec4	Example and practice of system reconstruction.	2
Lec5	Synthesis - example and practice of process and system designing.	2
Lec6	Synthesis of own evaluation criteria.	2
Lec7	Classifying of significance of criteria.	2
Lec8	Organizing initial solutions.	2
Lec9	Assessment of preliminary designing solutions.	2
Lec10	Detailing of selected - pre-designed device or system.	2
Lec11	Selection of models - functional and analytical. Initial calculations.	2
Lec12	Documentation of the project.	2
Lec13	Remodelling of an own algorithm of designing.	2
Lec14	Methods of popularising solutions.	2
Lec15	Summary of the lectures and additional explanations.	2
		Total hours: 30
Form of classes – Project		Number of hours

Proj1	Scope of the project, rules of assessment, literature. Construction of object models (e.g. structures of: brakes, recuperation systems, steering mechanisms, etc.). Selection of the designing object.	2
Proj2	A practical usage of heuristic and algorithmic methods (morphological table, tree of solutions for own project).	2
Proj3	Synthesis of own evaluation criteria - example and practice. Classifying significance of criteria.	2
Proj4	Creating and managing initial solutions. Preliminary assessment of designing solutions.	2
Proj5	More detailed characterization of the selected pre-designed device.	2
Proj6	Preparation of technical documentation.	4
Proj7	Remodelling of an own algorithm of designing.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

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

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W06	C1	Lec1 - Lec15	N1, N2
PEK_W02	K2MBM_W06	C2	Lec1 - Lec15	N1, N2
PEK_W03	K2MBM_W06	C1, C2	Lec6 - Lec9	N1, N2
PEK_U01	K2MBM_U14	C2, C4	Proj1 - Proj6	N3
PEK_U02	K2MBM_U01	C3	Proj2	N3
PEK_U03	K2MBM_U07	C2, C3	Proj1	N2, N3
PEK_K01	K2MBM_K10	C1, C2	Proj1 - Proj4, Proj7	N3
PEK_K02	K2MBM_K03	C3	Proj1 - Proj6	N3, N4
PEK_K03	K2MBM_K05	C4	Proj1 - Proj5	N3

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie maszyn i urządzeń**
Name in English: **Machines and devices control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041003**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student schould be able to explane design rules, programm and starting the most common used machines control systems.
PEK_W02 - In the result of lesson student schould be able to explane design rules of machines equipped with hydraulic and electrohydraulic drive.
PEK_W03 - In the result of lesson student schould be able to call and describe advanced automatics systems equipped with different kinds of regulators.

II. Relating to skills:
PEK_U01 - In the result of lesson student schould be able to select apptioprate components machines control systems and programm control device to propertly realize specified functions.
PEK_U02 - In the result of lesson student schould be able to design and build hydraulic and electrohydraulic systems performing defined functions.
PEK_U03 - In the result of lesson student schould be able to prepare to operation electrohydraulic device and plan and execute tests. On the basis of tests results student schould be able to formulate appriopriate conclusions.

III. Relating to social competences:
PEK_K01 - Student can cooperate and work in the group during building hydraulic and electrohydraulic systems and during report preparation.
PEK_K02 - Student can plan and execute tests during laboratory.
PEK_K03 - Student can propertly identify and solve problems during program control systems and building hydraulic and electrohydraulic systems. Student can formulate appriopriate conclusions.

PROGRAMME CONTENT

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

Lec9	Methods of speed control of hydraulic actuator.	2
Lec10	Proportional valves as control components in systems.	2
Lec11	Hydraulic regulators and proportional directional control valves	2
Lec12	Logic valves in proportional technique.	2
Lec13	Load-sensing - systems, efficiencies.	2
Lec14	Controllers and regulators in hydraulic systems.	2
Lec15	Regulation systems with electrohydraulic servovalves.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Sensors in automation systems.	2
Lab2	Examples of logic systems.	2
Lab3	Construction of sequence control system.	2
Lab4	Continous regulation systems, controlles sets selection and regulation quality tests.	2
Lab5	Programming controllers freely programmed PLC.	2
Lab6	Numerical control systems of CNC machines tool.	2
Lab7	RC control systems of industrial robots.	2
Lab8	Reversible systems.	2
Lab9	Fast movement systems.	2
Lab10	Throttle-serial speed control of hydraulic actuator.	2
Lab11	Throttle-parallel speed control of hydraulic actuator.	2
Lab12	Volumetric speed control of hydraulic actuator.	2
Lab13	Hydraulic actuator control with proportional directional control valve.	2
Lab14	Hydraulic actuator control with Load-sensing directional control valve.	2
Lab15	Position regulation system with electrohydraulic servovalve.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

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

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041004**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Students should obtain basic knowledge from the linear programming and 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	Duality in linear programming. Matrix calculus in solving tasks of PL. The dual problem, its measurement and interpretation.	2
Lec4	Sensitivity analysis of the optimum solution. Changes in the parameters of the objective function and the free terms of constraints. Addition or removing decision variables.	2
Lec5	Comprehensive analysis of the optimal solution.	2
Lec6	Integer Programming (discrete).	2
Lec7	Classical transportation models and algorithms.	2
Lec8	Transportation model (unbalanced, with limited bandwidth routes). The problem of localization of production.	2
Lec9	Examples of problems that may be transferred into the transportation problem models. Problems of warehousing, transportation and production.	2
Lec10	Minimization of empty runs. Blocking routes. The multi-stage transportation problem.	2
Lec11	Introduction to graph theory. Project management (network programming). The maximum flow in a network. Ford-Fulkerson algorithm. Decision trees.	2
Lec12	Minimum spanning tree. The shortest routes in the graph.	2
Lec13	Deterministic Network Models (CPM, PERT). Time and cost analysis. Gantt charts. Resource optimization in network.	2
Lec14	Salesman Problem. Little's algorithm. The knapsack roblem. The production and inventory models. Multi-criteria optimization and chosen non-linear decision models.	2

Lec15	Final exam.	2
		Total hours: 30

TEACHING TOOLS USED
N1. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, 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, Le2, Le3, Le4	N1
PEK_W02	K2MBM_W01	C1, C2. C3	Le5, Le6, Le7, Le8, Le9	N1
PEK_W03	K2MBM_W01	C1, C2. C3	Le10-Le115	N1

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika Analityczna**
Name in English: **Analytical Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041005**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Curriculum. Requirements. Examples of dynamic systems. Constrains and their types, classification systems for the sake of the constrain types (holonomic systems), possible velocities and possible displacements.	2
Lec2	The fundamental problem of dynamics, virtual displacement, the notion of ideal constraints, the general equation of dynamics, the virtual work principle.	2
Lec3	The dynamic general equation for the rotational and planar motion of rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples).	2
Lec5	Generalized forces. Configuration space. Lagrange’s equations (of II type).	2
Lec6	Lagrange’s equations (cont. examples, applications). Lagrangian.	2
Lec7	Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	2
Lec8	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes.	2
Lec9	Harmonically forced vibration, frequency characteristics, an example of oscillation analysis of two- degree- of- freedom system.	2
Lec10	The dynamics of a rigid body in general motion: the orientation, the recognition issue. Kinematics and dynamics of rigid body in case the spherical rotation about a fixed point (reminder of the course Mechanics II), the angular momentum in the general movement.	2
Lec11	The dynamic equations for general motion of rigid body (Euler's equation).	2
Lec12	Gyroscope (approximate theory).	2
Lec13	An outline of linear elastic particle collisions theory, inelastic collision rate.	2
Lec14	Variational approach of Lagrangian mechanics.	2
Lec15	The central Lagrange’s equation. Fundamental integral mechanical principle (Hamilton’s principle)	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements.	2
Cl2	Solving of static problems by using a principle of virtual work	2
Cl3	Solving of dynamic problems by using a dynamic general equation (d'Alembert’ s principle).	2
Cl4	Derivation of motion differential equations based on the energy conservation law and Lagrange’s equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl5	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl6	Solving some kinematic and dynamic problems in case of the spherical rotation about a fixed point of a rigid body.	2
Cl7	Final test	2
Cl8	Credits. Improvement of marks	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

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

PRIMARY AND SECONDARY LITERATURE

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

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Analytical Mechanics** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechanical Engineering and Machine Building**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_W01, K2MBM_W02	C1, C2	Lec 1 to Lec 15	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K2MBM_U02, K2MBM_U04	C3	Cl 1 to Cl 8	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K06	C4	Cl 1 to Cl 8	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie materiałów inżynierskich**
Name in English: **Design of engineering materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041006**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possesses advanced knowledge on structure- properties relationship as well as on strengthening mechanisms in materials and their practical usage for material design of products.
PEK_W02 - Knows the fundamentals and design philosophy of modern engineering materials.
PEK_W03 - Knows the criteria and methodology of materials selection and can participate in engineering design of products.

II. Relating to skills:
PEK_U01 - Able to design the materials structure in order to obtain the desired operational properties of product.
PEK_U02 - Able to select a material for a specific product with consideration of economical and ecological aspects.
PEK_U03 - Able to conduct the failure analysis of material and design the repair process for improvement of product durability.

III. Relating to social competences:
PEK_K01 - Possesses the collaboration skills and able to lead the research teams in engineering design process.
PEK_K02 - Is prepared to conduct the research on materials design of products.
PEK_K03 - Possesses the skills of objective evaluation of arguments and formulation of rational conclusions concerning the use of engineering materials for different products and operational conditions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to design of materials. Effect of chemical composition, processing and microstructure on properties of materials.	2
Lec2	Design of structure of material for specific working conditions.	2
Lec3	The role and significance of alloy phase diagrams in design of materials.	1
Lec4	Strengthening mechanisms in metals and alloys - theory and practice.	4
Lec5	The failure analysis - case study.	1
Lec6	Metal matrix composites - fundamentals in design.	3
Lec7	Criteria and quantitative methods of materials selection in engineering design.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Selection of material for chosen structural component - project, part I.	2
Proj2	Design of chemical composition of steel with desired hardenability.	2
Proj3	Design of microstructure of steel in the process of heat treatment - part I.	2
Proj4	Design of microstructure of steel in the process of heat treatment - part II.	2
Proj5	Individual materials expertise combined with selection of material - part I.	2
Proj6	Individual materials expertise combined with selection of material - part II.	3
Proj7	Selection of material for chosen structural component - project, part II.	2
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. case study N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03	short test, oral answers, report, discussion
F2	PEK_U01÷PEK_U03;PEK_K01, PEK_K03	defence of project
P = 0,3F1+0,7F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

O. Wyatt, Introduction to Materials engineering; M.F. Ashby, Selection of Materials in Engineering Design, G.E. Totten, Steel Heat Treatment; 1.J.P. Schaffer, A. Saxena, S.D. Antolovich, T.H. Sanders, S.B. Warner: The science and design of engineering materials, WCB/McGraw-Hill, 1999; W. Dudzinski, Structural Materials in Machine Construction

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_W05, K2MBM_W10	C1, C2	Lec1÷Lec7	N1, N2, N3
PEK_U01 - PEK_U03	K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C1, C2, C3	Pr1÷Pr7	N2, N3, N4
PEK_K01 - PEK_K03	K2MBM_K03, K2MBM_K06, K2MBM_K07, K2MBM_K09, K2MBM_K10	C2, C3	Pr1÷Pr7	N2, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria powierzchni**
Name in English: **Surface engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041007**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristic properties of the surface layer (SL) of an object	2
Lec2	The ways and test methods and measurement SL 2D and 3D roughness	2
Lec3	Functional features of the surface in operation of machinery and equipment	2
Lec4	Opportunities to develop surfaces with specific properties and chip and chipless methods	2
Lec5	Methods for modifying the physical and geometrical characteristics of SL with chipless methods	2
Lec6	The correlation between physical attributes and geometric properties of the SL and its functional features	2
Lec7	Coating	2
Lec8	Colloquium	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Analysis of surface changes in the machining process I	2
Lab2	Analysis of surface changes in the machining process II	2
Lab3	Measurement of shape and position of machine parts	2
Lab4	Measurement of physical characteristics of the surface layer	2

Lab5	Application of wavelet analysis, fractal and FFT to describe the condition of the surface	2
Lab6	The use of a vision system to measure the impact of protective coatings on cutting edges wear	2
Lab7	Mathematical modeling of surface structures	2
Lab8	Grading	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F2	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F3	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F4	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F5	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
F6	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises

F7	PEK_U01; PEK_U02; PEK_U03PEK_K01; PEK_K02; PEK_K03	test, verbal querying, report on laboratory exercises
P = (F1+F2+F3+F4+F5+F6+F7)7		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

1. Oczos K., Lubimov V., tytuł: Struktura geometryczna powierzchni. Podstawyklasyfikacji., wydawnictwo: Oficyna Wydawnicza Politechniki Rzeszowskiej, rok: 20032. Wieczorowski M., Cellary A., Chajda J., tytuł: Przewodnik po pomiarach nierównosci powierzchni czyli o chropowatości i nie tylko, wydawnictwo: Zakład WydawniczyM-Druk, Poznan, rok: 2003

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2MBM_W08	C1; C2; C3	Lec1 - Lec7	N1
PEK_U01; PEK_U02; PEK_U03	K2MBM_U05, K2MBM_U08, K2MBM_U11	C1; C2; C3	La1 - La7	N2; N3
PEK_K01; PEK_K02; PEK_K03	K2MBM_K05, K2MBM_K06, K2MBM_K07	C1; C2; C3	La1-La8	N2; N3

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041008**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of the production and manufacturing processes.
C2. Knowing 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. Characteristics of production systems.	2
Lec2	Manufacturing system, its organization and components.	2
Lec3	Classification of production processes. Types and forms of production.	2
Lec4	Methods of manufacturing control systems (pull, push and squeeze).	2
Lec5	Methods of organization of production systems. Characteristics of bottlenecks in manufacturing processes.	2
Lec6	Methods of manufacturing inventory management.	2
Lec7	Principles of planning and scheduling.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**
Name in English: **Strength of materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041009**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Explanation of the nature and consequences of distinct behavior of non-uniform materials, with particular regard to metallic materials including fractures and/or exposed to subcritical fracture development and materials fracturing due to deformations located in shear bands
C2. Adoption of the criteria and assessment principles for material resistance to development of brittle fracture and the criteria for controlling plastic fracture development and the criteria for creep fracture
C3. Presentation of the possibilities and principles of practical application of the acquired knowledge for the purposes of preventing catastrophic brittle fracture development, preventing and/or controlling shear and creep fracture and for the purposes of predicting and evaluating durability, quality improvement and reliability determined by the above-mentioned types of fracture

SUBJECT EDUCATIONAL EFFECTS **I. Relating to knowledge:** PEK_W01 - The students are able to determine the potential causes and effects of particular types of material fracture, and propose a method to address the problem PEK_W02 - The students are able to propose the assessment methodology for material resistance to fracture, and use the obtained results to select a method to prevent the potential consequences of brittle, ductile and creep fracture PEK_W03 - The students are able to evaluate the differences between, and results of particular types of damage and propose actions which delay and/or eliminate the most dangerous material damage, i.e. fracture. In other words, the students have basic impact on the quality of production processes, reliability and durability of finished products, and thereby on safety and the costs of production, exploitation, monitoring and renovations **II. Relating to skills:** **III. Relating to social competences:**

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	The principles of the analysis of potential damages and their consequences. Risk assessment criteria. The importance of the knowledge about damage mechanism.	2
Lec2	Maps of strain, local damage and material fracture mechanisms	2
Lec3	Introduction to the mechanisms of brittle fracture	2
Lec4	The methodology for testing resistance to catastrophic fracture development in plane strain condition (KIC) and plain stress condition (Kc). The methodology for testing COD and the J-integral	2
Lec5	The possibilities and principles of practical application of KIC for the purposes of predicting and preventing catastrophic fracture development	2
Lec6	Application of the criteria of yield before fracture and leak before fracture as a method to avoid catastrophic fracture development. The principles of using material properties diagrams (KIC-R0,2)	2
Lec7	The strain rate as a criterion for the assessment of material resistance to creep. The factors affecting the strain rate during creep	2
Lec8	The methods for predicting and evaluating the durability of materials working in creep conditions	2
Lec9	Introduction to the mesomechanics of fracture caused by the location of strains in shear bands	2
Lec10	The criteria and principles of preventing and/or controlling fracture caused by the location of strains in shear bands. Examples of practical applications	2
Lec11	The diagrams of yield strains depending on the location of strains and the fracture of materials during their cold-working	2
Lec12	The principles of using the forming limit diagrams to solve typical technical issues.	2
Lec13	The maps of strain mechanisms and the mechanisms of fracture of hot-working materials. The principles of using the maps to prevent fracture	2

Lec14	The principles and examples of multicriteria selection of materials. The definition and meaning of material index	2
Lec15	The causes and effects of properties degradation due to the processing and exploitation of materials in particular conditions. The methodology for testing the degree of degradation of the mechanical properties of a material and its impact on the assumed durability of a technical structure (examples)	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01, PEK_W02, PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Neimitz A.: Mechanika pękania. PWN, Warszawa 1998. 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,C2,C3		N1,N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania elementów i zespołów maszyn**
Name in English: **Testing of Elements and Assemblies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041010**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can choose the right measurement method based on the test piece of machinery and carry out a measurement.
PEK_U02 - Student can prepare a report and discussion the results.

III. Relating to social competences:
PEK_K01 - Student is able to think and act creatively.
PEK_K02 - Student is able to work on tasks independently and in groups.
PEK_K03 - Student understands the need and knows the possibility of lifelong learning.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Non-contact determination of the spatial structure and shape of the surface.	2
Lab2	Holographic interferometry application in displacements measurements of machine elements.	2
Lab3	Speckle photography application in solids investigations.	2
Lab4	Application of electronic speckle pattern interferometry (ESPI) to examine of machine parts	2
Lab5	Application of photoelasticity method in experimental design of machine elements.	2
Lab6	Investigations of machine elements using photoelasticity coating method.	2
Lab7	Determine of fluid velocity distribution using laser method.	2
Lab8	Measurement of the geometry of machine elements using navigation system.	2
Lab9	Strain gage method application in machines testing.	2
Lab10	Performance testing of the propulsion system overhead traveling crane winch.	2
Lab11	Automatic evaluation of defective butt welded joints.	2
Lab12	Measurement and analysis of noise.	2
Lab13	Fuel consumption as a function of engine load.	2
Lab14	Loading of load-carrying structure of overhead travelling crane.	2
Lab15	Research static and dynamic characteristics of wheels.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U02, PEK_K01- PEK_K03	Lab exercise reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

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

SECONDARY LITERATURE
J.W. Dally, Experimental Stress Analysis, College House Enterprises Llc, 2005.
Beckwith T.G., Mechanical Measurements, Prentice Hall, 1995.
Rastogi K., Optical Measurement Techniques and Applications., Artech House, 1997.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2MBM_U05, K2MBM_U11, K2MBM_U12	C1, C2, C3		N1, N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2MBM_K10	C1, C2, C3		N1, N2, N3, N4

SUBJECT SUPERVISOR
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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041011**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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 analyzes of physically and geometrically nonlinear problems
PEK_U03 - Ability to perform advanced 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	1
Lec2	Load carrying structures assessment after years of operation	2
Lec3	Modeling of complex structures, load application, supports, connections and material	2
Lec4	Modeling of elements made of plastics and composites. Strength criterion of composite materials.	2
Lec5	Advanced analysis of the non-geometric and non-linear type of the structures	2
Lec6	Structural dynamics: modal analysis	2
Lec7	Structural dynamics: explicit and implicit analysis	2
Lec8	Heat flux analysis in the carrying structures in constant and unstable conditions	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		4

Lab11		4
Lab12		2
Lab13		2
		Total hours: 30

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	4
Proj6	Assembly design, connectors, parameters set-up	4
Proj7	Developments of numerical models of selected elements: boundary conditions	4
Proj8	Advanced strength analysis simulations (non-linear, dynamics, thermoelaticity)	4
Proj9	Design modifications	4
Proj10	Report preparation	2
		Total hours: 30

TEACHING TOOLS USED

N1. Problem exercises
N2. Multimedia presentation
N3. Self study - self studies and preparation for examination
N4. Self study - preparation for project class
N5. Traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	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 - Lec4, Lec8	N2, N3, N5
PEK_W02	K2MBM_W06	C3	Lec5, Lec8	N2, N3, N5
PEK_W03	K2MBM_W05, K2MBM_W06	C3	Lec6, Lec7	N2, N3, N5
PEK_U01	K2MBM_U01, K2MBM_U09	C1, C2	Proj1 – Proj7	N1, N4
PEK_U02	K2MBM_U04, K2MBM_U07, K2MBM_U09	C3	Proj8 – Proj10	N1, N4
PEK_U03	K2MBM_U01, K2MBM_U07, K2MBM_U09	C3	Proj8 – Proj10	N1, N4
PEK_K01-PEK_K03	K2MBM_K09	C1, C2, C3	Proj1 – Proj10	N2-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszyny technologiczne**
Name in English: **Manufacturing machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041014**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has an established knowledge in the area of use and communication using engineering drawing
2. The student has 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	Introduction, the notion of a system, the manufacturing system.	2
Lec2	The functional structure of the manufacturing system.	2
Lec3	The conditions for the development of the flexible automation of manufacturing.	2
Lec4	Flexible manufacturing system (FMS) implementation concepts.	2
Lec5	Machine tools used in FMS.	2
Lec6	Burr removal from workpieces.	2
Lec7	Coolants, chips and deburring and washing workpieces.	2
Lec8	Tool management system in FMS	2
Lec9	Part management system in FMS.	2
Lec10	Manipulation and transport systems in FMS.	2
Lec11	Storage systems in FMS.	2
Lec12	Information systems in FMS.	2
Lec13	The supervision and diagnosis of FMS operation.	2
Lec14	FMS availability	2
Lec15	Final test	2
		Total hours: 30

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	colloquium
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	Wy1-Wy15	N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zintegrowane systemy wytwarzania**
Name in English: **Integrated manufacturing systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041015**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define tasks of informatics subsystem for manufacturing processes by machining ad chip-less methods
PEK_W02 - Able to select of proper programs aiding of engineering, assuring information flow consistency
PEK_W03 - Able to indicate sources of manufacture disturbances and efficient organizing of the process

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Know role of man in integrated manufacturing systems
PEK_K02 - Able to teem working

PROGRAMME CONTENT

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

Lec15	Business and engineering areas integration, problems with exchange of different type of information, development of exchange information on product systems, standard IS95.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. problem lecture
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

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

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W03	K2MBM_W04, K2MBM_W06, K2MBM_W07, K2MBM_W09	C1, C3	Lec1 - Lec3, Lec5, Lec12 - Lec15	N1, N2, N3
PEK_W02	K2MBM_W05, K2MBM_W06, K2MBM_W07	C1 - C3	Lec4, Lec6 - Lec11, Lec13, Lec14	N1, N2, N3
PEK_K01- PEK_K02	K2MBM_K04, K2MBM_K10	C1 - C3	lec1-15	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy diagnostyki i degradacji maszyn**
Name in English: **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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041101**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of 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. Analog and digital signals. Noisy signal. FFT analysis, correlation function. Signal filtering, aliasing. Statistics in diagnostic signal analysis.	4
Lec3	Measurement sensors. Review of various sensors used in machines and facilities diagnostics. Measuring amplifiers.	2
Lec4	Thermography and thermometry.	2
Lec5	Vibration and noise measurements.	2
Lec6	Non-destructive structure testing.	2
Lec7	Long-term experiment. Loading history estimation.	2
Lec8	Origin of degradation theory. Introduction.	4
Lec9	Modeling of degradation process in machines.	4
Lec10	Material degradation.	2
Lec11	Structure corrosion and machines degradation.	2
Lec12	Test.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 ÷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
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	Lec3, Lec4, Lec5, Lec6, Lec7	N1, N2
PEK_W02	K2MBM_KE_W06	C1, C2	Lec1, Lec2, Lec8	N1, N2
PEK_W03	K2MBM_KE_W06	C1, C2	Lec9, Lec10, Lec11, Lec12	N1, N2

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041102**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The ability to carry out mathematical calculations and knowledge of the physical laws known in higher education institutes of technology
2. The ability to group work, the ability to conduct research and use of basic measuring equipment

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 - The 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	2
Lec10	Suspension systems for wheeled transport vehicles - aspects of operational stability, driver comfort	2

Lec11	Integrated chassis tracked vehicles - Functional diagrams, application areas, comparative analysis	2
Lec12	Caterpillars steel and elastomer - construction defects ways to bring the advantages of drive tracks	2
Lec13	Suspension systems tracked transport vehicles - construction aspects of the operating	2
Lec14	Rectilinear motion - motion resistance, traction calculation for arbitrary substrates, the balance of power	2
Lec15	Curvilinear motion systems - turning motion resistance steel tracks and elastomeric power balance	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Classes organizational procedures for obtaining laboratory safety, laboratory presentation of content	1
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
Lab6	Research unbalance forces and moments of the wheels	2
Lab7	The test vehicle's steering system	2
Lab8	Stability tests of working vehicle on wheel chassis	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. laboratory experiment
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_W	
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_U, PEK_K	
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_U, PEK_K	
P = F1		

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_W	K2MBM_KE_W01, K2MBM_KE_W02, K2MBM_KE_W09		Lec	
PEK_U	K2MBM_KE_U01, K2MBM_KE_U02		La	
PEK_K	K2MBM_K01, K2MBM_K03, K2MBM_K04, K2MBM_K05, K2MBM_K09		La, Se	
PEK_U	K2MBM_KE_U02		Se	

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Dynamika maszyn roboczych i pojazdów**
Name in English: **Dynamics of working machines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041103**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has consolidated and expanded knowledge of dynamics of systems with one degree of freedom, many degrees of freedom and continuous
PEK_W02 - has expanded and consolidated knowledge of ways to minimize vibrations and the dynamics of working machines
PEK_W03 - has expanded and consolidated knowledge of vehicle dynamics

II. Relating to skills:
PEK_U01 - is able to apply the appropriate computational methods and appropriate computer programs for vibration analysis and dynamic phenomena in mechanical devices
PEK_U02 - is able to shape and modify the dynamic properties of working machines and vehicles according to the needs
PEK_U03 - is able to plan and carry out experiments for identifying some dynamic properties of various working machines and vehicles

III. Relating to social competences:
PEK_K01 - has expanded the competence in care about the aesthetics of the work, including projects and reports
PEK_K02 - has consolidated the awareness of second-degree graduate, as a future leader

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Dynamics of mechanical linear systems with one degree of freedom	2
Lec2	Dynamics of mechanical linear systems with finite amount of degrees of freedom	2
Lec3	Dynamics of continuous mechanical systems	2
Lec4	Classical and operational modal analysis	2
Lec5	Nonlinear dynamics - selected issues	2
Lec6	Classical methods of vibration isolation. Tuned mass damper	2
Lec7	Active and semi-active vibration isolation	2
Lec8	Selected methods of description and analysis of random vibrations. Stochastic description of road surfaces irregularities	2
Lec9	Vertical dynamics of vehicles	2
Lec10	Longitudinal vehicle dynamics	2
Lec11	Lateral Vehicle Dynamics	2
Lec12	Dynamics and vibration in powertrains in vehicles systems and working machines	2
Lec13	Mitigation and damping of noxious vehicle movements	2
Lec14	Selected problems the dynamics of cranes	2
Lec15	Vibration machines - vibrators	1
Lec16	Selected problems of dynamics of rotating machinery	1
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Experimental determination of the moments of inertia of machines and their components	2
Lab2	Identification of the dynamic model of crane girder with use of classical experimental modal analysis	2
Lab3	Testing of dynamic effects in the steering system of industrial vehicle	2
Lab4	Testing of a dynamic properties of pneumatic nonlinear vibroisolation system	2
Lab5	Testing of a effectiveness load sway damping system for overhead crane	2
Lab6	Testing of a dynamic properties of mobile working machine manipulator	2
Lab7	Testing of a vibration stability system for unsprung wheeled vehicle	2
Lab8	Testing of dynamic load of a crane caused driving on uneven track	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Analysis of the work of a given crane and familiarization with a norms refer to dynamic calculations of this type of machines	2
Proj2	Building a simple mathematical model that allows approximate analysis of selected dynamic phenomena occurring during the operation of a given crane	2
Proj3	Building a crane simulation model that takes into account, inter alia, rope flexibility and stiffness of the rail-wheel contact	2
Proj4	Simulation studies of selected dynamic phenomena occurring during crane operation. Interpretation of the results with respect to current standards	2
Proj5	Simulation studies of the impact of applied solutions on dynamics of virtual crane	2
Proj6	Analysis of construction and operating conditions of given industrial wheeled vehicle. Familiarization with selected standards referring to the dynamics of this type of machines	2
Proj7	Building a simple mathematical model that allows approximate analysis of selected dynamic phenomena occurring during the operation given industrial vehicle	2
Proj8	Building the simulation model of given industrial wheeled vehicle	2
Proj9	Simulation studies of selected phenomena and dynamic characteristics of an object such as: snaking, angular oscillations and dynamic stability	2
Proj10	Simulation studies the impact on the dynamics of the test vehicle different structural changes	2
Proj11	Getting acquainted with construction and analysis of operation of the given machine as a source of excessive vibration	2
Proj12	A preliminary assessment of the possibility of minimizing vibration of given machine supported by relevant calculations	2
Proj13	Building of simulation models of given machine redesigned in order to reduce vibroactivity	2
Proj14	Simulation study of effectiveness of solutions used to minimize vibrations	2
Proj15	Presentation of the results obtained by students. Preparation of the report	2
		Total hours: 30

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W02	C1	Lec1÷Lec5	N2, N5
PEK_W02	K2MBM_KE_W02	C1	Lec6, Lec7, Lec12, Lec14÷Lec16	N2, N5
PEK_W03	K2MBM_KE_W02	C1	Lec8÷Lec13	N2, N5
PEK_U01	K2MBM_KE_U01	C2	Pr1÷Pr15	N2, N3
PEK_U02	K2MBM_KE_U01	C2	Pr5, Pr10÷Pr15	N2, N3
PEK_U03	K2MBM_KE_U01	C2	La1÷La8	N1, N2, N4
PEK_K01	K2MBM_K03	C3	La1÷La8, Pr1÷Pr15	N2
PEK_K02	K2MBM_K07	C3	Pr1÷Pr15	N2, N3

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041104**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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.
PEK_W02 - To know the object reliability models.
PEK_W03 - To know the methods of risk analysis

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	Elements of machinery degradation. Characters, causes and effects of the damage	2
Lec3	The model of irreparable component reliability	2
Lec4	The reliability structure of unrecoverable system. Basic and simple structures.	2
Lec5	The reliability structure of unrecoverable system. Complex structures. Suitability path / Cut set. Reserving	2
Lec6	Reliability model of repairable element.	2
Lec7	Reliability model of repairable system. Markov process. Stationary solution	2
Lec8	Markov process. Non-stationary solution	2
Lec9	Maintenace strategies. Optimization of maintenance of facilities.	2
Lec10	Maintenace strategies. Reliability Centered Maintenance.	2
Lec11	Safety of installations and technical systems. The notion of risk	2
Lec12	Risk analysis methods: FMEA / FMECA.	2
Lec13	Risk analysis methods: FTA / ETA	2
Lec14	Fundamentals of risk management methods: PHA, PSA, HAZOP.	2
Lec15	Trends in development of the science of reliability and safety. Terrorism.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, 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	N1
PEK_K01	K2MBM_K09	C1	Lec.15	N1
PEK_W02	K2MBM_KE_W06	C2	Lec. 2 - Lec. 10	N1
PEK_W03	K2MBM_KE_W06	C2	Lec. 11 - Lec. 14	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Problemy smarowania i zużywania maszyn**
Name in English: **Lubrication and wear problems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041105**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Terms and organization of classes, framework programs, the terms of credit. Introduction to lubrication and wear in the construction and operation of machinery.	2
Lec2	Tribological wear. Terms: adhesion of the surface layer, the surface free energy. Work of adhesion.	2
Lec3	Types and characteristics of lubricants. Properties and application of lubricants. The testing of lubricants (including lubricity, mechanical stability, service life and thermal stability).	2
Lec4	Basic rheology of lubricants. Capillary and rotational rheometry. Rheological greases steady flow conditions and with the use of methods for dynamic oscillation. Linear viscoelasticity.	2
Lec5	Methods of lubrication. Selection of the type and amount of lubricant for the lubrication of friction.	2
Lec6	Process automation lubrication. Construction of central lubrication systems. Examples of applications for central lubrication systems in various industries.	2
Lec7	Basic design of lubrication. The environmental aspects of lubrication assemblies.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Test of resistance to abrasive wear of the materials used in the nodes of friction.	2

Lab2	Measurement of density and viscosity of lubricating oils. Determination of the viscosity index of lubricating oils.	2
Lab3	Lubrication of slioding bearings. Determination of the frictional characteristics of the cross slide bearing. Evaluation of the impact of oil viscosity on the process of hydrodynamic lubrication.	2
Lab4	Determining the properties of lubricating greases.	2
Lab5	Measuring the degree of penetration of lubricating greases and study the rheological properties of lubricating greases (compilation flow curves, determination of yield stress).	2
Lab6	Research on the influence of the wall material for the formation of a boundary layer greases in the lubricant.	2
Lab7	Studies on impact of length, diameter and shape of circular pipe pressure drop in lubricants arts.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_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	K2MBM_KE_W03, K2MBM_W05, K2MBM_W08	C1	Lec1, Lec2	N1, N2, N3
PEK_W02	K2MBM_KE_W03, K2MBM_W05	C2	Lec3, Lec4	N1, N2, N3
PEK_W03	K2MBM_KE_W03, K2MBM_KE_W06, K2MBM_W05	C3	Lec5, Lec6, Lec7	N1, N2, N3
PEK_U01	K2MBM_U05, K2MBM_U07, K2MBM_U14	C1	Lab1	N3, N4, N5
PEK_U02	K2MBM_U05, K2MBM_U07, K2MBM_U14	C2, C3	Lab2 - Lab5	N3, N4, N5
PEK_U03	K2MBM_KE_U03, K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C3	Lab5 - Lab7	N3, N4, N5

PEK_K01	K2MBM_K01, K2MBM_K07, K2MBM_K10	C1, C2, C3	Lab1 - Lab7, Lec1-Lec7	N1 - N5
PEK_K02	K2MBM_K01, K2MBM_K07	C1, C2, C3	Lab1 - Lab7, Lec1-Lec7	N1 - N5
PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K07, K2MBM_K10	C1, C2, C3	Lab1 - Lab7, Lec1-Lec7	N2, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Synteza układów mechanicznych**
Name in English: **SYNTHESIS OF MECHANICAL SYSTEMS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041106**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Forms of mechanisms' structure notation.	2
Lec2	Methods of type synthesis, set of possible solutions creation.	2
Lec3	Criteria and selection of optimal structure solution.	2
Lec4	Criteria and selection of optimal structure solution.	2
Lec5	Methods of dimensional synthesis of linkages mechanisms.	3
Lec6	Methods of dimensional synthesis of adjustable mechanisms.	2
Lec7	Synthesis of mechanisms with higher pairs.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Analysis of topology of kinematics systems. Rattionality of mechanism topology (test and project).	2
Proj2	Methods of notation of topology (test and project).	2
Proj3	Type synthesis. Making of possible sets of the solutions (test).	2
Proj4	Type synthesis cont. Selection for optimal solution (project).	2
Proj5	Dimensional synthesis of linkages mechanisms (test and project).	3
Proj6	Synthesis of mechanisms with higher pairs.	2
Proj7	Synthesis of planetary gears (project).	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

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

PEK_W01 - PEK_W03	K2MBM_KE_W04	C1-C2	L1-L7	N1-N2
PEK_U01-PEK_U03	K2MBM_KE_U04	C1-C2	Pr1-Pr7	N3-N4
PEK_K01	K2MBM_K03	C1-C2	L1-Wy7, L1-Pr7	N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041116**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

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

III. Relating to social competences:

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

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, discussion of the structure and the way of editing the diploma work.	2
Sem2	Introductory discussion on the diploma works.	6
Sem3	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the fundamental areas.	2
Sem4	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the design area.	2
Sem5	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the technology area.	2
Sem6	Presentation of the students' work effects.	14
Sem7	Summary.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem discussion
N2. 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 =		

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_K07, K2MBM_U17	C1,C2	Sem1-Sem15	N1-N3

SUBJECT SUPERVISOR

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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, full-time**

Kind of subject: **optional**

Subject code: **MMM041121.**

Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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 characteristics	2
Lec3	Timing system, construction	2
Lec4	Timing system, diagnostic	2
Lec5	Piston-crank system, diagnostic	2
Lec6	Crank system diagnostic	2
Lec7	Block engine diagnostic	2
Lec8	Power system diagnostic	2
Lec9	Elements control system diagnostic	2
Lec10	Control system, diagnostic	2
Lec11	Lubrication system, diagnostic	2
Lec12	Cooling system, diagnostic	2
Lec13	Starting system, diagnostic	2
Lec14	Methods of diagnostic test	2
Lec15	Diagnostics of engines I.C. with recharging	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Endoscopic engine I.C. diagnostic	2
Lab2	Measurements of piston-cylinder system components	2
Lab3	Measurements of piston-crank system	2
Lab4	Measurements of block cylinder	2
Lab5	Measurements of the timing system components	2
Lab6	Measurements of the power system	2
Lab7	Measurements of the control system	2
Lab8	Analysis of the operation of the control system	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class
N3. multimedia presentation
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 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		

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	K2MBM_KE_W09	C2		N2,N3
PEK_W02	K2MBM_KE_W08	C1,C2		N2,N3,N5
PEK_W03	K2MBM_KE_W08	C3		N2,N3,N5
PEK_U01	K2MBM_KE_U01	C1		N1,N2,N4

PEK_U02	K2MBM_KE_U06	C2		N1,N2, N4,N5
PEK_U03	K2MBM_KE_U01	C1,C3		N1,N2, N4,N5
PEK_K01	K2MBM_K10	C1,C3		N2,N5
PEK_K02	K2MBM_K10	C1,C2,C3		N2,N5
PEK_K03	K2MBM_K08	C3		N1,N4,N5

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **optional**
Subject code: **MMM041122**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in the field of 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	2
Lec2	Fuel consumption and toxic components emissions by modern motor vehicles	2
Lec3	Ecological balance of a motor vehicle	2
Lec4	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

Lec5	Ecological aspect of constructing piston rings of modern internal combustion engines. Lubricating oil consumption and its combustion	2
Lec6	The ecological aspect of the construction of connecting rods of modern internal combustion engines	2
Lec7	Ecological aspect of the crankshaft construction of modern internal combustion engines. Selection of manufacturing technology in the aspect of reducing carbon dioxide emissions during their production	2
Lec8	The fuel storage and refueling system of the fuel tank in a modern car	2
Lec9	Constructing power systems for spark-ignition engines to reduce carbon dioxide emissions from motor vehicles	2
Lec10	Constructing power systems for self-ignition engines to reduce carbon dioxide emissions from motor vehicles	2
Lec11	An ecological aspect of constructing timing systems of modern internal combustion engines in order to minimize the emission of carbon dioxide	2
Lec12	An ecological aspect of the design of cooling 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
Lec13	Ecological aspect of the construction of lubrication systems for modern internal combustion engines in order to minimize the consumption of lubricating oil as a result of the use of new materials and technologies of the surface layers	2
Lec14	Topping up combustion engines as a method of reducing carbon dioxide emissions	2
Lec15	Decreasing the displacement of internal combustion engines with the maintenance of 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: 30
Form of classes – Laboratory		Number of hours
Lab1	Execution of load characteristics of the internal combustion engine	2
Lab2	Execution of the external characteristics of the internal combustion engine	2
Lab3	Preparing a universal characteristic based on laboratory exercises number 2 and 3 with the determination of carbon dioxide emission to the atmosphere	2
Lab4	Tests of the filling factor of the internal combustion engine	2
Lab5	Calculation of cylinder filling factor based on laboratory exercise number 4 with the calculation of the fuel-air mixture composition in the aspect of determining the composition of exhaust gases; poor, rich mix	2
Lab6	Examination of the content of unburned hydrocarbons and nitrogen oxides in the exhaust gas, during the implementation of the selected load characteristics	2
Lab7	Examination of the content of carbon dioxide and carbon monoxide in the exhaust gas of the internal combustion engine, during the implementation of the chosen load characteristics	2
Lab8	Examination of exhaust smoke intensity of an internal combustion engine during the implementation of the selected load characteristics	1
		Total hours: 15

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
F6	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F7	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
P = (F1+F2+F3+F4+F5+F6+F7)/7		

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 Lec4	N1. N5.
PEK_W02	K2MBM_KE_W08, K2MBM_W06	C2	Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N1. N5.
PEK_W03	K2MBM_KE_W08	C3	Lec 14 Lec 15	N1. N5.
PEK_U01	K2MBM_KE_U06	C1	La1 La2	N2. N3. N4.
PEK_U02	K2MBM_KE_U06	C1 C2	La4 La6 La7 La8	N2. N3. N4.
PEK_U03	K2MBM_KE_U06	C3	La3 La5	N2. N3. N4.
PEK_K01	K2MBM_K06, K2MBM_K08	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N1. N5.
PEK_K02	K2MBM_K06, K2MBM_K08	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N1. N5.
PEK_K03	K2MBM_K06, K2MBM_K09	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5	N1. N5.

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **optional**
Subject code: **MMM041123**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of operation of technical facilities and measures combustion engines
2. ability to choose the internal combustion engine to drive the vehicle
3. teamwork in particular the human team management

SUBJECT OBJECTIVES

C1. learn the rules of use of vehicles including, in particular internal combustion engines
C2. understanding of the vehicle crossing from the state using to the state service
C3. learn the methods of use of vehicles, in particular the repair of 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 state from using the state service
PEK_W02 - defines and describes systems damaged vehicles, including the internal combustion engine in which they occurred
PEK_W03 - It suggests ways to repair and determines the time is reached again by the drive system status Use

II. Relating to skills:
PEK_U01 - analyzes the criteria for the attainment of the border state by vehicle
PEK_U02 - organizes and plans the repair of vehicles, including internal combustion engines
PEK_U03 - verifies the correctness of performed maintenance and repair of vehicles, including major repairs combustion engines

III. Relating to social competences:
PEK_K01 - He understands the need and know the possibilities of continuous training, especially raising his knowledge of the operation of vehicles, including engineering repairs (third degree studies, postgraduate courses)
PEK_K02 - It is aware of the importance, responsibility and impacts of engineering degree in mechanical engineering and in terms of responsibility for the environment resulting from proper operation of vehicles, especially correctly performed maintenance and repairs, which are a significant threat to the environment
PEK_K03 - recognizes the need to improve professional skills, personal and social benefits, particularly in terms of human resources management, including service centers of the vehicles and internal combustion engine

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.	2
Lec3	Types of maintenance activities including types of repairs	2
Lec4	Principles of disassembly and maintenance of vehicle components, including internal combustion engines	2
Lec5	Service, damage and repair of the fuselage of combustion engine	2
Lec6	Service, damage and repair of the cylinder head of combustion engine	2
Lec7	Operation of the components of the engine's timing system including their wear and repair	2
Lec8	Operation of crank and reciprocating engines of internal combustion engines including wear and technology of repairs of crankshafts	2
Lec9	Operation of crank and reciprocating engines of internal combustion engines including wear and technology of repairs of pistons, piston rings, connecting rods	2
Lec10	Operation of the lubrication system of the internal combustion engine and wear and repair of their components	2
Lec11	Operation of the cooling system of the internal combustion engine and wear and repair of their components	2
Lec12	Operation of the recharging system and wear and repair of its components, including compressor, free and dynamic charge systems	2

Lec13	Exploitation of diesel fuel system components, including repair of their components and assemblies	2
Lec14	Exploitation of spark ignition fuel system components, including repair of their components and assemblies	2
Lec15	Operation of vehicle transmission systems, including repair of its components and systems	2
		Total hours: 30

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 crankshaft wear and selection of repair technology	2
Lab4	Measurements of piston and connecting rod wear as well as piston rings and selection of repair technology	2
Lab5	Measurements and methods of identification of damage to lubrication system elements and selection of repair technology	2
Lab6	Measurements and methods of repairing engine fuel system components of the diesel and spark ignition engines	2
Lab7	Measurements and ways to repair elements of vehicle transmission systems	2
Lab8	Measurements and ways to repair elements of suspention of vehicle	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. report preparation
N5. 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
F6	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F7	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
F8	PEK_U01 PEK_U02 PEK_U03	quiz, report on laboratory exercises
P = (F1+F2+F3+F4+F5+F6+F7)/7		

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 Lec4	N1. N4.

PEK_W02	K2MBM_KE_W08	C2 C3	Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 lec11 Lec12 Lec13 Lec14 Lec15	N1. N4.
PEK_W03	K2MBM_KE_W08	C3	Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 lec11 Lec12 Lec13 Lec14 Lec15	N1. N4.
PEK_U01	K2MBM_KE_U06	C1 C2		N2. N3.
PEK_U02	K2MBM_KE_U06	C3		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 lec11 Lec12 Lec13 Lec14 Lec15	N1. N2. N3. N4.
PEK_K02	K2MBM_K05, K2MBM_K08	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 lec11 Lec12 Lec13 Lec14 Lec15	N1. N2. N3. N4
PEK_K03	K2MBM_K09	C1 C2 C3	Lec1 Lec2 Lec3 Lec4 Lec5	N1. N2. N3. N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza stanów ustalonych i nieustalonych układów hydraulicznych**
Name in English: **Analysis stable and transient states of hydraulic systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041124**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student can describe the dynamic interactions in hydraulic and pneumatic systems. Can describe the impact of dynamic phenomena in these systems. Student be able to list, identify the cause and source of the differences in the operation of systems working in steady and unsteady conditions. Student be able to define the benefits and risks of dynamic interactions occurring during work in the unsteady conditions.
PEK_W02 - The student knows the dynamic characteristics of selected elements of hydraulic and pneumatic systems. Students can indicate the influence of parameters of selected elements on the operating characteristic of the entire system and is able to make informed and positive changes the individual components for prevent the negative effects of dynamic interactions or to improve the functioning of the system.
PEK_W03 - The student can described by mathematical models of the hydraulic and pneumatic systems working in steady and unsteady state. The student on the design stage uses mathematical models mentioned above to identify the risks resulting from dynamic interactions in the system.

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

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

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Introduction, presentation of the lecture content, requirements and forms of the completion. Pulsation flow and pressure - the sources , the reduction of the pressure pulsation amplitudes.	2
Lec2	The methods of calculation and modeling of unsteady flow in the hydraulic lines.	4
Lec3	Basic concepts describing the condition of the elements and the whole hydraulic system. The principle of models construction for lumped and distributed parameters.	2
Lec4	The steady operating status of hydraulic components (pumps, motors, valves) - ideal and real characteristics.	2
Lec5	Indicators describing the dynamic quality of the component of the hydraulic system.	2
Lec6	The steady operating status of the hydrostatic transmission - the ideal and the real characteristics.	2
Lec7	The dynamic models of the hydraulic valves.	2
Lec8	Analysis of the simplifying assumptions impact on the accuracy of the representation actual object by the model.	2
Lec9	Comparison of the characteristics of the hydrostatic power system during the starting phase with and without the participation of the maximum valve.	2
Lec10	Analysis of the system startup process with the hydro-pneumatic accumulator.	2
Lec11	The inhibition of the hydrostatic power system.	2
Lec12	The hydraulic long line - the resonance phenomenon.	2
Lec13	Methods of shaping hydraulic transient processes. Methods to prevent the adverse effects caused by transition phases in the machine with hydrostatic power system.	2
Lec14	Completion of the course.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	Determination of static and dynamic characteristics of the relief valve.	2
Lab3	Experimental identification of the pressure pulsation components in the hydraulic system.	2
Lab4	The experimental determination of the frequency characteristic of the proportional valve.	2
Lab5	The experimental determination of the frequency characteristic of the electrohydraulic amplifier.	2
Lab6	Mitigation method of the start phase of the hydrostatic system using the proportional valve.	2
Lab7	The impact of the hydro-pneumatic accumulator on the start phase of the hydrostatic system.	2

Lab8	Completion of the course.	1
		Total hours: 15

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

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

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_KE_W02, K2MBM_KE_W07	C1, C2	Lec1÷Lec14	N1, N2
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_KE_U02	C3	Lab1÷Lab7	N2, N3, N4, N5

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **optional**
Subject code: **MMM041125**
Group of courses: **yes**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basics of machine design.
2. Student has knowledge in the field of manufacturing technology
3. 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 for a concept
C3. Familiarizing the student 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 the adopted assessment criteria.
PEK_W03 - Student knows contemporary concepts and strategies of the design process

II. Relating to skills:
PEK_U01 - Student is able to skilfully 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	2
Lec2	Marketing product concept and implications for the design process	2
Lec3	Method, methodology and methodology of design. The structure of the design process	3
Lec4	Formulating a design problem and design requirements. Goal function. Problem analysis, its structure and elements	3
Lec5	Methods of searching for solutions - an overview of heuristic methodsystems: abstracting, brainstorming, synektics, 635, the matrix of exploration, morphology, solution tree, playing with words. The choice of the method of writing.	4
Lec6	Issues of evaluation and selection of solutions (variants). Assessment criteria and limitations. Selected methods of selection and evaluation of variants of solutions: T, Delphi cards, forced decisions, weighted characteristics of the utility value. A problem of selecting the assessment methods. decision making process in the technical design process - competence levels	4
Lec7	Morphological method of generating system structures, functions of hydraulic systems.	2
Lec8	Morphological method of generating system structures, functions of hydraulic systems.	8
Lec9	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
Lec10	Static characteristics of hydraulic systems, thermal balance of the hydraulic system.	2
		Total hours: 32
Form of classes – Project		Number of hours
Proj1	Analysis of the design problem - operating principle of the machine or devices	2

Proj2	Selection of the method of drawing and generating solutions	2
Proj3	Evaluation and choice of solution	2
Proj4	Preparation of the preliminary design	3
Proj5	Performing calculation calculations and selection of typical (commercial) elements	3
Proj6	Preparation of technical documentation	2
Proj7	Project evaluation	1
		Total hours: 15

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, PEK_K01	Defense project
P = 0,3*Fw+0,7F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Autor: Tarnowski W., tytuł: Podstawy projektowania techniczneg, wydawnictwo: WNT,rok: 1997Autor:Pokojski J., tytuł: Systemy doradzcze w projektowaniu maszyn, wydawnictwo:WNT, rok: 2005Autor: ProctorT., tytuł: Twórcze rozwiazywanie problemów, wydawnictwo: GdanskieWydawnictwo Psychologiczne, rok:2002Autor: Pokojski J. (red), tytuł: Inteligentne wspomaganie procesu integracji srodowiskadokomputerowego wspomagania projektowania maszyn, wydawnictwo: WNT, rok: 2000Autor: Krick E.V.,tytuł: Wprowadzenie do techniki i projektowania technicznego,wydawnictwo: WNT, rok: 1974Autor: Pahl G.,Beitz W., tytuł: Nauka konstruowania, wydawnictwo: WNT, rok: 1982Autor: Dietrich M., tytuł: Podstawykonstrukcji maszyn. t. 1-4, wydawnictwo: PWN, rok:1989Autor: Miller S., tytuł: Teoria maszyn imechanizmów, wydawnictwo: WNT, rok: 1989Autor: Stryczek S., tytuł: Naped i sterowanie hydrostatyczne.t. 1 i 2, wydawnictwo: WNT,rok: 1991Autor: Tall M., Drobinski W., tytuł: Napedy i urzadzenia elektryczne,wydawnictwo: Wyd.Politechniki Wrocławskiej , rok: 1980Autor: Skarbinski M., tytuł: Technologicznosckonstrukcji maszyn, wydawnictwo: WNT,rok: 1977Autor: Jones Ch, tytuł: Metody projektowania,wydawnictwo:

SECONDARY LITERATURE

Autor: Rohatynski R., Miller D. , tytuł: Problemy metodologii i komputerowegowspomagania projektowaniatechnicznego. t. 1 i 2. , wydawnictwo: Oficyna WydawniczaPolitechniki Wrocławskiej , rok: 1994Autor:Hubka V., tytuł: Theorie Technisscher Systeme. Springer Verlag, wydawnictwo: ,rok: 1987

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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie hydraulicznych układów napędowych**
Name in English: **Hydraulic drive systems control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041126**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - In the result of lesson student has extended knowledge of description of more advanced hydraulic components like proportional valves and servovalves.
PEK_W02 - In the result of lesson student has extended knowledge of explanation advanced control and regulation methods of selected hydraulic systems parameters.
PEK_W03 - In the result of lesson student has extended knowledge of description of advanced hydraulic and electrohydraulic systems.

II. Relating to skills:
PEK_U01 - In the result of lesson student is able to bulid hydraulic and electrohydraulic systems and analyse its working principle.
PEK_U02 - In the result of lesson student is able to preper to work hydraulic device or electrohydraulic and plan and execute measurements of selected parameters. On the basis of measurements results student is able to formulate appropriate conclusions.
PEK_U03 - In the result of lesson student is able to design device with hydraulic or electrohydraulic system according to specified requirements.

III. Relating to social competences:
PEK_K01 - Student can cooperate in group during hydraulic and electrohydraulic system building and report preparation.
PEK_K02 - Student can plan measurements during laboratory and report preparate.
PEK_K03 - Student correctly identyfi and solve problems with hydraulic and electrohydraulic system building. Student formulate appropriate conclusions

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements.	1
Lec2	Control and regulation methods in hydrostatic systems.	2
Lec3	Technique of hydraulic proportional control.	2
Lec4	Working principle and characteristics of directional control valves with proportional control.	2
Lec5	Working principle and characteristics of flow regulators and pressure valves with proportional control.	2
Lec6	Logic valves in proportional technique.	2
Lec7	Electrohydraulic servovalves.	2
Lec8	Hydrostatic systems of position regulation.	2
Lec9	Hydrostatic systems of force or torque regulation.	2
Lec10	Load-sensing systems in machines with hydrostatic drive.	1
Lec11	Load-sensing systems with fixed displacement pump.	2
Lec12	Load-sensing systems with variable displacement pump.	2
Lec13	Controllers in hydraulic systems.	3
Lec14	Volumetric control and regulation.	2
Lec15	Pump capacity regulation for Q = const., p = const., N = const.	2

Lec16	Check.	1
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory range presentation, check form, requirements.	2
Lab2	Throttle-serial regulation of hydraulic actuator speed.	2
Lab3	Throttle-parallel regulation of hydraulic actuator speed.	2
Lab4	Control and regulation throttle methods comparison.	2
Lab5	Application of proportional reliefe valve.	2
Lab6	Experimental test for critical frequency for system with proportional directional control valve.	2
Lab7	Tests of position regulation system with electrohydraulic servovalve.	2
Lab8	Check.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

F3	PEK_U01 PEK_U03	student's activity note
P = (2F1+F2+F3)/4		

PRIMARY AND SECONDARY LITERATURE

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

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

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

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

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Uszczelnienia i techniki uszczelniania**
Name in English: **Seals and sealing technique**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041127**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to define the characteristics of the seals used in the technique and describe their mode of use.
PEK_W02 - The student defines the basic parameters and the use of standard technical seals, also can make differentiation and identification of the seals.
PEK_W03 - The student is able to select the the correct type of seal to the requirements of a particular application while explaining and describing the working conditions of selected seal.

II. Relating to skills:
PEK_U01 - The student is able analyze the phenomenon occurring during the seal exploitation, so that acquires the ability to control and describe the condition of the seal.
PEK_U02 - The student is able to prepare and conduct a laboratory experiment indicates the technical condition of the seal.
PEK_U03 - The student has the ability to decide on authorization to exploitation or exchange the seal on the basis of analysis of the seal technical condition.

III. Relating to social competences:
PEK_K01 - The student taking part in the work of a team of students which aim is to interpret the laboratory results based on theoretical knowledge.
PEK_K02 - Students gain the ability to link theoretical knowledge with the results of the experiment, and the formulation of a coherent conclusions.
PEK_K03 - Student presents conclusions formulated on the basis of their knowledge and the results of the laboratory tests and provide their justification of the group with teacher.

PROGRAMME CONTENT

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

Lec9	Examples of the seals selection process of the piston rod and piston in the pneumatic actuator. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec10	Examples of the seals selection process of the piston rod and piston in the hydraulic actuator. Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec11	Seals operating in especially difficult work conditions, description, classification, basic parameters and materials.	2
Lec12	Examples of the selection process of the seals working in the especially difficult work conditions . Determine the working conditions, the execution of sample calculations, the final selection of seals, design of the slot of sealing.	2
Lec13	Seals untypical, special and dedicated for a specific application.	2
Lec14	Presentation of the directions of development of the seals. New trends in sealing technology.	2
Lec15	Completion of the course.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	Examination of the impact the gap width on the flow rate and pressure difference.	2
Lab3	Examination of the impact the direction of movement the piston rod on the forces measure on the seal contact area.	2
Lab4	Examination of the impact of pressure difference on the frictional force occurring in the packing set seals of the piston rod.	2
Lab5	Examination of the impact moving speed on the frictional force measure on the seal contact area.	2
Lab6	Determine the energy losses in the sealing during movement.	2
Lab7	Determining the optimal parameters of the seal exploitation.	2
Lab8	Determining the optimal parameters of the seal exploitation.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

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

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

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

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

PEK_W01	K2MBM_KE_W07	C1	Lec1÷Lec3, Lec13, Lec14	N2, N4
PEK_W02, PEK_W03	K2MBM_KE_W07	C2	Lec4÷Lec12	N2, N4
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2MBM_K03, K2MBM_K09, K2MBM_KE_U06	C3	Lab1÷Lab7	N1, N3, N4, N5

SUBJECT SUPERVISOR
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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, full-time**
Kind of subject: **optional**
Subject code: **MMM041128**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge 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	3
Lec3	Acoustic units	2
Lec4	The source of vibrations and noise	2
Lec5	Selected noise of machinery and equipment	2
Lec6	Criteria for the assessment of noise	2
Lec7	Minimize vibrations	2
Lec8	Minimize noise	2
Lec9	Reduction of noise in hydraulic systems	2
Lec10	Passive noise reduction methods	2
Lec11	Active noise reduction methods	2
Lec12	Construction and selection of acoustic filters	2
Lec13	Building acoustics	2
Lec14	Energy methods in the diagnosis of acoustic condition of machinery and equipment	2
Lec15	Exam	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory	1

Lab2	Construction of measuring track and the measurements of the basic units of vibroacoustics.	3
Lab3	Acoustics psychofizjological, perception of sound.	2
Lab4	Sound power measurements in rooms with acoustic adaptation.	2
Lab5	Measurement of noise of the devices constituting the technical equipment of the building.	2
Lab6	Measurement of noise in the workplace.	2
Lab7	The use of probes and acoustic holography diagnose acoustic status of machinery and equipment.	2
Lab8	Passing of the course	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K03	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_W01	K2MBM_KE_W02	C1	Wy1 - Wy6	N1,N2
PEK_W02, PEK_W03	K2MBM_KE_W02	C4	Wy7 - Wy12, Wy13, W14	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 - La6	N3,N4,N5
PEK_U03	K2MBM_KE_U05, K2MBM_KE_U06	C3	La7	N3,N4,N5
PEK_K01-PEK_K03	K2MBM_K08, K2MBM_K10	C2-C4	La1-La7	N3,N4,N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria urządzeń transportu przemysłowego**
Name in English: **Engineering of industrial transport devices**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041130**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic structural and operational features of a cyclic (cranes) industrial transport devices (i.t.d.), review and specification of their structures, major parts and components, examples of design solutions	2
Lec2	Basic structural and use features of a continuous operating (conveyors) industrial transport devices (i.t.d.), review and specification of their structures, major parts and components, examples of design solutions	2

Lec3	Basic technical and operational parameters of the cyclic i.t.d., principles of standardization and evaluation criteria for intensive use, the duty exploitation groups of cranes	2
Lec4	Principles of calculation and classification of the code-based operating conditions of cranes	2
Lec5	Rules for the selection of the form and the structural development of the major nodes of load-carrying structures and mechanisms of cranes	2
Lec6	Loads for proof calculations of load-carrying structures and mechanisms of cranes, according to European standards	2
Lec7	Rules for proof calculations of the load-carrying structures and mechanisms of cranes, according to European standards	2
Lec8	Rules for selection of type of structure and structural development of major carrying joints and mechanisms-drive nodes of conveyors	2
Lec9	Calculating loads of major carrying joints and mechanisms-drive nodes of conveyors	2
Lec10	Rules for loads and proof calculations of major carrying joints and mechanisms-drive nodes of conveyors	2
Lec11	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with flat horizontal movement	2
Lec12	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with flat vertical movement.	2
Lec13	Principles of calculation and selection of the unified elements and components in the i.t.d. systems with three-dimentional movement.	2
Lec14	Methods and systems of control for cranes	2
Lec15	Methods and systems of control for conveyors	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Analysis of the operating conditions for a given crane and calculation of its code-based classification parameters, determination of crane technical parameters to ensure meeting its required operating characteristics.	2
Proj2	Determination of the load-carrying structure and propulsion system for a givenb crane, development of computational schemes for indicated superstructure subassembly and propulsion system of the crane	2
Proj3	Calculations of code-based loads for given crane superstructure specified subassembly, determination of the most important nodes for safety of this structure, execution of a design sketches of the crane specified welded and screwed nodes.	2
Proj4	The initial selection of typical elements of specified subassembly of the crane propulsion system, design sketches of the crane specified nodes of this subassembly	2
Proj5	The calculation of the maximum overload of the selected element of specified crane propulsion system subassembly in its transient periods of work and validation of the typical elements selection	2
Proj6	Analysis of given conveyor operational conditions and the initial calculation of technical parameters to satisfy these conditions, determination of the conveyor drive system structure	2

Proj7	Initial selection of typical elements of the conveyor drive system specified subassembly, the execution of a design sketch of a given node of this subassembly, the calculation of the maximum overload of the selected elements of specified conveyor propulsion system subassembly in its start-up, validation of the conveyor typical elements selection	2
Proj8	Ordering of the crane and conveyor calculations and design sketches before their presentation for mark	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

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

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W09	C1	Lec1, Lec2	N1, N2, N3
PEK_W02	K2MBM_KE_W09	C1	Lec3 to Lec15	N1, N2, N3
PEK_U01, PEK_U02	K2MBM_U01, K2MBM_U07	C2	Proj3 to Proj7	N2, N3, N4
PEK_K01, PEK_K02	K2MBM_K06	C3	Lec1 to Lec15, Proj1 to Proj7	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy hybrydowe w pojazdach i maszynach roboczych**
Name in English: **Hybrid drives in working machines and vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041131**
Group of courses: **yes**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

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

Lec5	Structures mixed hybrid propulsion systems. The choice of elements and calculations	2
Lec6	Structures mixed hybrid propulsion systems. The choice of elements and calculations	2
Lec7	Propulsion systems of "mild", selection of components and calculations. Non-conventional propulsion systems equipment and vehicles.	2
Lec8	Computational method for selecting the individual components of hybrid powertrains. Problems associated with the delivery of energy recovered to the source. The amount and efficiency of energy recuperation based on the cycle of the vehicle.	2
Lec9	Computational method for selecting the individual components of hybrid powertrains. Problems associated with the delivery of energy recovered to the source. The amount and efficiency of energy recovery based on the schedule of the vehicle.	2
Lec10	Analysis of the possibility of reducing engine power and efficiency of the transmission.	2
Lec11	The recuperative braking wheeled vehicles. Problems with receiving energy and preserving the direction of motion. Construction of hybrid brakes.	2
Lec12	The braking proces of working tools of earth working vehicles. The methodology and energy.	2
Lec13	The use of electronic systems to control hybrid systems working machines.	2
Lec14	Modeling of hybrid drive systems for wheeled vehicles. Modeling of sources and receivers of energy.	2
Lec15	Overview of hybrid drives for use in vehicles and working machines.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Study the possibility of accumulation of energy in the hydrostatic drive system extended arm loader bucket.	2
Lab2	Performance testing of the propulsion system overhead traveling crane.	2
Lab3	Accumulation and recuperation of energy in the inertial propulsion system.	2
Lab4	Energy efficiency of the filling process of a bucket in earth working vehicles.	2
Lab5	Hydrostatic driving system experimental test.	2
Lab6	Accumulation and energy recuperation mechano-electrical and electrical drive systems.	2
Lab7	Badania sprawności przetwarzania energii generatora prądotwórczego.	2
Lab8	Badanie procesu urabiania ośrodków ziarnistych. Wpływ doboru narzędzia na energooszczędność procesu.	2
		Total hours: 16

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03 PEK_K01-02	final test
P = F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W01, K2MBM_KE_W04, K2MBM_KE_W09	C1	Lec1-Lec7	N1,N3
PEK_W02	K2MBM_KE_W01, K2MBM_KE_W04	C2	Lec1-Lec7	N1,N3
PEK_W03	K2MBM_KE_W09	C1, C2	Lab1-Lab8	N1, N3
PEK_U01	K2MBM_KE_U01	C3	Lec1-Lec15	N1, N3
PEK_U02	K2MBM_KE_U06	C3	Lab1-Lab8	N2
PEK_U03	K2MBM_U01, K2MBM_U05	C3	Lab1-Lab8	N2
PEK_K01	K2MBM_K10	C1, C2, C3	Lec1-Lec15	N1, N3
PEK_K02	K2MBM_K02, K2MBM_K09	C1, C2, C3	Lec1-Lec15	N1, N3
PEK_K03	K2MBM_K04, K2MBM_K05	C3	Lab1-Lab8	N2

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy mechatroniczne w pojazdach i maszynach roboczych**
Name in English: **Mechatronics systems in industrial vehicles and machines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041132**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introduction to mechatronic systems in vehicles and working machines	2
Lec2	Sensors in mechatronic systems of working machines and vehicles. Temperature sensors. Proximity transducers	2
Lec3	Sensors in mechatronic systems of working machines and vehicles. Sensors of linear and angular displacement. Speed and acceleration sensors	2
Lec4	Sensors in mechatronic systems of working machines and vehicles. Sensors for measurement of forces, moments, pressures and flows	2
Lec5	Controllers and operator panels in mechatronic systems of working machines and vehicles and their programming	2
Lec6	Microcontrollers in mechatronic systems of working machines and vehicles and their programming	2
Lec7	Typical communication standards used in control systems of vehicles and working machines	2
Lec8	Navigation systems used in industrial vehicles	2
Lec9	Automation systems used in transmission systems of industrial vehicles and working machines	2
Lec10	Advanced automation systems supporting the process of positioning of manipulators of earthmoving machines	2
Lec11	Automatic systems for excavating and loading of crushed material	2
Lec12	Automatic safety and diagnostic systems in industrial vehicles	2
Lec13	Selected automation systems used in agricultural machines	2
Lec14	Automation of storage and transhipment processes	2
Lec15	Overview of automation systems used in cranes	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Experimental studies of selected transducers from the point of view their efficiency in automatic systems of working machines and vehicles	2
Lab2	Selection of elements and programming of the control system of working machine manipulator	2
Lab3	Sample operator panel programming for industrial vehicle	2
Lab4	Examination of jib crane monitoring system	2
Lab5	The investigation of the new generation's mechatronic steering system for articulated vehicle	2
Lab6	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab7	Experimental studies of a robot used for ropeway's rope diagnostics	2
Lab8	Testing of a laser positioning system of transhipment vehicle manipulator	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec1÷Lec4	N2, N5
PEK_W02	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec5÷Lec7	N2, N5
PEK_W03	K2MBM_KE_W05, K2MBM_KE_W09	C1	Lec8÷Lec15	N2, N5
PEK_U01	K2MBM_KE_U06	C2	La1÷La3, La5, La7, La8	N1, N2, N3, N4
PEK_U02	K2MBM_KE_U06	C2	La1, La4, La6	N1, N2, N3, N4
PEK_K01	K2MBM_K06	C3	Lec1÷Lec15, La1÷La8	N1, N2, N3, N4, N5
PEK_K02	K2MBM_K05	C3	La1÷La8	N1

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **optional**
Subject code: **MMM041133**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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. Acquiring knowledge on the virtual design of industrial vehicles and machines.
C2. Acquiring the ability to use modern methods and tools for virtual 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 criteria, utility and economical.
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 the design of 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 of elements or groups of designs machinery 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 today's technology. 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.	2
Lec4	Managing a complex project in CAD systems. Group work in CAD systems.	2
Lec5	Numerical tests (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
Lec6	Conversion and adaptation of data (numerical models) between different CAD / FEA / MBS. Standard formats.	2
Lec7	Tools (programs) to the numerical investigations (simulation) designed objects: strength analysis: static and dynamic (MES: Abaqus, Nastran), analysis of kinematics and dynamics (MBS Adams, Matlab + Simulink, etc.).	2

Lec8	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
Lec9	Strength analysis: choice of numerical solution methods, presentation of the results of calculation, evaluation of their correctness, estimation errors, optimizing computational model.	2
Lec10	Strength analysis: Nonlinearities in the calculation models (geometric and material), computational models of the nonlinear issues -method of solving.	2
Lec11	Analysis of kinematics and dynamics of the object as a system wielomasowego (MBS): Defining the parameters of components and connections between them.	2
Lec12	Analysis MBS: 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
Lec13	Analysis MBS: Defining the boundary conditions. The choice of method and specify simulation parameters and their impact on the correctness of the results.	2
Lec14	Analysis MBS: ways of presenting the results of simulations (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
Lec15	Exchange of data (and results of calculations) between MBS and MES 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: 30

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	2
Proj2	Construction of a geometric model (3D) of the proposed facility.	3
Proj3	Modeling mass properties, connections, kinematic and sensitive subject. Modeling of the drive system facility and extortion external.	2
Proj4	Numerical optimization of dynamic properties of an object, the term burdens for strength calculations	2
Proj5	Rating geometrical model of the proposed facility. Required modifications and simplified geometric model. Verification of the proposed materials and the selection of the parameters necessary for numerical analysis (FEA).	2
Proj6	Construction of numerical model (FEA) 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.	2
Proj7	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	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. self study - preparation for 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	Lec8, Lec10, Lec12	N1, N2
PEK_W02	K2MBM_W06	C1	Lec1-Lec15	N1, N2
PEK_W03	K2MBM_KE_W07	C1	Lec15	N1, N2
PEK_U01	K2MBM_U09	C2	Proj1-Proj7	N3-N5
PEK_U02	K2MBM_U07	C2	Proj1-Proj7	N3-N5
PEK_U03	K2MBM_U01	C2	Proj1-Proj7	N3-N5
PEK_K01	K2MBM_K03	C2	Proj1-Proj7	N3, N4
PEK_K02	K2MBM_K10	C2	Proj1-Proj7	N3, N4
PEK_K03	K2MBM_K10	C3	Proj1-Proj7	N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Machine Design and Operation**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041135**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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)	9
Proj6	Calculation of section dimensions based on analytical formulas and / or computer methods	9
Proj7	Verification of the strength of the joints used (welds, screw joints, bolts, etc.)	9
Proj8	Development of design documentation (assembly drawing and executive drawings)	6
		Total hours: 45

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-K03	K2MBM_K04, K2MBM_K05, K2MBM_K10	C3	Proj1-Proj8	N1 - N3

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041151, MMM041152.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes					

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_K07, K2MBM_K10			

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja procesów produkcyjnych**
Name in English: **Automation of production processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041201**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: Fundamentals of Automatic Control

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic concepts, building automation systems and their classification.	1
Lec2	The mathematical description of automation.	1
Lec3	Industrial control system. PLCs	2
Lec4	Aspects of safety.	1
Lec5	Network communication systems	2
Lec6	Electric drives	2
Lec7	Industrial robots	2
Lec8	Vision Systems	1
Lec9	HMI and SCADA systems	2
Lec10	Test	1
		Total hours: 15

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

Lab11	Automating the process of identification and measurement	2
Lab12	Automating the process of treatment process	2
Lab13	Automating the process of transport	2
Lab14	Automating the process of assembly	2
Lab15	Automation of continuous processes	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_W04	c1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_W02	K2MBM_W04	c2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_W03	K2MBM_W04	c3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9,	N1, N4, N5
PEK_U01	K2MBM_U13	C3	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9	N2,N3, N5
PEK_U02	K2MBM_U13	C3	LA10, LA11, LA12, LA13, LA14, LA15	N2,N3, N5
PEK_U03	K2MBM_U13	C2	LA1, LA2, LA3, LA4, LA5, LA6, LA7, LA8, LA9	N2,N3, N5
PEK_K01	K2MBM_K09	C1,C2,C3	LA1-LA15	N1-N5
PEK_K02	K2MBM_K06	C1, C2, C3	Lec1-Lec10	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania nieniszczące wyrobów**
Name in English: **Non Destructive Testing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041202**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Principles of assessment. Visual examination.	2
Lec2	Liquid penetrant testing	2
Lec3	Magnetic-particle testing	2
Lec4	Radiographic testing	2
Lec5	Ultrasonic testing of welding joints , part 1	2
Lec6	Ultrasonic testing, part II. Assessment the size of flaw by ultrasonic testing.	2
Lec7	Ultrasonic testing of spot welds using 2D arrays. Test grade.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Principles of assessment. Visual examination.	2
Lab2	Liquid penetrant testing	2
Lab3	Magnetic-particle testing	2
Lab4	Radiographic testing	2
Lab5	Ultrasonic testing of welding joints , part 1	2
Lab6	Ultrasonic testing, part II. Assessment the size of flaw by ultrasonic testing.	2
Lab7	Ultrasonic testing of spot welds using 2D arrays. Test grade.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
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	lect1 - lect7	N1
PEK_U01-PEK_U03	K2MBM_U01, K2MBM_U11, K2MBM_U12	C1, C2	lab1-lab7	N2, N3
PEK_K01-PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K08	C1, C2	lab1-lab7 lect1 - lect7	N2, N3, N4

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041203**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade		Crediting with grade	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.	3
Lec2	Producibility machines due to assembly.	3
Lec3	Methodology for product design assessment due to the installation of DFA.	2
Lec4	Manual assembly, ergonomics and mechanization of work as the primary design criteria assembly stands.	2
Lec5	The methodology and analysis of standardization work time: MTM	3
Lec6	Methodologies and analysis of the standardization work time: MOST, RENAULT	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Analysis of the input data and the structure of the unit to be mounted	2
Proj2	Analysis of the requirements and conditions of technical and technological	2
Proj3		2
Proj4	Assembly sequence planning and the development schemes and plans of assembly	2
Proj5		2
Proj6	The design assessment of the product due to the installation of DFA method	2
Proj7	Standardization of the assembly process using the MTM method and direct time measurment	3
		Total hours: 15

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03 PEK-K01	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] Bruno 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,N4
PEK_W02, PEK_W03	K2MBM_PMS_W05, K2MBM_PMS_W06	C1,C2	Wy4-Wy7	N1, N3, N4,
PEK_U01, PEK_U02	K2MBM_PMS_U02, K2MBM_PMS_U03	C2,	Pr1, Pr3-Pr7	N2,N3
PEK_U02, PEK_U03	K2MBM_PMS_U04, K2MBM_PMS_U05	C2,C3	PR1-Pr7	N2,N3
PEK_K01, PEK_K02	K2MBM_K05, K2MBM_K07, K2MBM_K09, K2MBM_K10	C3	PR1-Pr7	N2,N3
PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K07	C3	Wy1-Wy7, Pr1-Pr7	N4

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041204**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge 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	Organization of work in technical preparation of production - TPP.	2
Lec4	Product Development Management - PDM and PLM systems	2
Lec5	Mapping of production processes.	2
Lec6	Process modeling - eg BPMN method	2
Lec7	Process modeling - selected modeling methods	2
Lec8	Process Simulation - Objectives and Tools.	2
Lec9	Tools and methods for improving production processes.	2
Lec10	Reorganization of processes in the manufacturing company.	2
Lec11	New methods of managing a manufacturing company.	2
Lec12	Elements of the concept of sustainable development in the organization of production processes.	2
Lec13	Summary and verification of acquired knowledge.	2
		Total hours: 26
Form of classes – Project		Number of hours
Proj1	Implementation of the fragment model of the manufacturing system.	6
Proj2	Conducting experiments - simulation of the manufacturing process	4
Proj3	Development of the optimal model of the production system fragments for the given criteria.	5
		Total hours: 15

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- Wy12	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- Wy12 Pr1 - Pr3	N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Specjalne metody łączenia**
Name in English: **Special methods of joining**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041206**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - A student knows the definitions and characteristics of special joining methods
PEK_W02 - A student knows the bonded materials obtained by using special joining methods and their typical applications
PEK_W03 - A student knows the methods of inspection/test of joints made by special bonding methods

II. Relating to skills:
PEK_U01 - A student is able to choose the right method of special joining group and define the basic parameters of the process
PEK_U02 - A student is able to propose the right joining technology for a particular product
PEK_U03 - A student is able to perform basic joints with different special methods

III. Relating to social competences:
PEK_K01 - A student shows ability to search for information and its critical analysis
PEK_K02 - A student shows the ability to team work on improving methods of strategy selection aimed to optimal solving of assigned problems
PEK_K03 - The student shows the ability of an objective evaluation of arguments, rational explanations and justifications of own position using knowledge of welding

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Application of laser technology in welding	2
Lec2	Application of electron beam in bonding, cutting, overlapping the layers and materials heat treatment	2
Lec3	Application of plasma in welding, cutting, spraying and surfacing	2
Lec4	Adhesive bonding of engineering materials	2
Lec5	Special methods of soldering and brazing of advanced materials	2
Lec6	Special methods of resistance welding	2
Lec7	Special methods of welding	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Modern applications of friction welding	2
Lab2	Plasma welding and cutting	2
Lab3	Laser welding and cutting	2
Lab4	Underwater welding	2
Lab5	Modern applications of adhesive technology	2
Lab6	Termite welding	2
Lab7	Explosion welding	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

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

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie przyrostowe**
Name in English: **Additive Manufacturing Technologies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041207.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Additive Manufacturing Technologies
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_W03	C1 - C5		N1 - N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytwarzanie kompozytów metodami odlewniczymi**
Name in English: **Manufacturing of composite materials by casting methods**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041208**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Basic knowledge about production and application of composite materials. Knowledge of matrix types and strengthening mechanisms.
PEK_W02 - Basic knowledge about production and application of composite materials. Knowledge of matrix types and strengthening mechanisms.
PEK_W03 - Basic knowledge about strength and wear investigations of composite materials. Can define wear mechanism and metallographic observations.

II. Relating to skills:
PEK_U01 - Can use terminology related to composite materials, their manufacturing, and investigation of properties.
PEK_U02 - Can characterize selected composite materials. Can apply proper process parameters.
PEK_U03 - Can select and prepare composite components to achieve good reinforcing effect.

III. Relating to social competences:
PEK_K01 - Can think and act in a creative way.
PEK_K02 - Follows the rules and customs prevailing in academia.
PEK_K03 - Can correlate the effects of industry activity with the impact on the environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Composite materials - basic terms, groups	2
Lec2	Reinforcing mechanisms. Types of matrix-reinforcement interface.	2
Lec3	Surface phenomena, wetting of reinforcement by liquid metal, capillary phenomena, chemical reactions between composite components.	2
Lec4	Phase-reinforcing effect on crystallization of the matrix, adhesive and cohesive phenomenon.	2
Lec5	Producing methods of composite materials, in-situ and ex-situ composites.	2
Lec6	Squeeze casting, stir casting.	2
Lec7	Compocasting	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Manufacturing of porous ceramic performs to reinforce composite materials	2
Lab2	Pressure infiltration of ceramic preforms.	2
Lab3	Direct squeeze casting	2
Lab4	Production of hybrid composite materials	2
Lab5	Preparation of composite suspensions by stir casting.	2
Lab6	Centrifugal casting gradient materials.	2
Lab7	Investigations of basic properties of composite materials. Credit.	3
		Total hours: 15

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Lab report
F2	PEK_W01 - PEK_W03PEK_U01 - PEK_U03PEK_K01 - PEK_K03	Test
P = ocena średnia=(F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE
SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03 PEK_K01 - PEK_K03	K2MBM_PMS_W04, K2MBM_PMS_W06	C1,C2	Lec1-Lec7	N1, N2, N3
PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	K2MBM_K10, K2MBM_PMS_U02	C2, C3	Lab1-Lab7	N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane metody kształtowania plastycznego**
Name in English: **Advanced methods of metal forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041209**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possess a knowledge on modern metal forming methods and their analysis
PEK_W02 - Know relations between material properties, metal forming process parameters and strain and load distributions
PEK_W03 - Able to indicate of directions of process modification with respect to efficiency

II. Relating to skills:
PEK_U01 - Able to design a modern process of metal forming, to analyze of limit conditions, to optimize of a process
PEK_U02 - Able to design tools, to choose of materials, machines and process automation methods
PEK_U03 - Able to calculate of necessary efforts of materials and tools

III. Relating to social competences:
PEK_K01 - Has awareness of the effect of method selection on environment
PEK_K02 - Able to use different information sources for decision making
PEK_K03 - Able to organize of teem working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview of limitations in metal forming processes	1
Lec2	Definition of advanced metal forming methods as e way of limits elimination	1
Lec3	Trends of metal forming process development, accuracy of parts, efficiency of processes, improvement of the process flexibility, forming of hard deformed materials, shortening of production preparation time, preservation of environment	2
Lec4	Development of materials for metal forming, automobile industry, light materials, special materials	2
Lec5	Modern tool materials	2
Lec6	Part accuracy improvement methods in sheet metal forming	2
Lec7	Progressive and transfer methods in sheet metal forming processes	2
Lec8	Part accuracy improvement methods in bulk metal forming	2
Lec9	Application of powder metallurgy for manufacturing materials and parts on specific properties	2
Lec10	Unconventional metal forming methods	2
Lec11	Enhancement of metal forming methods flexibility	2
Lec12	Numerical methods in analyze, designing and optimization of metal forming processes	2
Lec13	Engineering, dedicated FEM programs	2
Lec14	Application of physical modeling methods for metal forming processes analysis	2
Lec15	Modern machines for metal forming	2
Lec16	Control methods of metal forming processes	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Evaluation of significance and placement of risk of fracture, wrinkling and part accuracy on the base of literature	2
Proj2	Technology selection for risk minimize	2
Proj3	Elaboration of assumptions to the process project, number of operations, conception of intermediate shapes, preliminary selection of parameters, assessment of necessary machines availability	2
Proj4	Elaboration of 3D CAD model and geometry transfer to FEM program	2
Proj5	Metal forming process modeling by engineering FEM program	2
Proj6	Process parameters optimization with respect to cracking or an accuracy on the base mathematical modeling results	2
Proj7	Metal forming tools design	2
Proj8	Assessment of process efficiency in relation to typical metal forming methods	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Richert J., Innovative methods of metal forming. AGH publishing, Krakow, 2010.

Gronostajski Z., Applied research in advanced metal forming processes. Editorial Office of Wroclaw university of Technology, Wroclaw, 2003.

Dyja H., Rheology of plastically deformed metals. Polytechnic of Czestochowa publishing.

SECONDARY LITERATURE

Boljanovic V., Sheet metal forming processes and die design New York : Industrial Press, cop. 2005.

Walsh R. A., McGraw-Hill Machining and metalworking handbook, McGraw-Hill, 2006

Rao S. S., Engineering optimization theory and practice . John Wiley & Sons. 2009

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_PMS_W02	C1, C3	Lec1 - Lec3, Lec12, Lec14	N1, N2, N5
PEK_W02	K2MBM_PMS_W02, K2MBM_PMS_W06	C1, C3	Lec4 - Lec6, Lec8, Lec9, Lec16	N1, N2, N5
PEK_W03	K2MBM_W05, K2MBM_W06, K2MBM_W07, K2MBM_W10	C1 - C3	Lec3 - Lec15	N1, N2, N4, N5
PEK_U1 - PEK_U3	K2MBM_PMS_U01, K2MBM_U01, K2MBM_U02, K2MBM_U10, K2MBM_U20	C1 -C3	Lec1 - Lec16, Proj1 - Proj8	N1 -N4, N5
PEK_K01 - PEK_K03	K2MBM_K07, K2MBM_K08, K2MBM_K09	C1, C3	Lec1 - Lec16, Proj1 - Proj8	N1 - N5

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041212**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has 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 - The student can critically analyze the functioning of a manufacturing system in order to improve its performance.

PEK_K03 - The student is aware of the responsibility for her/his works and its effect on the functioning of the enterprise.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction to flexible manufacturing systems (FMS); providing students with issues to develop a presentations.	1
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 smart systems used in FMS on the example of stacker cranes and automated guided vehicles.	2
Sem6	Presentations on robots and mechatronic systems used in FMS.	2
Sem7	Presentations on the systems used for deburring and removing and processing chips in FMS.	2
Sem8	Discussion on flexible production automation.	2
		Total hours: 15

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	
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	Se1-Se8	N1, N2, N3
PEK_K01 - PEK_K03	K2MBM_K09, K2MBM_K10	C1-C3	Se1-Se8	N1, N2, N3

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041213**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	60			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			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. Learning 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. Classification of machine tools and basic forms of constructions.	2
Lec2	Spindle units including spindle designs, bearing units, lubrication and cooling systems.	2
Lec3	Carrier systems including machine bodys and slides connections.	2
Lec4	Main drives, drives of feed motion with measuring systems.	2
Lec5	Static, dynamic and thermal properties of machine tools. Selected problems of designing machine tools: modeling, simulation, optimization, FEM calculations.	2
Lec6	Auxiliary machine tool modules: tool heads, tool magazines, tool changers, chip conveyors, cooling systems.	2
Lec7	Control of machine tools, systems monitoring and diagnostics	2
Lec8	Final test	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Compensation of machining thermal error	2
Proj2	-model CAD and FEM machine tools for determining the thermal deformation	4
Proj3	-Simulation machining error the selected operating conditions	4
Proj4	develop error correction for the control system	3
Proj5	-evaluation of quality results obtained.	2

	Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. self study - preparation for project class N3. project presentation 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 (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 = F1		

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

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041214**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge 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	2
Lec2	Thermodynamic and metallurgical foundations of bonding processes	2
Lec3	Metallurgy for welding construction steels	2
Lec4	Metallurgy welding of alloy steels	2
Lec5	Metallurgy welding of high-alloy steels	2
Lec6	Metallurgy of copper and aluminum bonding	2
Lec7	Unlike connections	2
Lec8	Final test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03, PEK_K01	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		N1
PEK_K01	K2MBM_K06	C1, C2		N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Narzędzia do przeróbki plastycznej**
Name in English: **Tools for metal forming**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041215**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

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

II. Relating to skills:

III. Relating to social competences:

PEK_K01 - Acquires the ability to take responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification of basic technologies shaping by machining plastic. Development of cold and hot. Construction of the forming.	2
Lec2	Cold forming. The types of treatment used tool. Classification of materials used in cold forming.	2
Lec3	Forged in the heat. The types of treatment used tool. Classification of materials used in the treatment of hot forming.	2
Lec4	Design solutions for the construction working tools surgery. Heat treatment of the materials used in the construction of tools Forming.	2
Lec5	Analysis of the sample preparation process in detail plastic forming. Applied design solutions, materials and Technology for tools.	2
Lec6	Design tools for shaping metal sheets	2
Lec7	Design tools for shaping vol.	2
Lec8	Unconventional punching and forming tools.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. MARCINIAK Z.: Konstrukcja tłoczników, WNT, Warszawa 2002.
2. ZIMNIAK Z.: System wspomagania projektowania, zapewnienia jakości i diagnozowania tłoczenia blach, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005
3. Ćwiczenia laboratoryjne z budowy maszyn część II Obróbka Plastyczna pod redakcją Henryka Ziemby, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1981.
4. MAZURKIEWICZ A., KOCUR L.: Obróbka plastyczna laboratorium , Politechnika Radomska, Radom 1997.

SECONDARY LITERATURE
[1] H.J. Kleemola, M.T. Pelkkikangas, Effect of predeformation and strain path on the forming limits of steel copper and brass, Sheet Met. Ind. 63 (2) (1997) 591–599.
[2] R. Arrieux, C. Bedrin, M. Boivin, Determination of an intrinsic forming limit stress diagram for isotropic metal sheets, in: Proceedings of the 12th Biennial Congress IDDRG, 1982.
[3] A.K. Ghosh, J.V. Laukonis, The influence of strain-path changes on the formability of sheet steel, in: Proceedings of the Ninth Biennial Congress of the International Deep Drawing Research Group, Sheet Metal Forming and Energy Conservation, ASM Publication, New York, 1976.
[4] T.B. Stoughton, A general forming limit criterion for sheet metal forming, Int. J. Mech. Sci. 42 (1) (2000) 1–27.
[5] A.F. Graf,W.F. Hosford, Calculations of forming limit diagram for changing strain paths, Metall. Trans. A 24 (3) (1993) 2497–2501.
[6] A. Graf, W.F. Horsford, Effects of changing strain paths on forming limit diagrams of Al 2008–T4, Metall. Trans. A 24 (3) (1993) 2503–2512.
[7] R. Arrieux, Determination and use of the forming limit stress diagrams, J. Mater. Process. Technol. 53 (3) (1995) 47–56.
[8] R. Hill, Math. Proc. Camb. Philos. Soc. 85 (4) (1979) 179–185.
[9]. BOLJANOVIC V.: Sheet metal forming processes and die design, Industrial Press, New York 2004.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2MBM_PMS_W02, K2MBM_PMS_W06, K2MBM_PMS_W07	C1, C2, C3	Wy1-Wy8	N1, N2, N3
PEK_K01	K2MBM_K05	C1, C2, C3	Wy1-Wy8	N1,N2,N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041216**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

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

III. Relating to social competences:

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

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, discussion of the structure and the way of editing the diploma work.	2
Sem2	Introductory discussion on the diploma works.	6
Sem3	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the fundamental areas.	2
Sem4	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the design area.	2
Sem5	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the technology area.	2
Sem6	Presentation of the students’ work effects.	14
Sem7	Summary.	2
		Total hours: 30

TEACHING TOOLS USED

N1. 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_U01, PEK_K01	K2MBM_K07, K2MBM_U17	C1, C2	Se1-Se15	N1-N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041217**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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 skills of a critical analysis for selection the planning technology and methods to manufacture the products.
C2. Acquisition 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.	9
Proj4	Selection of machines, tools and equipment for realization of the agreed manufacturing process.	6
Proj5	Execution the structure of technological process, with detailed plan of selected operations, the order of basic and additional treatments, time standards, technological brochures, etc.	9
Proj6	Development of the project design documentation (assembly drawing and executive drawings). Presentation with the project defense.	12
		Total hours: 45

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_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	Pr1 - Pr6	N1 -N3
PEK_K01 - PEK_K03	K2MBM_K03, K2MBM_K04, K2MBM_K05, K2MBM_K10	C1 - C3	Pr1 - Pr6	N1 - N3

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041251, MMM041252**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

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

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041301**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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	2
Lec2	Solid state of matter, properties.	2
Lec3	Defects in Crystals.	2
Lec4	Techniques for physicochemical characterization of solids.	4
Lec5	Quantum mechanical aspects of chemical bonds. Physical interactions.	2
Lec6	Electron spectroscopy of solids, absorption, emission, photon upconversion	4
Lec7	Syntheses of solids, photonic effect.	4
Lec8	Magnetic properties of solids.	2
Lec9	Basic electrochemistry - electrolysis, electrolytic cells, corrosion.	2
Lec10	Basic nanotechnology - nanometerials, synthesis, application, properties.	4
Lec11	Qualifying class –test	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	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-Lec10	N1, N2, N3

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041302**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The 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.	4
Lec3	The overview of engineering materials (metals alloys, polymers, ceramics, composites).	4
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.	4
Lec7	Modern low-alloed martensitic steels.	2
Lec8	Modern materials, used in higher and lowered temperatures.	2
Lec9	Materials applied to wear-resistant requirements.	2
Lec10	The issues of materials issue on machines and mechanisms parts.	2
Lec11	Test.	2
		Total hours: 30

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, 2003[2] Ashby. M.F, Jones.D.R, Materiały inżynierskie, WNT,1995[3]Dobrzański.L.A, Materiałoznawstwo z podstawami nauki o materiałach,WNT,2004

SECONDARY LITERATURE

[4]Pękalski.G, Materiały dydaktyczne dla IPS, 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	Lecture1-Lecture3	N1,N2
PEK - W02	K2MBM_IMK_W01, K2MBM_IMK_W03	C1,C2	Lecture2-Lecture4	N1,N2
PEK W03	K2MBM_IMK_W02, K2MBM_IMK_W03	C3	Lecture3-Lecture9	N1 - N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza wymiarowa w projektowaniu eksperymentu**
Name in English: **Dimensional Analysis in Experiment Design**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041303**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis, linear algebra.

SUBJECT OBJECTIVES

C1. Knowledge of dimensional analysisas a tool for theory of identification and experiment planning.
C2. Skill of construction of empirical mathematical models.
C3. Acqurement and consolidation of social competences contaiining emotional intelligence based on skills of co-operation in a student group in order to efficiently solve the problems. i

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of dimensional analysis in Drobot's formulation.
PEK_W02 - Knowledge of rudiments of parametrical identification.
PEK_W03 - Knowledge of rules of model similarity.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Definition of dimensional space according to Drobot.	2
Lec2	Relations between elements of dimensional space & images described in classical theory of measurement.	2
Lec3	Postulates of obiectivision & synonymity.	2
Lec4	Elements of measurement theory .	2
Lec5	Dimensional homogenity & invariability.	2
Lec6	Construction of empirical mathematical models .	2
Lec7	Dimensional transformation - so called Π-theorem.	2
Lec8	Dimensional analysisas vs theory of identification and experiment planning.	2
Lec9	Dimensional complex function.	2
Lec10	Multistage identification.	2
Lec11	Rule of correspodence.	2
Lec12	Theory of model similarity.	2
Lec13	Change of dimensional basis. Experiment planning.	2
Lec14	Testing of completeness of similarity invariants set.	2
Lec15	Presentation & disscusion of control works, Crediting.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.W. Kasprzak, B. Lysik, M. Rybaczuk, Measurements, Dimensions, Invariant Models and Fractals, Wrocław-Lwów 2004,
2.W. Kasprzak, B. Lysik, M. Rybaczuk, Dimensional Analysis in the Identification of Mathematical Models. World Scientific Singapore, 1990,
3.Pr. zb. pod red. W. Myszki, Komputerowy system obsługi eksperymentu, WNT Warszawa 1991,
4.M. Szata, Opis rozwoju zmęczeniowego pękania w ujęciu energetycznym, Oficyna Wydawnicza PWr, Wrocław 2002.

SECONDARY LITERATURE

W. Kasprzak, B. Lysik, Analiza wymiarowa. Algorytmiczne procedury obsługi eksperymentu, WNT Warszawa 1988.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dimensional Analysis in Experiment Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03.	K2MBM_IMK_W03	C1	Lec1 - Lec15	N1, N2, N3

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041304**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of physics and chemistry at 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.	2
Lec4	Vacuum pumps and gauges. Scanning electron microscope - construction, working principle.	2
Lec5	Applications of a scanning electron microscope. Topographic and material contrast. Crystallographic investigations in a scanning electron microscope.	2
Lec6	X-ray microanalysis. X-ray spectrometers, methods of analysis, applications.	2
Lec7	Interaction of electrons with solids. Elastic and inelastic scattering of electrons.	2
Lec8	Transmission electron microscope - construction, working principle.	2
Lec9	Methods of specimen preparation for transmission electron microscopy.	2
Lec10	Scattering and phase contrasts in a transmission electron microscope and their applications.	2
Lec11	Electron diffraction in a transmission electron microscope. Geometry of diffraction, interpretation of electron diffractograms.	2
Lec12	Dynamical theory of electron diffraction. Diffraction contrast and its applications.	2
Lec13	High resolution transmission electron microscopy. Electron energy loss spectroscopy. Lorentz microscopy.	2
Lec14	Scanning probe microscopes (scanning tunneling microscope, atomic force microscope, magnetic force microscope).	2
Lec15	Methods of surface analysis (Auger electron spectroscopy, secondary ion mass spectroscopy, photoelectron spectroscopy).	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to structure investigations. Explanation of exercises schedule.	1
Lab2	Interpretation of X-ray diffractograms.	2
Lab3	Scanning electron microscope - demonstration + interpretation of micrographs.	2
Lab4	X-ray microanalysis - demonstration + interpretation of results of analysis.	2
Lab5	Interpretation of ring electron diffractograms.	2
Lab6	Interpretation and indexing of point electron diffractograms.	2
Lab7	Transmission electron microscope - demonstration + interpretation of micrographs.	2
Lab8	Course summary and getting credits.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of audiovisual means
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 - Lec15	N1 - N2
PEK_U01 - PEK_U03	K2MBM_IMK_U01	C1 -C3	Lab1 - Lab7	N3 - N4

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041305**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of machine operation, statistics, machine parts

SUBJECT OBJECTIVES

C1. To know how to analyse and assess object reliability
C2. Abilities of management of technical systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Understanding relations between processes running in operation and failure process

II. Relating to skills:
PEK_U01 - Student is able to analyse technical system and calculate basic reliability measures

III. Relating to social competences:
PEK_K01 - Student is able to work in a team

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Information sources related to reliability and safety	2
Lec2	Statistical tests. Programming reliability test.	2
Lec3	Computer reliability systems. Results analysis	2
Lec4	Application of reliability results in operation management	2
Lec5	Reliability of complex systems. Design calculation using probabilistic measures	2
Lec6	Symulation modeling in relaibility	2
Lec7	Analytical methods in reliability: RBD	2
Lec8	Analytical methods in reliability: FTA, ETA	2
Lec9	Analytical methods in reliability: FMEA	2
Lec10	Analytical methods in reliability: FMEA	2
Lec11	Multistate systems: Markov chains	2
Lec12	Numerical simulation. random numbers generating.	2
Lec13	Simulation in reliability. Programming	2
Lec14	Simulation in reliability. Results analysis	2
Lec15	Final test	2
		Total hours: 30

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	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
as above

SECONDARY LITERATURE
as above

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 PEK_UO1	K2MBM_IMK_W04	C1	Wy1-Wy15	N1

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041306**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Passing the course Material Science.

SUBJECT OBJECTIVES

C1. Understanding of phase transformations and mechanisms of metal reinforcement sufficient to select materials for construction and development of product technologies.
C2. Understanding the relationship between the structure, the manufacturing process and the properties of steel.
C3. Acquisition of knowledge about the characteristics of basic groups of metallic structural materials - ferrous and non-ferrous alloys.
C4. Acquire skills in information retrieval and critical analysis.
C5. Acquiring and perpetuating social competence involving the ability to collaborate in a student group to effectively solve problems. Responsibility, honesty, adherence to the customs of the academy and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the mechanisms of crystallization and phase transformation during heating and solidification of metals and alloys, and methods of designing their basic mechanical properties.
PEK_W02 - He knows the basic types of heat treatments and their effect on the properties of the steel.
PEK_W03 - He has knowledge of the classification and application of basic steel grades.

II. Relating to skills:
PEK_U01 - He can choose the appropriate construction material and propose a method of shaping its properties based on an adequate strengthening mechanism.
PEK_U02 - He can choose the appropriate method of thermal improvement and determine the basic parameters of the process.
PEK_U03 - He can diagnose and interpret the basic errors (defects) arising from the production and shaping of basic building materials.

III. Relating to social competences:
PEK_K01 - Information search and critical analysis.
PEK_K02 - Collaborative collaboration and objectively selecting and evaluating the arguments of the problem solving strategies.
PEK_K03 - Observing the customs and rules of the academic world.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizing activities. Crystallization mechanisms, dendritic crystallization, cast structure, solidification of alloys under conditions of imbalance.	2
Lec2	Metal deformation and recrystallization.	2
Lec3	Phase transitions in steel during heating.	2
Lec4	Basic types of annealing. Hardening and tempering of steel.	2
Lec5	TTT charts. Hardenability.	2
Lec6	Surface treatment of steel: surface hardening, carburizing, nitriding.	2
Lec7	Respiration and aging.	2
Lec8	Effect of alloying elements on phase transformations in steels.	2
Lec9	General classification of steel. Structure and properties of non-alloy steel.	2
Lec10	Structural alloy steels.	2
Lec11	Tool steels.	2
Lec12	Steels with special properties: corrosion-resistant, heat-resistant, maraging steels and permanently abrasion resistant.	2
Lec13	Foundry iron alloys.	2
Lec14	Copper and copper alloys.	2
Lec15	Light metals and light metal alloys.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours

Lab1	Organizing activities. Effect of carbon content and methods of production on microstructure and mechanical properties of steel.	3
Lab2	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	Microstructure of steel with special properties.	2
Lab6	Microstructure and properties of cast iron.	2
Lab7	Microstructure and properties of copper alloys and aluminum alloys.	2
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides.
N2. Tutorials.
N3. Self study - preparation for laboratory class.
N4. 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-oral exam.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	U01-U03; K01-K03;	Cardinals - entry ticket, oral answers.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

R. Haimann, Metaloznawstwo część I, skrypt PWr, 2000
L. A. Dobrzański, Metaloznawstwo z podstawami nauki o materiałach, WNT, 1996
W. Dudziński, K. Widanka i inni, Ćwiczenia laboratoryjne z materiałoznawstwa, 2005, skrypt PWr
W.Dudziński, Ćwiczenia laboratoryjne. Materiały konstrukcyjne w budowie maszyn. Skrypt PWr. 1994

SECONDARY LITERATURE

L. A. Dobrzański, Podstawy nauki o materiałach i metaloznawstwo, WNT, 2002
Ashby M.F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT, 1996

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-Lec3, Lec8	N1, N2, N4
PEK_W02	K2MBM_W08	C2	Lec4-Lec7	N1, N2, N4
PEK_W03	K2MBM_W08	C3	Lec9-Lec15	N1, N2, N4
PEK_U01 PEK_U02 PEK_U03	K2MBM_U01, K2MBM_U07	C1, C2, C3	Lab1-Lab7	N2, N3, N5
PEK_K01 PEK_K02 PEK_K03	K2MBM_K01, K2MBM_K02, K2MBM_K03, K2MBM_K06	C1, C2, C3	Lab1-Lab7	N2, N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika materiałów-badania, modelowanie**
Name in English: **Mechanics of materials; testing and modeling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041307**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the courses: Technical Mechanics, Calculus I,
Algebra and Analytic Geometry.
2. Physics, Strength of Materials I and II
3. Student has fundamental knowledge of materials science and plastics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the structure, properties, investigation and modelling methods of selected group of advanced materials.
C2. Acquisition of skills related to constitutive equations and their identification with reference to advanced materials for mechanical constructions.
C3. Acquisition of skills related to physical fundamentals and methodology of experimental investigations aimed at determining the properties of advanced materials.
C4. Acquisition and strengthening of the social competence including emotional intelligence that is based on the ability to cooperate in a group of students, which is aimed at effective problem solving.
Responsibility, honesty and diligence in one's code of conduct; obeying the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the structure and properties of selected advanced materials,
PEK_W02 - Student knows how to describe properties of materials using constitutive models,
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods essential to determine the properties of advanced materials.

II. Relating to skills:
PEK_U01 - Student can select a material on the basis of knowledge of its properties and application in mechanical constructions,
PEK_U02 - Student can apply a body model to describe properties of a material,
PEK_U03 - Student can apply experimental verification methods to selected advanced materials.

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the strength of materials,
PEK_K03 - Student adheres to the customs and rules of academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Advanced materials. Thematic scope of the course. Classification of materials.	2
Lec2	Composites with continuous fibre for extremely strenuous constructions. Material, technology, exemplary applications.	2
Lec3	High pressure composite vessels for gaseous fuel storage. Design, manufacture, testing, applications.	3
Lec4	Testing methods of high pressure composite vessels for gaseous fuel storage	2
Lec5	Classification, structure, manufacture, application of Smart materials.	2
Lec6	Cross effects. Methods of experimental investigations, measuring apparatus, software for experiment handling.	3

Lec7	Properties of Smart materials stimulated by magnetic field. Examples of experimental investigations.	3
Lec8	Metallic glasses. Manufacture, properties, testing.	2
Lec9	Properties of the materials with martensitic phase transformation induced by plastic strain. Examples of experimental investigations.	3
Lec10	Body models; constitutive equations for selected advanced materials.	3
Lec11	Methods to identify constitutive models for Smart materials.	2
Lec12	Examples of application of Smart materials.	3
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Cyclic tests of high pressure composite vessels for gaseous fuel storage.	2
Lab2	Use of optical fibre sensors in investigations of advanced materials.	2
Lab3	Selected methods of investigation of metallic glasses.	2
Lab4	Investigation of the properties of composites subjected to complex stress states.	2
Lab5	Investigation of martensitic phase transformation induced by plastic strain.	2
Lab6	Application of magnetomechanical effects in the investigations of construction materials. Magnetovision.	2
Lab7	Application of the Thomson effect. Thermovision in the investigations of advanced materials.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K04	Written test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics of materials; testing and modeling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_IMK_W03	C1,C2		N1,N2, N3,N4
PEK_U01-PEK_U03	K2MBM_IMK_U03	C2,C3		N1,N2
PEK_K01-PEK_K03	K2MBM_K10	C4		N1,N2

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041308**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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	4
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).	4
Sem5	Planning, fields and examples of expertise works.	6
Sem6	Analysis of studies and own research work accoring to IIIrd Generation University requirements.	4
Sem7	The presentation of results of own work.	4
		Total hours: 30

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 = F1		

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	Seminary1-Seminary6	N1, N3, N4
PKE - K01 - PEK - K02	K2MBM_K01, K2MBM_K04, K2MBM_K09	C1 - C3	Seminary5-Seminary7	N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Korozja i ochrona przeciwkorozyjna**
Name in English: **Corrosion and anticorrosion protection**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041310**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The 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	2
Lec2	Technical and economical meaning of corrosion	2
Lec3	Types of corrosion processes, clasifiaction and cahracteristics of corrosive damages	2
Lec4	Characteristic of corrosive enviroments.	2
Lec5	Theoretical background of electrochemical corrosion.	2
Lec6	Voltage series of metals and alloys, galvanic series of metals and alloys.	2
Lec7	Mechanism of high-temperature corrosion	2
Lec8	Polarization processes, passivation and depassivation	2
Lec9	Classifiaction and characteristic of anti-corrosion protection methods	2
Lec10	Corrosion as one of the issues in the process of materials degradation	2
Lec11	The rules of materials choosing in the corrosion-damaged enviroment	2
Lec12	The influence of construction solution and materials microstructure on corrosion process	2
Lec13	Corrosion of non-metallic materials	2
Lec14	Methods of corrosion investigations	2
Lec15	Test	2
		Total hours: 30

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
Lab6	Own analysis of materials choosing and anti-corrosion protection - part 1	2
Lab7	Own analysis of materials choosing and anti-corrosion protection - part 2, Passing of laboratory courses	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. 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 = 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	The report from laboratory courses, introduction test
P = F1		

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.L.A, Podstawy nauki o materiałach i metaloznawstwo,WNT,2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Corrosion and anticorrosion protection
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_W06	C1	Lecture1-Lecture3	N1
PEK - W02	K2MBM_IMK_W02, K2MBM_IMK_W06	C2	Lecture3-Lecture4	N1
PEK - W03	K2MBM_IMK_W01, K2MBM_IMK_W02, K2MBM_IMK_W06	C3,C4	Lecture9, Lecture10	N1
PEK - U01	K2MBM_IMK_U02, K2MBM_IMK_U03, K2MBM_IMK_U04, K2MBM_IMK_U05	C3	Laboratory2, laboratory3	N3,N5
PEK - U02	K2MBM_IMK_U04	C3	Laboratory5	N3,N5
PEK - U03	K2MBM_IMK_U04, K2MBM_IMK_U05	C4	Laboratory5, Laboratory6	N3,N5
PEK - K01	K2MBM_K10	C1,C3	Lecture1-Lecture4	N1,N4
PEK - K02	K2MBM_K06	C1	Lecture2	N1,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041316**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

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

III. Relating to social competences:

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

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, discussion of the structure and the way of editing the diploma work.	2
Sem2	Introductory discussion on the diploma works.	6
Sem3	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the fundamental areas.	2
Sem4	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the design area.	2
Sem5	Revision, analysis of the basic exam questions and the way of conducting the discussion during the diploma examination – questions from the technology area.	2
Sem6	Presentation of the students' work effects.	14
Sem7	Summary.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem discussion
N2. multimedia presentation
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_W01, PEK_U01, PEK_K01	K2MBM_K07, K2MBM_U17	C1, C2, C3		N1,N2, N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Problemy smarowania i zużywania maszyn**
Name in English: **Lubrication and wear problems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041320**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Terms and organization of classes, framework programs, the terms of credit. Introduction to lubrication and wear in the construction and operation of machinery.	2
Lec2	Tribological wear. Terms: adhesion of the surface layer, the surface free energy. Work of adhesion.	2
Lec3	Types and characteristics of lubricants. Properties and application of lubricants. The testing of lubricants (including lubricity, mechanical stability, service life and thermal stability).	2
Lec4	Basic rheology of lubricants. Capillary and rotational rheometry. Rheological greases steady flow conditions and with the use of methods for dynamic oscillation. Linear viscoelasticity.	2
Lec5	Methods of lubrication. Selection of the type and amount of lubricant for the lubrication of friction.	2
Lec6	Process automation lubrication. Construction of central lubrication systems. Examples of applications for central lubrication systems in various industries.	2
Lec7	Basic design of lubrication. The environmental aspects of lubrication assemblies.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Test of resistance to abrasive wear of the materials used in the nodes of friction.	2

Lab2	Measurement of density and viscosity of lubricating oils. Determination of the viscosity index of lubricating oils.	2
Lab3	Lubrication of slioding bearings. Determination of the frictional characteristics of the cross slide bearing. Evaluation of the impact of oil viscosity on the process of hydrodynamic lubrication.	2
Lab4	Determining the properties of lubricating greases.	2
Lab5	Measuring the degree of penetration of lubricating greases and study the rheological properties of lubricating greases (compilation flow curves, determination of yield stress).	2
Lab6	Research on the influence of the wall material for the formation of a boundary layer greases in the lubricant.	2
Lab7	Studies on impact of length, diameter and shape of circular pipe pressure drop in lubricants arts.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_IMK_W08	C1	Lec1, Lec2	N1, N2, N3
PEK_W02	K2MBM_IMK_W08	C2	Lec3, Lec4	N1, N2, N3
PEK_W03	K2MBM_W05, K2MBM_W06	C3	Lec5, Lec6, Lec7	N1, N2, N3
PEK_U01 - PEK_U03	K2MBM_IMK_U07, K2MBM_U01, K2MBM_U05, K2MBM_U07	C1, C2, C3	Lab1 - Lab7	N3, N4, N5
PEK_K01 - PEK_K03	K2MBM_K01, K2MBM_K03, K2MBM_K05, K2MBM_K06	C1, C2, C3	Lab1 - Lab7, Lec1-Lec7	N1 - N5

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Problemy smarowania i zużywania maszyn**
Name in English: **Lubrication and wear problems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041320**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Terms and organization of classes, framework programs, the terms of credit. Introduction to lubrication and wear in the construction and operation of machinery.	2
Lec2	Tribological wear. Terms: adhesion of the surface layer, the surface free energy. Work of adhesion.	2
Lec3	Types and characteristics of lubricants. Properties and application of lubricants. The testing of lubricants (including lubricity, mechanical stability, service life and thermal stability).	2
Lec4	Basic rheology of lubricants. Capillary and rotational rheometry. Rheological greases steady flow conditions and with the use of methods for dynamic oscillation. Linear viscoelasticity.	2
Lec5	Methods of lubrication. Selection of the type and amount of lubricant for the lubrication of friction.	2
Lec6	Process automation lubrication. Construction of central lubrication systems. Examples of applications for central lubrication systems in various industries.	2
Lec7	Basic design of lubrication. The environmental aspects of lubrication assemblies.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Test of resistance to abrasive wear of the materials used in the nodes of friction.	2

Lab2	Measurement of density and viscosity of lubricating oils. Determination of the viscosity index of lubricating oils.	2
Lab3	Lubrication of slioding bearings. Determination of the frictional characteristics of the cross slide bearing. Evaluation of the impact of oil viscosity on the process of hydrodynamic lubrication.	2
Lab4	Determining the properties of lubricating greases.	2
Lab5	Measuring the degree of penetration of lubricating greases and study the rheological properties of lubricating greases (compilation flow curves, determination of yield stress).	2
Lab6	Research on the influence of the wall material for the formation of a boundary layer greases in the lubricant.	2
Lab7	Studies on impact of length, diameter and shape of circular pipe pressure drop in lubricants arts.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_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	K2MBM_IMK_W08, K2MBM_W05, K2MBM_W08	C1	Lec1, Lec2	N1, N2, N3
PEK_W02	K2MBM_IMK_W08, K2MBM_W05	C2	Lec3, Lec4	N1, N2, N3
PEK_W03	K2MBM_IMK_W07, K2MBM_IMK_W08	C3	Lec5, Lec6, Lec7	N1, N2, N3
PEK_U01	K2MBM_U05, K2MBM_U07, K2MBM_U14	C1,C2	Lab1	N3, N4, N5
PEK_U02	K2MBM_U05, K2MBM_U07, K2MBM_U14	C3	Lab2-Lab5	N3, N4, N5
PEK_U03	K2MBM_IMK_U07, K2MBM_U05, K2MBM_U07, K2MBM_U12, K2MBM_U14	C3	Lab5, Lab6, Lab7	N3, N4, N5

PEK_K01	K2MBM_K01, K2MBM_K07, K2MBM_K10	C1, C2, C3	Lab1 - Lab7, Lec1-Lec7	N1 - N5
PEK_K02	K2MBM_K01, K2MBM_K07	C1, C2, C3	Lab1 - Lab7, Lec1-Lec7	N1 - N5
PEK_K03	K2MBM_K01, K2MBM_K04, K2MBM_K05, K2MBM_K07, K2MBM_K10	C1, C2, C3	Lab1 - Lab7, Lec1-Lec7	N2, N4, N5

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **optional**
Subject code: **MMM041321**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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 wibroakustyki.
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 ability to objective judging, reasoning, rational and justify their own point of view, using knowledge of vibroacoustics area.
PEK_K03 - As a result of the carried out activities the student should possess the ability to respect the Customs and rules in academia.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory	2
Lab2	Propagation of sound, sound level and vibration	4
Lab3	Acoustic units	2
Lab4	The source of vibrations and noise	2
Lab5	Selected noise of machinery and equipment	4
Lab6	Criteria for the assessment of noise	4
Lab7	Methods of noise reduction	4
Lab8	Construction and selection of acoustic filters	2
Lab9	Holography and acoustic probe	4
Lab10	Passing of the course	2
		Total hours: 30

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

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika materiałów "Smart"**
Name in English: **Mechanics of Smart materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041322**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competence resulting from the completion of the courses: Technical Mechanics, Calculus I,
Algebra and Analytic Geometry, Physics.
2. Strength of Materials I and II
3. Student has fundamental knowledge of materials science and plastics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on the structure, properties, investigation and modelling methods of selected group of Smart materials.
C2. Acquisition of skills related to constitutive equations and their identification with reference to Smart materials, particularly in the area of mechanical constructions.
C3. Acquisition of skills related to physical fundamentals and methodology of experimental investigations aimed at determining the properties of Smart materials.
C4. Acquisition and strengthening of the social competence including emotional intelligence that is based on the ability to cooperate in a group of students, which is aimed at effective problem solving.
Responsibility, honesty and diligence in one's code of conduct; obeying the customs of the academic community and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows physical fundamentals of the structure and properties of selected Smart materials
PEK_W02 - Student knows how to describe properties of Smart materials using constitutive models
PEK_W03 - Student has knowledge of the fundamentals and applications of selected experimental methods essential to determine the properties of Smart materials.

II. Relating to skills:
PEK_U01 - Student can select a material from the Smart materials group on the basis of knowledge of its properties and application in mechanical constructions,
PEK_U02 - Student can apply a body model to describe properties of a Smart material,
PEK_U03 - Student can apply experimental verification methods to selected Smart materials.

III. Relating to social competences:
PEK_K01 - Student can search and critically analyse information,
PEK_K02 - Student can objectively assess arguments, rationally explain and justify his/her viewpoint using the knowledge of the strength of materials,
PEK_K03 - Student adheres to the customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Cross effects; classification, structure, manufacture, application of Smart materials.	2
Lec2	Magnetorheological fluids and ferrofluids and composites based on these fluids; magnetorheological elastomers. Structure, properties and application possibilities.	2
Lec3	Magnetostrictive materials and composites based on these materials. Design of dampers, actuators and measurement systems.	2
Lec4	Magnetocaloric and electrocaloric materials and effects. Cooling systems utilizing Smart materials.	2

Lec5	Smart magnetic materials in the design of NDT measurement systems. Magnetovision and its applications.	2
Lec6	Energy Harvesting. Methods of energy acquisition from vibrations and waste heat using Smart materials.	3
Lec7	Methods of description of Smart materials. Overview of constitutive models. Elastic, pseudoelastic and magnetoelastic materials etc.	2
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Investigation of properties of the magnetorheological damper with a magnetorheological fluid and a magnetorheological composite.	2
Cl2	Determination of damping in a magnetorheological elastomer.	2
Cl3	Testing of the actuator with the "giant magnetostriction" core in the acoustic band; the so-called "playing table"	2
Cl4	Testing of the harvester which acquires electrical energy from vibrations.	2
Cl5	Determination of the properties of the harvester device which acquires electrical energy from waste heat.	2
Cl6	Use of magnetovision in experimental mechanics.	2
Cl7	"Magnetic refrigerator" demonstrator utilizing Smart materials. Testing.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J. Skrzypek, Plastyczność i pełzanie, PWN, Warszawa 1986.
2. Teoria plastyczności, praca zbiorowa pod red. Wacława Olszaka, PWN 1965.
3. Opracowania własne zespołu autora kursu z zakresu wybranych materiałów zaawansowanych.

SECONDARY LITERATURE

Author's own publications (for each topic).

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_IMK_W03	C1	lec1-7	N1,N2,N4
PEK_U01-PEK_U03, PEK_K01-PEK_K03	K2MBM_IMK_U03, K2MBM_K01, K2MBM_K03	C2,C3,C4	cl1-7	N1,N2, N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe cząstkowe**
Name in English: **Partial Differential Equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041323**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the elements of calculus and linear algebra
2. Knowledge of the elements of ordinary differential equations
3. Ability to perform calculations and analysis of the results

SUBJECT OBJECTIVES

C1. Ability to solve the equations of physics
C2. Ability to analyze the course of the processes of physical
C3. he ability to search for information and its analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge about the different types of partial differential equations and methods of solving them
PEK_W02 - Knowledge of the physical issues described partial differential equations
PEK_W03 - Knowledge allows to analyze the results

II. Relating to skills:
PEK_U01 - Ability to formulate and describe the problem
PEK_U02 - Ability to analyze the equations obtained and the use of appropriate methods of solution.
PEK_U03 - Ability to analyze the results.

III. Relating to social competences:
PEK_K01 - Ability to work independently with the use of literature
PEK_K02 - Ability to work systematically and, in particular, the consulting.
PEK_K03 - Collective ability to solve problems in the classroom

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Linear partial differential equations of the first order and second	2
Lec2	Equation of strings	2
Lec3	Wave equations	3
Lec4	Laplace equation	4
Lec5	The equation of transverse vibration of beams	2
Lec6	Test	2
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Equation of strings	2
Cl2	Wave equations	3
Cl3	Laplace equation	4
Cl4	The equation of vibration of beams	4
Cl5	Solving these equations using the equations discussed during the course	2
		Total hours: 15

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials
N3. traditional lecture with the use of transparencies and slides

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U02+PEK_U03	test
P = ocena z kolokwium przeprowadzonego na wykładzie		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
W. Żakowski, W. Leksiński, Mathematic part IV

SECONDARY LITERATURE
N. Matwiejew, Methods integration of ordinary differential equations

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

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

PEK_W01+PEK_W2+PEK_W3	K2MBM_IMK_W01	C1+C2+C3	Lec1-Lec6	N3
PEK_K01+PEK_K2+PEK_K3+PEK_U01+PEK_U2+PEK_U3	K2MBM_IMK_U02	C1+C2+C3	Cl1-Cl5	N1 i N2

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **optional**
Subject code: **MMM041325**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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	Changes of the microstructure and mechanical properties as the function of time and kind of loading.	2
Lec8	The role of corrossion for degradation	2
Lec9	Methods of cracking mechanism in the assessment od degradation processes	2
Lec10	Economic and social aspects of machines and materials degradation	2
Lec11	Ecoloical and economic aspects of recycling.	2
Lec12	Boxes recycling.	2
Lec13	Electronic and electrical devices recycling.	2
Lec14	Cars recycling.	2
Lec15	Proecological design of constructions and technological processes.	2
		Total hours: 30

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 (light optical microscopu, SEM, TEM) in the degradation investigations - part 1	2
Lab5	Microscopic methods (light optical microscopu, SEM, TEM) in the degradation investigations - part 2	2
Lab6	Methods of corrosive investigations - the overview, application background.	2
Lab7	Macroscopis anfd strength corrosive investigations.	2
Lab8	Microscopic and gravimetric methods of corrosion rate asssessment	2
Lab9	The examples of expertises in the field of degratation research - part 1	2
Lab10	The examples of expertises in the field of degratation research - part 2	2
Lab11	Evidency and segregation of thrown goods. Separation of their elements.	2
Lab12	Polymers recycling.	2
Lab13	Recycling and re-usage of cellulise materials.	2
Lab14	Recycling methods of cars after usage.	2
Lab15	Test laboratory	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. 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_K01, PEK_K02	Introduction test, report from laboratory classes

P = P

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Ashby.M, Shercliff.H, Cebon.D, Inżynieria materiałowa (t.1,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- Przywecki, 2003

SECONDARY LITERATURE

[1]Aschby.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 - W01- PEK -W-03	K2MBM_IMK_W04, K2MBM_IMK_W06, K2MBM_IMK_W07	C1,C2, C3,C4,C5	Lecture1- Lecture15	N1,N2,N4
PEK - U01- PEK U02	K2MBM_IMK_U01, K2MBM_IMK_U05, K2MBM_IMK_U06	C1-C5	Laboratory1- Laboratory15	N3,N5
PEK -K01- PEk- K02	K2MBM_K01, K2MBM_K03, K2MBM_K09	C1-C5	Laboratory1- Laboratory15	N3,N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy teorii sprężystości i plastyczności**
Name in English: **Elements of Theory Elasticity and Plasticity**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041326**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the elements of calculus and linear algebra.
2. Knowledge of the elements of strength of materials, in particular knowledge of the state of stress and strain state
3. Ability to perform calculations and analysis of the results obtained in the strength of materials.

SUBJECT OBJECTIVES

C1. Kknowledge of the theory of elasticity and acquisition, in this respect, problem-solving skills to complex stress states.
C2. Knowledge of the theory of plasticity and acquisition, in this respect, problem-solving skills to complex stress states.
C3. Acquiring the ability to formulate equations describing the state of the mechanical components.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Ordered knowledge of the theory of elasticity, particularly in the area of plane stress.
PEK_W02 - Ordered knowledge of the theory of plasticity, particularly in the area of plane stress.
PEK_W03 - Ordered knowledge of the constitutive equations used to describe the materials.

II. Relating to skills:
PEK_U01 - The ability to determine the stresses and strains in complex conditions in various designs.
PEK_U02 - The ability to formulate problems of mechanics of materials of construction.
PEK_U03 - Ability to analyze the results.

III. Relating to social competences:
PEK_K01 - Ability to work independently with the use of literature.
PEK_K02 - Ability to work systematically, in particular, participation in the consultation.
PEK_K03 - Collective ability to solve problems in the classroom.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Stress state	2
Lec2	Strain state	2
Lec3	Transformacja składowych stanu naprężenia i odkształcenia	2
Lec4	Equations of equilibrium and strain compatibility conditions.	2
Lec5	Plane stress and plane strain for elastic medium	2
Lec6	Airy stress function	2
Lec7	Elastic energy volumetric and non-volumetric.	2
Lec8	Strength hypothesis.	4
Lec9	Kinematic, isotropic and mixed hardening.	4
Lec10	Elasto-plastic torsion of prismatic bars	2
Lec11	Elasto-plastic bending of prismatic bars	2
Lec12	Viscoelastic and visciplastic models	4
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Determination of the stress tensor and the strain in the case of differently loaded components.	2
Cl2	Determinant of the principal stress and strain	2
Cl3	Analysis of various types of hardening. Determination of the relationship between stress and strain in the case of uniaxial compression and tension.	4
Cl4	Application of Airy function.	2
Cl5	Determination of the yield strength of the elastic area using the various strength hypotheses	2
Cl6	Application of fundamental equation of the theory of plasticity	2

Cl7	Elasto-plastic torsion of prismatic bars, determining the state of stress and strain	4
Cl8	Elasto-plastic bending of prismatic bars, determining the state of stress and strain.	4
Cl9	Elasto-plastic problems rotationally symmetric	2
Cl10	Bending and torsion of viscoelastic bar	4
Cl11	test	2
		Total hours: 30

TEACHING TOOLS USED

N1. calculation exercises
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01+PEK_W2+PEK_W3	test
P = Ocena z kolokwium na ćwiczeniach		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01+PEK_U2+PEK_U3	test
P = ocena z kolokwium		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Walczak, The strength of materials and the foundations of the theory of elasticity and plasticity.

SECONDARY LITERATURE
J. Skrzypek, Plasticity and creep.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Elements of Theory Elasticity and Plasticity
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Tea t nu
PEK_W01+PEK_W2+PEK_W3	K2MBM_IMK_W03	C1+C2+C3	Lec1-Lec12	N1
PEK_K01+PEK_K02+PEK_K03PEK_U01+PEK_U02+PEK_U03	K2MBM_IMK_U04, K2MBM_K06	C1+C2+C3	Cl1-Cl11	N1

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **optional**
Subject code: **MMM041327**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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 by 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.	2
Lec2	Transformations in steel occurring during heating.	3
Lec3	Transformations in steel occurring during cooling.	3

Lec4	Graphs of austenite transformation supercooled during isothermal and continuous cooling	2
Lec5	Transformations in steel during tempering	2
Lec6	Technology of ordinary heat treatment of steel	4
Lec7	Heat treatment of structural steels	2
Lec8	Heat treatment of special and tool steels	3
Lec9	Surface hardening of steel	1
Lec10	Theoretical foundations of thermo-chemical treatment of steels	3
Lec11	Theoretical foundations of steel thermoplastic processing	1
Lec12	Steel hardenability	1
Lec13	Heat treatment of non-ferrous alloys	3
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Selection of heat treatment parameters of steel based on the Fe-Fe3C grap	2
Lab2	The influence of heat treatment treatments on the microstructure and properties of steel	2
Lab3	Steel microstructure after hardening and tempering	2
Lab4	Hardening and tempering of steel in practice. Independent metallographic analysis	6
Lab5	Selection of material based on the hardenability of steel	2
Lab6	Microstructure of tool steels after heat treatment	2
Lab7	Heat treatment of special steels. Own metallographic analysis	4
Lab8	Steel microstructure after thermo-chemical treatment	2
Lab9	Heat treatment of welded joints	2
Lab10	Heat treatment of non-ferrous alloys	4
Lab11	Passing the laboratory	2
		Total hours: 30

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	Participate 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	K2MBM_IMK_W02, K2MBM_W05	C1, C2, C3	Lec1-Lec13	N1
PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	K2MBM_IMK_U02, K2MBM_K03, K2MBM_K04, K2MBM_K05	C1, C2, C3	Lab1-Lab10	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Tribologia**
Name in English: **Tribology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041329**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 He has ordered knowledge about the types of engineering materials - metal, ceramic, polymer and composite materials.2. It has a basic knowledge of the construction, operation and use of the main components and machine assemblies.3. It has a basic knowledge of physics, chemistry, statistics.
2. Skills: 1. It can analyze the macroscopic fractures, microstructure of materials, technological drawbacks of origin, is able to determine the characteristics of the microstructure of metallic materials.2. He can choose the material on a given machine element and can explore its basic properties.
3. Competencies: 1 Is aware of the importance and understanding of non-technical aspects and impacts of mechanical engineer.2. Is aware of the importance of behavior in a professional manner and have a sense of responsibility for their own work.

SUBJECT OBJECTIVES

C1. Familiar with the processes of friction, wear and lubrication of moving nodes and methods for machine control these processes in terms of minimizing their effects (special attention will be paid to the construction and technological methods of increasing the reliability and durability of sliding pairs, as well as the problem of lubrication and lubricant selection as an effective prevention of friction and wear).
C2. Understanding the impact of selected parameters of friction vector, ie, pressure, velocity slip material cooperating associations and grease on the tribological characteristics of sliding pairs. Get to know the influence of the structure of the material to abrasion and impact bushing stiffness for load distribution in the bearing friction.
C3. Show students that they can effectively counteract the negative effects of friction in the moving solid contact with real objects illustrate some of the issues discussed theoretically in the lecture.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the processes of friction, wear and lubrication of moving nodes machine.
PEK_W02 - Know the basic types of lubricants and their applications.
PEK_W03 - He knows the design and technological methods of increasing the reliability and durability of sliding pairs.

II. Relating to skills:
PEK_U01 - It can choose materials for sliding nodes and understand relationships and dependencies between the material used and its durability.
PEK_U02 - It can perform basic tests of materials used in the nodes of friction, interpret them and implement in the final node machines.
PEK_U03 - He can use the theoretical knowledge acquired friction and lubrication of the lecture and apply it in practice.

III. Relating to social competences:
PEK_K01 - It can search for information and critically analyze them.
PEK_K02 - Properly define and resolve dilemmas, adheres to the principle of professional ethics.
PEK_K03 - Able to work independently and as a team, and properly assess their own tasks and priorities of the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program and requirements. Brief history of tribology. Elastic contact of smooth bodies. The real contact of solids. The problem of the surface layer.	2
Lec2	Friction processes, their distribution and characteristics. Sliding and rolling friction. Theories of friction.	2
Lec3	Wear processes, their distribution and characteristics. Effect of pressure and sliding velocity on the friction and wear.	2
Lec4	Characteristics of materials (metal and others) on the sliding nodes and the rules for their selection. Simple and reversed pair of friction.	2

Lec5	Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2
Lec6	Grease as a construction material. Objectives lubrication. The way of obtaining o fluid friction. Distribution of lubricants. Lubricating oils and their properties.	2
Lec7	Greases, their distribution and characteristics.Their characteristics.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	1.Determining of properties of slide bearing materials.	2
Lab2	2.Determining of coefficient of static friction.	2
Lab3	3 Research of lubricity of greases using a four ball tester.	2
Lab4	4. Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	Analysis of the impact bushing stiffness for load distribution in the sliding bearing.	2
Lab6	Analysis of the impact on the structure of the material on abrasive wear (Tester T-07).	2
Lab7	Research of the frictions into screw gear.	2
Lab8	5. Study materials for the seizure.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Lawrowski Z.; Tribologia, Tarcie, zużywanie i smarowanie. W-a, PWN, 1993.2.Garkunov D. N.; Trybotechnika. Moskva, Mašinostroenie, 1999.3.Czarny R.; Smary plastyczne. Warszawa, WNT, 2004.4.Ćwiczenia laboratoryjne z podstaw konstrukcji maszyn. Praca zbiorowa pod red. F. Szymankiewicza, skrypt PWr., Wrocław , 1990.5. Embedded detailed instructions posted on the website: www.ikem.pwr.wroc.pl/pkmit

SECONDARY LITERATURE

1.Bartz W.; Schmierfette, Zusammensetzung, Eingeschaften, Prüfung und Anwen-dung. Renningen, Export Verlag, 2000.2.Lawrowski Z.; Technika smarowania. W-a, PWN, 1987.3.Płaza S.; Fizykochemia procesów tribologicznych, Łódź, Wyd. Uniwersytetu Łódzkiego, 1997.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_IMK_W02, K2MBM_IMK_W03, K2MBM_IMK_W04, K2MBM_W05	C1	Lec1, Lec2, Lec3	N1, N2, N5
PEK_W02	K2MBM_W06, K2MBM_W08	C1	Lec6, Lec7	N1, N2, N5
PEK_W03	K2MBM_IMK_W01, K2MBM_IMK_W07, K2MBM_W05	C1	Lec4, Lec5	N1, N2, N5
PEK_U01 - PEK_U03	K2MBM_IMK_U02, K2MBM_IMK_U04, K2MBM_IMK_U06	C2, C3	Lab1 - Lab8	N3, N4, N5
PEK_K01	K2MBM_K01	C1, C2	Lec1-Lec7	N1-N5
PEK_K02- PEK_K03	K2MBM_K01, K2MBM_K03, K2MBM_K09	C3	Lec4-Lec7, Lab1-Lab7	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Materials Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041330**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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	3
Proj2	Analysis of opportunities and the methods of task execution. Introduction and discussion about the final project strategy	6
Proj3	Conceptual design of experiment, selection of experimental methods and process parameters	9
Proj4	Literature review. Preparation of samples and test stand for examinations	6
Proj5	Execution of basic metallographic examinations as well as additional necessary studies	9
Proj6	Formulation of project documentation. Presentation and defence of pre-final project	12
		Total hours: 45

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

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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, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041351, MMM041352.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes					

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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Matematyka stosowana - metody badań operacyjnych w inżynierii pojazdów**
Name in English: **Applied Mathematics - Operational Methods in Automotive Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041401**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Students should obtain basic knowledge from the linear programming and the queuing theory, taking into account the aspects of their application
C2. Participants learn to formulate optimization problems in the field of management and construction, technology and systems designing. They also acquire the ability to formulate optimization problems from queuing theory.
C3. Participants obtain and consolidate social skills including emotional intelligence involving the ability to work in a group of students to solve problems effectively with regard to accountability, integrity and fairness in the proceedings

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course students are able to formulate and solve the problems in the field of linear programming and decision support. They can define queuing systems, know and apply algorithms to solve them. Participants of the course can also interpret the results of optimization as well as to analyze them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Operations research as a tool to support decision-making processes - classification decision-making processes. Methods of decision making under conditions of certainty. Linear programming (PL) - linear model of decision-making, decisions acceptable and optimal.	2
Lec2	Methods for solving PL. Graphical method of PL problems solving. Linear programming models. Formulation and solution of problems PL - interpretation of the results.	2
Lec3	Linear programming models. Simplex algorithm.	2
Lec4	Practice of material discussed during the lecture 1-3. The interpretation of the results.	2
Lec5	Duality in linear programming. Matrix calculus in solving tasks of PL. The dual problem, its measurement and interpretation. Sensitivity analysis of the optimum solution. Changes in the parameters of the objective function and the free terms of constraints. Addition or removing decision variables. Comprehensive analysis of the optimal solution.	2
Lec6	Integer Linear Programming (discrete). The method of shutoff surfaces.	2
Lec7	Practice of material discussed during the lecture 5-6. The interpretation of the results.	2
Lec8	Classical transportation models and algorithms. Transportation model with the criterion of time. Transportation model (unbalanced, with limited bandwidth routes). The problem of localization of production.	2
Lec9	Introduction to graph theory. Project management (network programming). The maximum flow in a network. Ford-Fulkerson algorithm. Decision trees. Minimum spanning tree. The shortest routes in the graph.	2
Lec10	Network Models - deterministic (CPM, PERT) and stochastic (GERT). Time and cost analysis. Gantt charts. Resource optimization in network. Salesman Problem. Little's algorithm. The knapsack problem. The production and inventory models.	2
Lec11	Practice of material discussed during the lecture 8-10. The interpretation of the results.	2

Lec12	Markov process, transition probabilities, Chapman-Kolmogorov equation. Markov processes with countable state space and discrete time, transition probability matrix, random walk process. Markov processes with countable state space and continuous time, Kolmogorov equations for the one-dimensional probability dustribution and the probability transition, the process of birth and death.	2
Lec13	Application of the mass service theory in transportation problems: basic definitions, types and classification of queuing systems, random processes of applications and service, group and multiphase service, queuing networks.	2
Lec14	Practice of material discussed during the lecture 12-13. The interpretation of the results.	2
Lec15	Final exam.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Hamdy A. Taha: Operations research: an introduction. Prentice Hall 1997.
[2] Frederick S. Hillier, Gerald J. Lieberman: Introduction To Operations Research, 1995.
[3] Dennis Blumenfeld: Operations Research Calculations Handbook, Second Edition, CRC Press, 2009.
[4] Donald Gross: Fundamentals of Queueing Theory, Wiley, 2009

SECONDARY LITERATURE
[1] A. Ravi Ravindran: Operations Research Applications, CRC Press, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Applied Mathematics - Operational Methods in Automotive Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W01	C1-C3	Lec1 to Lec14	N1-N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Budowa pojazdów i układów napędowych**
Name in English: **Energy Efficiency Design of Powertrain and Body**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041402**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of fundamentals of machine design, mechanics, mathematics and physics on the level adequate for first years of studies at Mechanical Department.
2. Competence in joining phenomenon with mathematical description.

SUBJECT OBJECTIVES

C1. Study of fundamental systems, assemblies and sub-assemblies of automotive vehicles.
C2. Understanding of relationshps between phenomenon connected with vehicle movement and respective vehicle assemblies.
C3. Understanding of development tendencies relating to particular vehicle systems, assemblies and sub-assemblies.
C4. Effort to forecast of vehicle choosen assemblies development.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Have fundamental knowledge related to building means of transport particulary cars, trucs, busses and one-track vehicles.
PEK_W02 - Have knowledge about phenomenon existing in main automotive vehicle systems.

II. Relating to skills:
PEK_U01 - Capable of analyzing relationships between requirements for means of transport and their structure.

III. Relating to social competences:
PEK_K01 - Have consciousness of practical application of knowledge achieved during studies for designing and exploatation means of road transport.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Hundred years of motorization development.	2
Lec2	Transportation systems.	2
Lec3	Systems in cars and lorries.	2
Lec4	Vehicle centre of gravity. Forces acting on vehicle during parking and movement.	2
Lec5	Collaboration between wheel and foundation. Rolling resistance.	2
Lec6	Aerodynamic resistance.	2
Lec7	Power necessary for vehicle movement.	2
Lec8	Engine map and required power.	2
Lec9	Power transmission system.	2
Lec10	Construction and functioninig of seering system.	2
Lec11	Construction and functioning of break system.	2
Lec12	Tendencies in application of new materials in automotive vehicles.	2
Lec13	Comunicational systems used in vehicles and by vehicles.	2
Lec14	Vehicle as a robot.	2
Lec15	Examination.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Safety first.	2
Lab2	Motion resistances.	2
Lab3	Investigation of steering system.	2
Lab4	Investigation of suspension system.	2
Lab5	Investigation of break system.	2
Lab6	Static and dynamic wheels balancing.	2

Lab7	Investigation of body geometry.	2
Lab8	Investigation of automobile vehicle noise.	2
Lab9	Investigation of comfort and visibility.	2
Lab10	Investigation of aerodynamic.	2
Lab11	Simultational investigation of automotive vehicles systems.	4
Lab12	FEM strength analysis of automotive vehicles.	4
Lab13	Credit for laboratory.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Short written examination
F2	PEK_U01, PEK_K01	Report
F3	PEK_U01, PEK_K01	Activity during lessons.
P = 0,7F1 + 0,15F2 + 0,15F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Mitschke Manfred: Dynamika Samochodu, WKŁ9 (in polish), also available in german Dynamik der Kraftferzeuge, Springer Verlag.

2.Kazimierz Studziński: Budowa Samochodu, WKŁ (in polish)

3. Victor Albert Walter Hillier.: Fundamentals of Motor Vehicle Technology. Nelson Thornes, 2001

4.R.K.Rajput, Text Book of Automobile Engineering, Laxmi Publications Ltd, 2007

5.Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals, SAE international, 2004

SECONDARY LITERATURE

1. William H. Crouse, Automotive Machanics, McGraw-Hill

2. Malcolm James Nunney.: Light and Heavy Vehicle Technology. Butterworth-Heinemann, 2007

3. Allan Bonnick.: Automotive Science and Mathematics. Elsevier, 2008

4. George Appel, International Correspondence Schools.: Automobile Manual Transmission Systems. International Correspondence Schools, 1970

5. Lambert M. Surhone,Miriam T. Timpledon,Susan F. Marseken.: Transmission: Transmission Mechanics, Speed, Torque, Gear Ratio, Fuel. Betascript Publishers, 2009

6.Ulrich W. Seffert, Hans Hermann Braess,Handbook of Automotive Engineering

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Energy Efficiency Design of Powertrain and Body
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W09, K2MBM_AE_W12	C1 - C3	Le 1 - Le 11	N1,N2
PEK_W02	K2MBM_AE_W09, K2MBM_AE_W12	C1-C3	Le 1 - Le 14	N1,N2
PEK_U01	K2MBM_AE_U06	C1-C3	Lab 1 - Lab 13	N3,N4,N5
PEK_K01	K2MBM_AE_K07	C1-C4	Lab 1 - lab 13	N1-N5

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie maszyn i urządzeń**
Name in English: **Machine and Device Control Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041403**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge about basic hydraulic components.
2. Basic knowledge about fluid power control systems.
3. Basic knowledge regarding pneumatic control systems.

SUBJECT OBJECTIVES

C1. Acquire knowledge about hydraulic and electrohydraulic control systems.
C2. Acquire knowledge about proportional valves and servovalves.
C3. Acquire knowledge about pneumatic control systems
C4. Acquire knowledge about design of control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know basic hydraulic and electrohydraulic control systems.
PEK_W02 - Know the design principles of proportional valves and servovalves.
PEK_W03 - Know basic kind of pneumatic systems.

II. Relating to skills:
PEK_U01 - Able to solve the problems connecting with hydraulic and electrohydraulic control.
PEK_U02 - Able to solve questions connected with application of proportional valves and servovalves.
PEK_U03 - Able to solve basic questions connected with pneumatic control systems.

III. Relating to social competences:
PEK_K01 - Effective search of informations and it critical evaluation.
PEK_K02 - Capability to work in a team with clear distribution of obligations and effectvie solving of entrusted tasks.
PEK_K03 - Capability of proper argumentation and substantiation of own point of view.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction and definition of machine control system.	3
Lec2	Structure of hydraulic control systems.	3
Lec3	Proportional valves and servo valves, examples of application.	2
Lec4	Open and close loop control systems	2
Lec5	Electrohydraulic control systems, controllers.	2
Lec6	Examples of industrial applications of electrohydraulic control systems.	3
Lec7	Pneumatic control systems.	3
Lec8	Setup for the measurement of rpm of the crankshaft	2
Lec9	Setup for measurement of the teeth numbers in a gearbox.	2
Lec10	System for the detection of instability.	2
Lec11	System for measurement of the temperature in the sliding bearings.	2
Lec12	System for the measurement of the pressure in tires.	2
Lec13	test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Hydraulic rewerse systems.	2
Lab2	Hydraulic rapid motion systems.	2
Lab3	Hydraulic systems - in parallel and in line throttling control.	2
Lab4	Control systems in vehicle with pneumatic drive - Pneumobil.	2
Lab5	Volumetric control systems.	2
Lab6	Control system with proportional directional control valve.	2

Lab7	Load sensing control.	2
Lab8	Final laboratory - credit and mark.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	short test at the beginning of the class - quiz
F2	PEK_U01 - PEK_U03 PEK_K01--PEK_K03	oral answers
F3	PEK_U01 - PEK_U03 PEK_K01--PEK_K03	report from laboratory
P = 0,2F1+0,4F2+0,4F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J. Stecki, A. Garbacik: Design and Steady-state Analysis of Hydraulic Control Systems, Fluid Power Net Publications, Cracow 2002
2. J. Ivantysyn, M. Ivantsynowa: Hydrostatic Pumps and Motors, Tech Books International, 2003 - 512
3. S. Stryczek: Napędy i Sterowania Hydrauliczne, PWN Warszawa
4. W. Kollek: Podstawy projektowania napędów i sterowań hydraulicznych , P. Wr., 2004

SECONDARY LITERATURE

1. Fluid Power Focused on Applications, Conference Procedings, Aachen, 2002, 2006

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MBM_AE_W11, K2MBM_W01, K2MBM_W02, K2MBM_W04	C1-C4	Lec1 - Lec12	N1.- N5.
PEK_U01, PEK_U02, PEK_U03	K2MBM_AE_U03, K2MBM_AE_U07, K2MBM_AE_U09, K2MBM_AE_U11	C1-C4	Lab1 - Lab8,	N2.- N5.
PEK_K01, PEK_K02, PEK_K03	K2MBM_AE_K02, K2MBM_AE_K07, K2MBM_AE_K08	C1-C4	Lab4	N2- N5.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania maszyn**
Name in English: **Machinery Design Process**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041404**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to the mechanics and strength of materials.
2. Knowledge of issues related to manufacturability of a design and manufacturing technologies.

SUBJECT OBJECTIVES

C1. Acquiring of knowledge about the basics of designing of vehicle's components.
C2. Acquiring of ability to select computational models for the main components used in vehicles.
C3. Acquiring of basic skills of designing subassemblies used in vehicles and analysing of selected solutions.
C4. Acquiring of ability to organize work in a team and to fulfil own specified tasks.

SUBJECT EDUCATIONAL EFFECTS

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

II. Relating to skills:
PEK_U01 - Management of team work as well as fulfil the assigned tasks inside the group.
PEK_U02 - Able to find information in the available literature on the techniques and methods of searching solutions in the designing process.
PEK_U03 - Formulation of guidelines for the designing process based on specific requirements and limitations.

III. Relating to social competences:
PEK_K01 - Thinjing creatively.
PEK_K02 - Making report of a carried out engineering work.
PEK_K03 - Determination of the consequences of decisions made in a team.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Formulation of designing models in the field of vehicles' construction.	4
Lec2	Methods of specifying a goal of designing of elements and assemblies of vehicles.	6
Lec3	Heuristic and algorithmic methods in vehicle's designing - theory and practice.	6
Lec4	Generation of initial solutions.	2
Lec5	Formulation of multi-criteria system for the evaluation of generated solutions. Determination of significance of the proposed criteria.	4
Lec6	Evaluation of generated project solutions.	4
Lec7	Remodelling of an own algorithm of designing of vehicle's components.	2
Lec8	Methods of popularising solutions.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	The scope of the project, rules of assessment, literature. Construction of object models (e.g. structures of: brakes, recuperation systems, steering mechanisms, etc.). Selection of the designing object.	2
Proj2	A practical usage of heuristic and algorithmic methods (morphological table, tree of solutions for own project).	2
Proj3	Synthesis of own evaluation criteria - example and practice. Classifying significance of criteria.	2
Proj4	Creating and managing initial solutions. Preliminary assessment of designing solutions.	2
Proj5	More detailed characterization of the selected pre-designed device.	2

Proj6	Preparation of technical documentation.	4
Proj7	Remodelling of an own algorithm of designing.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Participation in problem discussions.
F2	PEK_W01 - PEK_W03	Final test.
P = 0,2 F1 + 0,8 F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	Evaluation of the project preparation.
F2	PEK_U02, PEK_U03, PEK_K02, PEK_K03	Presentation of the project.
P = 0,5 F1 + 0,5 F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Avallone E. A., Baumeister III T., Sadegh A. M. Marks' Standard Handbook for Mechanical Engineers, The McGraw-Hill Companies, 2007.
[2] Norton R. L.: Machine Design: An Integrated Approach, 3/E, Prentice Hall, 2006.
[3] Pahl G., Beitz W. et al. Engineering Design. A Systematic Approach, Springer, 2007.
[4] Ullman D. G. The mechanical design process. McGraw-Hill, 2003.

SECONDARY LITERATURE
[1] Parmley R. O. Illustrated Sourcebook of Mechanical Components, The McGraw-Hill Companies, 2000.
[2] Shigley J. E., Mischke C. R., Brown Jr. T. H. Standard Handbook of Machine Design, The McGraw-Hill Companies, 2004.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W09, K2MBM_W06	C1, C3	Lec1 to Lec8	N1, N2
PEK_W02	K2MBM_AE_W09, K2MBM_W06	C1, C2, C3	Lec1 to Lec8	N1, N2
PEK_W03	K2MBM_AE_W09, K2MBM_W06	C3	Lec6	N1, N2
PEK_U01	K2MBM_AE_U19, K2MBM_AE_U21, K2MBM_U14	C3, C4	Proj1 to Proj6	N3
PEK_U02	K2MBM_AE_U01, K2MBM_AE_U02	C2, C3	Proj1; Proj2	N3
PEK_U03	K2MBM_AE_U15, K2MBM_U07	C2, C3	Proj1	N1, N2, N3
PEK_K01	K2MBM_AE_K01, K2MBM_AE_K11	C1, C3	Proj1 to Proj5; Proj7	N3
PEK_K02	K2MBM_AE_K03	C3	Proj6	N3, N4
PEK_K03	K2MBM_AE_K04, K2MBM_AE_K05	C4	Proj1 - Proj5	N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie układów wieloczłonowych**
Name in English: **Modelling of multibody systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041405**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the theory of machines and mechanisms
2. Ability to analyze the kinematics and kinetostatics of mechanisms

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

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

III. Relating to social competences:
PEK_K01 - Knowledge of how to take responsibility for own work
PEK_K02 - Acquires care about the aesthetics of the work, including projects and reports

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of building a multibody models	2
Proj2	Basics of modeling mechanisms in the MD.Adams system - modeling links, kinematic pairs, kinematic excitations	3
Proj3	Basics of modeling mechanisms in the MD.Adams system - modeling loads and perform calculations and analysis of results	3
Proj4	The test of modeling multibody system	2
Proj5	Kinematic and kinetostatic analysis of linkage mechanisms - building virtual models	2
Proj6	The analysis of kinematic and dynamic properties of the linkage mechanism (project)	2
Proj7	Analysis of gears (normal, planetary and differential) - principles of construction of virtual model	2
Proj8	The analysis of kinematic and dynamic properties of the gears (project)	3
Proj9	Building models of manipulators - direct and inverse task of kinematics	3
Proj10	Simulation researches of manipulators (project)	3
Proj11	Building models of spatial mechanisms - constraints, excitations	2
Proj12	Modeling and simulations of spatial mechanisms (project)	3
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K02	Evaluation of test
F2	PEK_U01-PEK_U03 PEK_K01-PEK_K02	The average of projects evaluation
P = 0,2*F1+0,8*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003.
2. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007.
3. MD. Adams – Reference Manual, 2008.
4. Haug E.J.: Computer Aided Kinematics and Dynamics of Mechanical Systems. Allyn and Bacon, Boston 19895.
5. Norton R., L.: Design of Machinery, An introduction to the synthesis and analysis of mechanisms of machines. WCB, McGraw-Hill, Boston, 1999.
6. Shabana A. Ahmed: Computational Dynamics, . A Wiley-Interscience Publications, NewYork, 1994.

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K2MBM_AE_U13	C1-C3	Proj1 to Proj12	N1-N4
PEK_K01-PEK_K02	K2MBM_AE_K03, K2MBM_AE_K05	C1-C3	Proj1 to Proj12	N1-N4

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania elementów i zespołów maszyn**
Name in English: **Testing of Vehicle Elements and Assemblies**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041406**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the construction and principles of operation of assemblies and systems of motor vehicles, as well as specialized terminology (in English).
2. Ability to interpret the observed physical phenomena.
3. Knowledge of the techniques of development and presenting the experiment measurements results.

SUBJECT OBJECTIVES

C1. Understanding of the fundamental theories, equipment and methods of analysis of the results of measurements of selected parameters characterizing the properties and/or the performance of elements and assemblies of motor vehicles using modern experimental methods.
C2. Mastering of the practical application of the selected measurement method (selection of the measuring system scheme, the identification of the factors influencing the accuracy of the measurement, interpretation of the data).
C3. Improving the ability to team work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Ability to practical application of the representative (for selected methods of measuring mechanical quatities) measurement techniques in the area: construction of the measuring system and data acquisition.
PEK_U02 - Performing a quantitative analysis based on measurements recorded data, including those obtained by optical methods.
PEK_U03 - Formulation of conclusions based on relationships between measured parameters and functioning of the elements and assemblies of the motor vehicles.

III. Relating to social competences:

PEK_K01 - Recognizes the importance of the experimental methods application in the design and operation of vehicles.
PEK_K02 - Demonstrates the ability of self-education (preparation for laboratory classes) and presentation of their work in a foreign language.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Application of the acoustic holography in vehicle assembly testing.	2
Lab2	Determination of the temperature field parameters using thermovision.	2
Lab3	Application of the holographic interferometryfor pneumatic valve cover displacement determination or for detection of the vehicle tire defects.	2
Lab4	The sandwich construction displacement measurement using the speckle photography method.	2
Lab5	Application of the ESPI method for chassis frame's element displacement determination.	2
Lab6	Photoelastic investigation of the towing hitch model.	2
Lab7	Application of the photoelastic coating technique for suspension element testing.	2
Lab8	Application of the videoextensometer for large strains determination in rubber or rubber-metal elements of motor vehicles	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K02	entry test; F1= (W1+...+W8)/8
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01	report on the experiment; every report has to good rating (min. 3.0); F2=(S1+...+S8)/8
P = 1/4*F1+3/4*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] instructions for the laboratory classes, [2] Cloud G. L., Optical methods of engineering analysis, Cambridge University Press, 1998.[3] Sharpe, Jr., Wiliam N. (ed.), Springer Handbook of Experimental Solid Mechanics, 2008.[4] Harwood N., Cummings W. M., Mackenzie A. K.: Thermoelastic Stress Analysis, IOP Publ. Ltd., London, 1991.

SECONDARY LITERATURE

[1] Dally J.W., Riley W.F., Experimental Stress Analysis (3rd ed.), McGraw-Hill, Inc., 1991.[2]] Kobayashi Alberts (ed.), Handbook on Experimental Mechanics, Englewood Cliffs, NJ, Prentice-Hall, Inc., 1987. [3] Falzon B.G., Aliabadi M.H., Buckling and Postbuckling Structures, Imperial College Press, 2008.[4] Laermann K-H., Optical Methods in Experimental Solid Mechanics, Springer, 2000.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2MBM_AE_U04, K2MBM_AE_U05	C1, C2	Lab1 to Lab8	N1-N3
PEK_K01, PEK_K02	K2MBM_AE_K10, K2MBM_AE_K11	C3	Lab1 to Lab8	N1, N3

SUBJECT SUPERVISOR

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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): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041407**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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. he acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and socjety

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT	
Form of classes – Lecture	Number of hours

Lec1	Curriculum. Requirements. Examples of dynamic systems. Constrains and their types, classification systems for the sake of the constrain types (holonomic systems), possible velocities and possible displacements.	2
Lec2	The fundamental problem of dynamics, virtual displacement, the notion of ideal constraints, the general equation of dynamics, the virtual work principle.	2
Lec3	The dynamic general equation for the rotational and planar motion of rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples).	2
Lec5	Generalized forces. Configuration space. Lagrange’s equations (of II type).	2
Lec6	Lagrange’s equations (cont. examples, applications). Lagrangian.	2
Lec7	Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	2
Lec8	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes.	2
Lec9	Harmonically forced vibration, frequency characteristics, an example of oscillation analysis of two- degree- of- freedom system.	2
Lec10	The dynamics of a rigid body in general motion: the orientation, the recognition issue. Kinematics and dynamics of rigid body in case the spherical rotation about a fixed point (reminder of the course Mechanics II), the angular momentum in the general movement.	2
Lec11	The dynamic equations for general motion of rigid body (Euler's equation).	2
Lec12	Gyroscope (approximate theory).	2
Lec13	An outline of linear elastic particle collisions theory, inelastic collision rate.	2
Lec14	Variational approach of Lagrangian mechanics.	2
Lec15	The central Lagrange’s equation. Fundamental integral mechanical principle (Hamilton’s principle)	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements.	2
Cl2	Solving of static problems by using a principle of virtual work	2
Cl3	Solving of dynamic problems by using a dynamic general equation (d'Alembert’ s principle).	2
Cl4	Derivation of motion differential equations based on the energy conservation law and Lagrange’s equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl5	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl6	Solving some kinematic and dynamic problems in case of the spherical rotation about a fixed point of a rigid body.	2
Cl7	Final test	2
Cl8	Credits. Improvement of marks	1
		Total hours: 15

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

M. Lunn, A First Course in Mechanics, Oxford Science Publications, 1991

SECONDARY LITERATURE

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_W03	K2MBM_AE_W03	C1,C2,C4	Lec1-Lec15	N1,N3,N4
PEK_U01-PEK_U03	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U03	C3	Cl1-Cl8	N2,N3,N4
PEK_K01-PEK_K03	K2MBM_AE_K01, K2MBM_AE_K07	C4	Cl-Cl8	N2,N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie materiałów inżynierskich**
Name in English: **Design of Engineering Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041408**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Possessing advanced knowledge on structure- properties relationship as well as on strengthening mechanisms in materials and their practical usage for material design of products.
PEK_W02 - Knowing the fundamentals and design philosophy of modern engineering materials.
PEK_W03 - Knowing the criteria and methodology of materials selection and can participate in engineering design of products.

II. Relating to skills:
PEK_U01 - Able to design the materials structure in order to obtain the desired operational properties of product.
PEK_U02 - Able to select a material for a specific product with consideration of economical and ecological aspects.
PEK_U03 - Able to conduct the failure analysis of material and design the repair process for improvement of product durability.

III. Relating to social competences:
PEK_K01 - Possessing the collaboration skills and able to lead the research teams in engineering design process.
PEK_K02 - Conducting the research activity on materials design of products.
PEK_K03 - Possessing the skills of objective evaluation of arguments and formulation of rational conclusions concerning the use of engineering materials for different products and operational conditions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to design of engineering materials. Effect of chemical composition, processing and microstructure on properties of materials.	2
Lec2	The role and signifcance of alloy phase diagrams in design of materials.	2
Lec3	The design philosophy of modern steels for automotive industry.	3
Lec4	Strengthening mechanisms in metals and alloys - part I.	2
Lec5	Strengthening mechanisms in metals and alloys - part II.	2
Lec6	Metal matrix composites - fundamentals in design.	2
Lec7	Criteria and quantitative methods of materials selection in engineering design.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Selection of material for chosen structural component - project, part I.	2
Proj2	Design of chemical composition of steel with desired hardenability.	2
Proj3	Design of microstructure of steel in the process of heat treatment - part I.	2
Proj4	Design of microstructure of steel in the process of heat treatment - part II.	2
Proj5	Individual materials expertise combined with selection of material - part I.	2
Proj6	Individual materials expertise combined with selection of material - part II.	3
Proj7	Selection of material for chosen structural component - project, part II.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. case study
N5. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03	short quiz, oral answers, report, discussions
F2	PEK_U01÷PEK_U03;PEK_K01-PEK_K03	defence of the project
P = 0,3F1+0,7F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.J.P. Schaffer, A. Saxena, S.D. Antolovich, T.H. Sanders, S.B. Warner: The science and design of engineering materials, WCB/McGraw-Hill, 1999; 2.M.F. Ashby: Materials Selection in Engineering Design, Pergamon Press, Oxford 1998; 3.Thomas H. Courtney: Mechanical Behaviour of Materials, 2th ed., McGraw-Hill, 2000;4.Ch. R. Brooks, A. Choudhury: Failure Analysis of Engineering Materials, McGraw-Hill, 2002.

SECONDARY LITERATURE
1.D. Henkel, A. W. Pense: Structure and properties of engineering materials, McGraw-Hill, 2002.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W04, K2MBM_AE_W06	C1	Lec1 to Lec5	N1, N2, N3
PEK_W02	K2MBM_AE_W04, K2MBM_AE_W06	C1	Lec1 to Lec3, Lec6	N1, N2, N3
PEK_W03	K2MBM_W05	C2	Lec7	N1, N3
PEK_U01	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U23	C1	Proj2 to Proj4	N2, N3
PEK_U02	K2MBM_AE_U01, K2MBM_AE_U19, K2MBM_AE_U23, K2MBM_U07	C2	Proj1; Proj7	N3
PEK_U03	K2MBM_AE_U04, K2MBM_AE_U06, K2MBM_AE_U21	C3	Proj5 to Proj6	N4
PEK_K01	K2MBM_AE_K01, K2MBM_AE_K04, K2MBM_AE_K05, K2MBM_AE_K06, K2MBM_AE_K08	C2, C3	Proj1 to Proj7	N2, N4, N5
PEK_K02	K2MBM_AE_K07, K2MBM_AE_K10, K2MBM_AE_K11	C1	Proj2 to Proj6	N2, N4, N5
PEK_K03	K2MBM_AE_K02, K2MBM_AE_K03, K2MBM_AE_K07, K2MBM_AE_U04	C2, C3	Proj1, Proj5 to Proj6, Proj7	N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**
Name in English: **Strength of Materials**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041409**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge, skills and competences resulting from the implementation of courses Technical Mechanics, Calculus I, Algebra and Analytic Geometry, Physics. The student mastered the course material provided Strength of Materials I and II, including: know how to fix it alone statically determinate systems for simple load cases (tension, bending, torsion) and selected complex cases (stretching and bending, bending and torsion).
2. The student is able to determine the reactions of the statically determinate beams and frames. He has mastered the knowledge of selected cases of indeterminate systems (thermal stress and the tension mounting, the reactions in indeterminate beams using differential equation of deflected axis, the reaction in the indeterminate twisted rod). Knows the basic of strength theories and
complex stress state.
3. The student mastered the basics of fatigue strength. Student is able to perform basic strength tests (tension, compression, torsion, fatigue).

SUBJECT OBJECTIVES

C1. Acquisition of knowledge on selected topics of strength of materials useful in the education of Automotive Engineering.
C2. Knowledge acquisition of the calculations of indeterminate systems using energy methods.
C3. Acquisition of knowledge in the basics of physical and experimental tests used to determine the properties of materials for the automotive and airplanes constructions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowing how to solve indeterminate systems using energy methods
PEK_W02 - Knowing selected modern methods of experimental determination of mechanical properties of materials for construction of land and air vehicles,
PEK_W03 - Knowledge of the foundations and applications of selected computational and experimental methods of strength of materials

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Isostatic and hyperstatic cases in mechanical systems. Externally and internally hyperstatic cases. Menabrea-Castigliano's theorem.	3
Lec2	Maxwella-Mohr theorem including Vereshchagin rule applied to hyperstatic issues	3
Lec3	Force method applied to hyperstatic issues	4
Lec4	Testing methods of high pressure composite vessels for gaseous fuels	2
Lec5	The basics of monitoring methods of mechanical structures in the manufacturing and operation process with the use of fiber optic systems	2
Lec6	The use of thermovision system in the study of mechanical engineering components: metallic and composite (polymeric)	2
Lec7	Application of cross effects during strength tests	3
Lec8	Methods for energy recovering from the vehicle using the materials in which there are cross effects (Energy Harvesting)	3
Lec9	Energy hypotheses of fatigue process. Methodology for determining the strain energy under cyclic loading. Cumulation of energy	2
Lec10	Cold martensitic transformation for a shape memory metals. Application possibilities in the study of strength of materials	2
Lec11	Physical properties of materials for semiactive damping	2

Lec12	Methods of testing of composite materials (longfibers) using specific samples (pipe, ring and a NOL type)	2
		Total hours: 30

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Dyląg Z., Jakubowicz A., Orłoś A., Strength of Materials. Part I and II. WNT.Warszawa 1996,in Polish.
2. Niezgodziński M.E., Niezgodziński T., Strength of Materials. PWN. Warszawa 2009,in Polish.
3. Timoshenko S., Strength of Materials,Part 1 and Part 2. D. van Nostrand Company (wyd. arch.).
4. Da Silva, V.D., Mechanics and Strength of Materials, Springer. 2005.

SECONDARY LITERATURE

1. Jastrzębski P., Mutermilch J., Orłowski W., Strength of Materials, Part 1 and 2,Arkady 1986, in Polish.
2. Surya Patnaik & Dale Hopkins, Strength of Materials, Elsevier. Amsterdam 2012.

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

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

PEK_W01, PEK_W02, PEK_W03	K2MBM_AE_W08	C1,C2,C3	Lec1 to Lec12	N1, N2, N3

SUBJECT SUPERVISOR
Prof. dr hab. inż. Jerzy Kaleta tel.: 27-66 email: jerzy.kaleta@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria powierzchni**
Name in English: **Surface engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041410**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physico-chemical and mechanical properties of materials engineering; basic understanding of heat and thermo-chemical treatment, able to analyze images of macro and microstructure of engineering materials.
2. Knowledge about the types of engineering materials - their structure, properties, applications and selection.
3. Structured knowledge about manufacturing techniques.

SUBJECT OBJECTIVES

C1. Understanding the possibilities of shaping and charaterize certain physical features of the surface layer, which are important for its future exploitational characteristics.
C2. Understanding the basic techniques of: analysis of the surface layer, profilographometry and locate and analyze of surface defects.
C3. Gaining knowledge on techniques to modify the properties of the surface layer of engineering materials. In this surface machining and coating.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to explain, including the physico-chemical properties of metallic materials, composites and plastics, rules of the selection of materials for the operating conditions.
PEK_W02 - Definition and formulation of the surface properties of components used in automotive engineering.
PEK_W03 - Appropriate linguistic resources for specialist meaning in the field of surface engineering to communicate effectively in a professional environment.

II. Relating to skills:
PEK_U01 - Gaining the skills to conduct research in industrial practice using profilographometry and microscopic techniques.
PEK_U02 - Able to measure and analyze the reasons for cutting tool wear.
PEK_U03 - Able to select engineering materials to the operating conditions.

III. Relating to social competences:
PEK_K01 - Objective evaluation of arguments to justify and the rational explanation his own point of view, using knowledge of surface engineering.
PEK_K02 - Awarness of professional conduct on the test stand and know the main principles of safe operation of measuring devices.
PEK_K03 - Understanding the need of life long learning by knowledge updating, training and enhance skills in the field of surface engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristic properties of the surface layer (SL) of an object.	2
Lec2	The methods and measurement for 2D and 3D roughness testing.	2
Lec3	Functional features of machine and devices, technological and exploitational, surface layers.	2
Lec4	Physico-chemical properties of the surface layer of engineering materials.	2
Lec5	Methods for modifying the physical and geometrical characteristics of surface layer.	2
Lec6	Possibilities of creating surfaces with specific properties applying different methods of shaping and forming.	2
Lec7	Surface coating methods.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Flat (2D) and spatial (3D) measurements and analysis of surface micro-geometry.	2
Lab2	Measurement of the mechanical and physico-chemical properties of the selected materials.	2
Lab3	Surface measuremnt using a computerized video analysis.	2
Lab4	Superfinish surface machining.	2
Lab5	Modifying of surface layer by roller burnishing.	2

Lab6	Measurement of shape and position deviations of machine components.	2
Lab7	Surface layer analysis after WEDM.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_WO2; PEK_W03	Final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01; PEK_UO2; PEK_U03PEK_K01; PEK_K02; PEK_K03	quiz
F2	PEK_U01; PEK_UO2; PEK_U03PEK_K01; PEK_K02; PEK_K03	participate in discussions problem
F3	PEK_U01; PEK_UO2; PEK_U03PEK_K01; PEK_K02; PEK_K03	laboratory report
P = 0,3F1+0,3F2+0,4F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. R.Chattopadhyay, 'Advanced Thermally Assisted Surface Engineering Processes' Kluwer Academic Publishers, MA, USA (now Springer, NY), 2004, ISBN 1-4020-7696-7, E-ISBN 1-4020-7764-5.
2. Sanjay Kumar Thakur and R. Gopal Krishnan, 'Advances in Applied Surface Engineering', Research Publishing Services, Singapore, 2011, ISBN 978-981-08-7922-8.

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2MBM_AE_W06, K2MBM_AE_W07	C1; C2; C3	Lec1 to Lec7	N1; N2; N3; N4
PEK_U01; PEK_U02; PEK_U03	K2MBM_AE_U05, K2MBM_AE_U12, K2MBM_AE_U19	C1; C2; C3	Lab1 to Lab7	N1; N2; N4
PEK_K01; PEK_K02; PEK_K03	K2MBM_AE_K02	C1; C2; C3	Lab1 to Lab7	N1; N2; N3; N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projekt CAD/FEM**
Name in English: **CAD/FEM Project (Metals)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041413**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				120	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				4	
including number of ECTS points for practical (P) classes				4	
including number of ECTS points for direct teacher-student contact (BK) classes				2.8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in field of designing with use of CAD and strength of materials
2. Ability to work independently with a computer
3. Knowledge of technical drawing

SUBJECT OBJECTIVES

C1. Knowledge ordering concerning the engineering and design of machines and strength calculations
C2. Application of Finite Element Analysis for the construction and operation of design of vehicles
C3. Proper definition of the boundary conditions coming from the operation of the design or tested object

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Be able to design a selected part of the vehicle structure using CAD
PEK_U02 - Be able to conduct simulation of the selected element of vehicle with use of FEM
PEK_U03 - Be able to analyze the results of the simulation and to optimize the part of the vehicle in accordance to the requirements

III. Relating to social competences:
PEK_K01 - Understands the need and has an ability of lifelong learning especially in the field of engineering computer tools
PEK_K02 - Recognizes the need to improve professional, personal and social skills
PEK_K03 - Has a sense of responsibility for the work performed by your own and acquire respect for work of another and for the team work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Basic definitions and Introduction into computer aided engineering CAE	3
Proj2	Principles of constructing the physical model, system idealization, simplification use in physical models	3
Proj3	The presentation of the calculating systems - selection of the element of vehicle for the project	6
Proj4	Principles and ways of designing in innovative designing – creative designing, spatial designing and assembly design	3
Proj5	Design of the selected element	6
Proj6	The building and creating the discrete models: - shell and beam models - spatial-volume models	6
Proj7	8.Defining the external loads and material review and its properties necessary for FEM simulations used in automotive industry	3
Proj8	Conduction of the calculations	3
Proj9	Interpretation and analysis of results	3
Proj10	Modernization of the model according to the guidelines (in accordance with the analysis of the results)	6
Proj11	Final editing and analysis of results, preparation of the report	3
		Total hours: 45

TEACHING TOOLS USED

N1. multimedia presentation N2. Calculation CAD/FEM system: CATIA, UGS - NX, ABAQUS N3. self study - preparation for project class N4. project presentation N5. report preparation

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusiński E.: Principles of supporting structures designing of automotive vehicle. Wroclaw University of Technology publishing house 2002.

SECONDARY LITERATURE

Zienkiewicz O.C.: Finite Element Method. ARKADY, Warszawa 1972.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
CAD/FEM Project (Metals)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_AE_U01, K2MBM_AE_U13	C2, C3	Proj1 to Proj11	N2, N3, N4
PEK_U02	K2MBM_AE_U04, K2MBM_AE_U13	C1, C2, C3	Proj2; Proj6; Proj7; Proj8	N2, N4
PEK_U03	K2MBM_AE_U03, K2MBM_AE_U13	C1, C2	Proj8; Proj9; Proj10; Proj11	N2, N4, N5

PEK_K01-PEK_K03	K2MBM_AE_K04, K2MBM_AE_K05, K2MBM_AE_K11	C1, C2	Proj1 to Proj11	N1-N5

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa - projekt CAD/FEM**
Name in English: **Flows Modeling in Automotive Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041414**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				45	
Number of hours of total student workload (CNPS)				120	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				4	
including number of ECTS points for practical (P) classes				4	
including number of ECTS points for direct teacher-student contact (BK) classes				2.8	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics - the rules of behavior: mass, energy and momentum
2. Ability to work independently with a computer
3. Awareness of the need to the team work

SUBJECT OBJECTIVES

C1. Knowledge of the methodology for the fields calculation of: velocity, pressure and temperature based on the principles of conservation laws (mass, energy and momentum) using a finite volume methods for engineering problems.
C2. Knowing the loads acting on the vehicle resulting movement of the car in the air as a liquid (gas) medium and the thermal loads due to the presence of various heat sources .
C3. Ability to obtain input data (boundary and initial conditions) required to model loads acting on the vehicle or its components.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Able to simulate the selected flow for a motor vehicle or its components
PEK_U02 - Analysing the results of the simulation to determine the loads acting on the vehicle or its components
PEK_U03 - Based on analysis, able to design the elements of motor vehicles

III. Relating to social competences:
PEK_K01 - Understanding the need and ability of lifelong learning especially in the field of computer engineering tools
PEK_K02 - Recognizing the need to improve professional skills - personal and social
PEK_K03 - Responsibility for own work and the willingness to comply with the rules of team work and taking responsibility for collaborative tasks

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to computing system, user registration accounts, raising the issue of the project, the organization of the subgroups.	3
Proj2	Measurement, import or estimate the size of the input to the calculation model	3
Proj3	Construction geometry	3
Proj4	Meshing	6
Proj5	Defining a computational model in the system	3
Proj6	Definition of boundary and initial conditions for simulation	3
Proj7	Calculations carring out	3
Proj8	Postprocesing	3
Proj9	Analysis of the results	3
Proj10	Modernization of the modeled object - changes in geometry	3
Proj11	Modernization of the modeled object - computing space discretization	6
Proj12	Introduction boundary and initial conditions, perform calculations	3
Proj13	Editing and analysis of the results, editing the report	3
		Total hours: 45

TEACHING TOOLS USED

N1. multimedia presentation
N2. ANSYS-Fluent
N3. self study - preparation for project class
N4. report preparation

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Flow modeling in automotive inginering. Łódź : PRINTPAP, 2011.
Blair G.P., Design and Simulation of Four–Stroke Engines. SAE.

SECONDARY LITERATURE

Ramos J.I.: Internal Combustion Engine Modeling, Hemisphere 1989
Stiesch G.: Modeling Engine Spray and Combustion Processes, Springer, 2003
Oran E.S., Boris J.P.: Numerical simulation of reactive flow, Cambridge University Press, 2001
Fletcher C.A.J.: Computational techniques for fluid dynamics, Springer, Berlin, 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Flows Modeling in Automotive Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_AE_U08	C1, C3	Proj1 to - Proj13	N2, N3, N4
PEK_U02	K2MBM_AE_U04, K2MBM_AE_U08	C2	Proj9; Proj13	N2, N4
PEK_U03	K2MBM_AE_U08	C3	Proj2; Proj6	N2, N3
PEK_K01-PEK_K03	K2MBM_AE_K04, K2MBM_AE_K11	C1, C3	Proj1 to Proj13	N1, N2, N3, N4

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody badań nieniszczących we współczesnych systemach**
Name in English: **Non Destructive Evaluation in Contemporary Manufacturing Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041416**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic mechanical properties of engineering materials, about the types of metallic materials engineering - their construction, properties, applications and selection rules.
2. Abilities of reading and interpretation of drawings and diagrams used in the technical documentation, abilities to perform the technical documentation.

SUBJECT OBJECTIVES

C1. Getting knowledge of non-destructive testing methods used in modern technology.
C2. Getting knowledge about the various methods of NDT: visual, liquid penetrant, magnetic-particle, ultrasonic eddy current and radiographic examinations.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Explanation the advantages and limitations of selected methods of non-destructive testing,
PEK_W02 - Proposals of method of non-destructive testing for a structural component or in-use means of transport (eg. vehicles, cranes, container extraction, welded pressure vessels, etc.),
PEK_W03 - Abilities to identify and assess risks of detected discontinuities

II. Relating to skills:
PEK_U01 - Abilities of applying non-destructive testing methods for welds, castings and products in service,
PEK_U02 - Abilities to develop a protocol of non-destructive examinations.
PEK_U03 - Abilities to do selected methods of NTD and assess its results

III. Relating to social competences:
PEK_K01 - Explanation in a clearly way the results of research and assess them critically.
PEK_K02 - Objectively evaluation of arguments, rationally explaination and justify their own point of view using the knowledge of non-destructive testing.
PEK_K03 - Knowing the rules of team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Rules of assessment. Visual examination.	2
Lec2	Liquid penetrant testing.	2
Lec3	Magnetic powder testing	2
Lec4	X-ray , γ-ray testing	2
Lec5	Ultrasonic testing of welding joints - part I	2
Lec6	Ultrasonic examination - Part. II. Evaluation the size of flaws by ultrasound.	2
Lec7	Ultrasonic testing of spot welds by matrix array transducer. Test grade.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Wstęp. Zasady zaliczenia. Badania wizualne.	2
Lab2	Liquid penetrant testing.	2
Lab3	Magnetic powder testing	2
Lab4	X-ray , γ-ray testing	2
Lab5	Ultrasonic testing of welding joints. Evaluation the size of flaws by ultrasound.	4
Lab6	Ultrasonic testing of spot welds by matrix array transducer. Test grade.	2
		Total hours: 14

TEACHING TOOLS USED

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.NDT Handbook - The American Society for Nondestructive Testing, 2nd and 3rd Edition
2.Chuck H. - Handbook of Nondestructive Evaluation, 2003 by The McGraw-Hill Companies

SECONDARY LITERATURE
1. Peter J. Shull - Nondestructive Evaluation: Theory, Techniques, and Applications, Marcel Dekker, Inc.,New York 2002

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Non Destructive Evaluation in Contemporary Manufacturing Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_AE_W12	C1, C2	Lect1 to Lect7	N1
PEK_U01-PEK_U03	K2MBM_AE_U02, K2MBM_AE_U06	C1, C2	Lab1 to Lab6	N2, N3
PEK_K01-PEK_K03	K2MBM_AE_K03, K2MBM_AE_K06	C1, C2	Lab1 to Lab6	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma Seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041419**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should have defined subject of M.Sc. thesis and agreed supervisor.

SUBJECT OBJECTIVES

C1. Preparation for public defense of M.Sc. thesis.
C2. Preparation forpresenting finished M.Sc. thesis.
C3. To acquaint with diploma exams questions and short repetition.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is capable to present in a short form the main achievements of own work as well as to answer related questions.

III. Relating to social competences:
PEK_K01 - Has consciousness of necessity presenting in a comprehensive and concrete form the results of own work and is able to evaluate reception of the work by the audience.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Principles of organizing and crediting the seminar.	2
Sem2	Gantt chart - principles of organizing projects realized in a well defined time.	2
Sem3	Examples of realized up to now works connected with design, investigation or manufacturing from different fields of interest at Mechanical Department of Wrocław University of Technology and familiarization with examinational questions as well as short repetition.	4
Sem4	Determination of the presentation schedule for each seminar participant.	2
Sem5	Presentations of diploma works by every seminar participant.	18
Sem6	Summary and creditation of the course.	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. problem discussion
N3. multimedia presentation
N4. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01	project presentation
F2	PEK_U01	activity and participation in problems discussion

P = 0,8F1 + 0,2F2

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
M.Sc. thesises available at person conducting seminar and in library.

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_AE_U22	C1,	Sem 3	N3, N4
PEK_K01	K2MBM_AE_K03, K2MBM_AE_K08	C1- C3	Sem 1 to Sem 6	N1 do N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia transportu drogowego**
Name in English: **Ecology of Road Transportation**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041420**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			45	
Number of hours of total student workload (CNPS)	30			60	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			2	
including number of ECTS points for practical (P) classes				2	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on field of transportation means design and operation
2. Awareness of necessity of team work and ability of technical problem solving in group

SUBJECT OBJECTIVES

C1. Understanding problems on field of ecology of road transportation
C2. Understanding vehicles production and operation via environment cause (including vehicle life-cycle)
C3. Understanding essence and principals of effective team work with engineering knowledge using material science, vehicle design and operation, ecology, recycling, legislation and logistics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has a knowledge on field of egological operation of car systems
PEK_W02 - Studen has detailed knowledge on field of vehicle life-cycle as well as EU end-of-life vehicles systems and legislations

II. Relating to skills:
PEK_U01 - Student is able to describe cause and effect relationship between vehicles production, operation, specific materials application or road infrastructure and environment
PEK_U02 - Student is able to diagnose and design complex logistic system of ELVs management
PEK_U03 - Student is able to find information, data bases and other sources and apply them in solving technical problems dealing with vehicles recycling

III. Relating to social competences:
PEK_K01 - Studen has local and global ecological awarness
PEK_K02 - Student takes care about written works aesthetics
PEK_K03 - Student develops sense of responsibility for other by team-working

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Ecology of road transportation: introduction and basic definitions	2
Lec2	Automotive industry environmental impacts (direct and indirect)	2
Lec3	Engine combustion process and toxic exhausts emission. Methods of pollution reduction.	4
Lec4	Car vehicle as a source of thermal and electromagnetic radiation	2
Lec5	Noise and vibrations emission caused by transportation sector	2
Lec6	Vehicle as a wastes source	2
Lec7	End-of-life vehicle recycling	2
Lec8	Vehicle as a source of hazardous wastes	2
Lec9	Road infrastructure and environmental problems	2
Lec10	Ecodriving	2
Lec11	Mobile emission sources and the Greenhouse Effect	2
Lec12	Alternative fuels and drive systems	4
Lec13	Test	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Intoduction	2
Proj2	ELVs problem in EU choosen region	4
Proj3	Vehicle material composition	4
Proj4	Identification of ELVs management according to EU and local legislation	3
Proj5	ELVs statistic data gaining for choosen region	3

Proj6	Identification of matter, information and finance flow on field of ELVs in choosen region	3
Proj7	Number of ELVs prognosis defining for choosen region	3
Proj8	Identification of ELVs collecting and dissasembly stations for choosen region	3
Proj9	Estimation of load of collecting and dissasembly stations	3
Proj10	Recyclers pointing for choosen region	3
Proj11	ARS management problem	3
Proj12	Design of model ELVs system concept for choosen EU region	5
Proj13	Project presentation and defence	3
Proj14	Final project reciving	3
		Total hours: 45

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Grading written report
F2	PEK_U01, PEK_U02, PEK_U03	Oral defence of the project
F3	PEK_U01, PEK_U02, PEK_U03 PEK_K01-PEK_K03	Activity during class and rating team working
P = F1 x 0,6 + F2 x 0,2 + F3 x 0,2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Janicka, Kolanek, Walkowiak: "Ecology of Road Transportation", PRINTPAP Łódz, 2011,

SECONDARY LITERATURE
DAVENPORT J: The Ecology of Transportation: Managing Mobility for the Environment (Environmental Pollution), Springer, 2006
Society of Automotive Engineers, Vehicle Recycling, Regulatory, Policy, and Labeling Issues (Special Publications)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology of Road Transportation
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W05, K2MBM_AE_W09	C1	Lec1 to Lec12	N4, N2
PEK_W02	K2MBM_AE_W14	C1, C2	Lec6	N4, N1, N2
PEK_U01	K2MBM_AE_U18	C2	Proj3 to proj 12	N1, N2
PEK_U02	K2MBM_AE_U18	C1, C2	Proj2; Proj12	N1, N2
PEK_U03	K2MBM_AE_U01	C1, C2	Proj2 to Proj12	N1, N2
PEK_K01	K2MBM_AE_K09	C1, C2	Proj2 to Proj12	N4, N1, N2
PEK_K02	K2MBM_AE_K03	C3	Proj12; Proj13	N2, N3
PEK_K03	K2MBM_AE_K04	C3	Proj12; Proj13	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo pojazdu**
Name in English: **Safety of vehicle**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041421**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of vehicle body constructions
2. Knowledge of designing and manufacturing of the car components
3. The basics of physics

SUBJECT OBJECTIVES

C1. Active and passive safety
C2. Issues of driver regarding to psychology and physiology
C3. New solutions enable improve safety of traffic system

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - To define active and passive safety
PEK_W02 - To describe active safety system - ABS, ASR, BAS
PEK_W03 - To explain new solutions enable improve safety of traffic system

II. Relating to skills:
PEK_U01 - To analyze vehicle construction regarding safety
PEK_U02 - To calculate absorption of energy for crash zone
PEK_U03 - To show the improvement methods of active and passive safety

III. Relating to social competences:
PEK_K01 - Student should be responsible for own and team work
PEK_K02 - To obey principles and customs valid in university

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Safety of traffic	2
Lec2	Definitions and exampels of active safety	2
Lec3	Definitions and exampels of passive safety	2
Lec4	Psychology and physiology characteristic of driver	2
Lec5	Traffic surroundings	2
Lec6	Driver	2
Lec7	Active safety system - ABS, ASR, BAS	2
Lec8	Construction of energy absorption elements	2
Lec9	Materials apply to energy absorption elements	2
Lec10	Air bags	2
Lec11	Safety belts	2
Lec12	Biomechanics of injury	2
Lec13	Crash test	2
Lec14	Compatibile of wehicle	2
Lec15	Stability of vehicle	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Dynamic deformation of thin-wall profile	2
Lab2	Model of dynamic deformation of thin-wall profile	2
Lab3	Determnaition of energy absorption of thin-wall profile	2
Lab4	Measurement of wehicle geometry	2
Lab5	Construction of dummy	2
Lab6	Research into system of servo brakes EBS	2

Lab7	Determination of g-force during crash test.	3
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. laboratory experiment N3. calculation exercises

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U02 PEK_K01, PEK_K02	F1=(test1+....+test7)/7+ all test passed
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Automotive Safety Handbook, Ulrich Seiffert, Lothar Wech,2003

SECONDARY LITERATURE
ADVANCED HIGH STRENGTH STEEL (AHSS) APPLICATION GUIDELINES
http://www.ivss.se

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W02	K2MBM_AE_W09	C1, C2, C3	Lec1 to Lec15	N1
PEK_U01, PEK_U01, PEK_U01	K2MBM_AE_U06, K2MBM_AE_U21	C3	Lab1 to Lab7	N2, N3
PEK_K01, PEK_K02	K2MBM_AE_K05	C3	Lab1 to Lab7	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Silniki spalinowe**
Name in English: **Developing Engine Technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041424**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the theory and design of internal combustion engines.
2. Ability to conduct measurements of mechanical and electrical engineering.
3. Knowledge of technical English vocabulary associated with internal combustion engines.

SUBJECT OBJECTIVES

C1. Arrangement engineering knowledge about the design and classification of internal combustion engines.
C2. Discussion of opportunities and identify development trends of internal combustion engines, coupled with the transfer of knowledge on the combustion process and engine characteristics.
C3. Familiar with laboratory measurement techniques needed in research and development of internal combustion engines.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Depth knowledge of the design and development trends of internal combustion engines.
PEK_W02 - A knowledge of the calculation and analysis of the combustion process in internal combustion engines.
PEK_W03 - A knowledge of the characteristics of the internal combustion engine and method of their use for the development of engine design with special consideration of environmental requirements and sports.

II. Relating to skills:
PEK_U01 - Getting eco-skills and sports operation of internal combustion engines.
PEK_U02 - Able to independently organize and carry out measurements of selected engine systems and engine bench testing of the complete motor and able to correctly interpret the results of theoretical analysis and laboratory testing of internal combustion engines.
PEK_U03 - Understand the need for lifelong learning including language skills to the free discussion of matters of research and development of internal combustion engines in English.

III. Relating to social competences:
PEK_K01 - Gaining characteristics of a person operating in accordance with the principles of ethics.
PEK_K02 - Meets the rules and customs, and different methods of training by the association in an international team.
PEK_K03 - The strengthened responsibility for the work carried out and get respect for the work of another man.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview engineering knowledge of internal combustion engines - history and classification.	2
Lec2	Overview engineering knowledge of internal combustion engines – design and technology (Part One).	2
Lec3	Overview engineering knowledge of internal combustion engines - design and technology (Part Two).	2
Lec4	The first and second law of thermodynamics in combustion engines.	2
Lec5	The operating factors of the internal combustion engine.	2
Lec6	The characteristics of internal combustion engines.	2
Lec7	The study of internal combustion engines according to current regulations.	2
Lec8	The development of internal combustion engines - construction and technological activities.	2
Lec9	The development of internal combustion engines in terms of the use of alternative fuels.	2
Lec10	The development of internal combustion engines by downsizing - the global ecological effect.	2
Lec11	The development of internal combustion engines for the sport.	2
Lec12	Durability of engines.	2
Lec13	Hybridization of combustion drive systems.	2

Lec14	Development trends of internal combustion engines for example engines as "Engines of the Years".	2
Lec15	Engine news in improving the overall efficiency.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	The organization of research in laboratory studies of internal combustion engines with a discussion of the safety and health at work.	2
Lab2	Methodology of engine research - selection and calibration of the brake, connections, sensors, data sheets, etc.	2
Lab3	Dimensional measurements of selected elements of the piston-crank set and assessment of the degree of wear.	2
Lab4	Design of various fuel supply systems for spark ignition engines with the determination of the characteristics of fuel injection	2
Lab5	Design of various fuel supply systems of diesel engines with the determination of the characteristics of fuel injection.	2
Lab6	Identification of the filling ratio for combustion engine and improvement of the overall efficiency.	2
Lab7	Determination of the performance map of the internal combustion engine – tests for different load and revolution - Part One.	2
Lab8	Determination of the performance map of the internal combustion engine – tests for different load and revolution - Part Two.	2
Lab9	The performance map of the internal combustion engine - interpretation of results.	2
Lab10	The pressure measurement in the combustion chamber of the engine for different settings.	2
Lab11	Determination of the heat balance of the internal combustion engine along with the measurement of temperature fields of outside walls by thermo vision technology.	2
Lab12	Tests of the efficiency of the catalyst in the exhaust system and gas chemical analysis.	2
Lab13	Research engines fitted to vehicles on a chassis dynamometer.	2
Lab14	Rating combustion engine based on data from the OBD system under natural operating conditions.	2
Lab15	Visit in garage - engine diagnostics.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	involvement in the class (class activity)
F2	PEK_W01; PEK_W02; PEK_W03	Written exam
P = 0,2F1+0,8F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02; PEK_U03; PEK_K02	entry quiz F1=(W1+…W14)/14
F2	PEK_U01; PEK_U02; PEK_U03; PEK_K02; PEK_K03	activity in the classroom F2=(A1+…+A15)/15
F3	PEK_U01; PEK_U02; PEK_U03; PEK_K02; PEK_K03	Laboratory report (at least a satisfactory rating of each laboratory) F3=(S1+…+S15)/15
P = 0,2F1+0,2F2+0,6F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Blair G.P. Design and Simulation of four-stok enignes, SAE, Warrendale 1996
Heywood J.B. Internal Combustion Engine Fundamentals, McGraw-Hill International Editions, Singapore 1989
Sroka Z.J., Kułażyński M. Developing Engine Technology, Printpap Łódź 2011

SECONDARY LITERATURE

Janicka A., Kolanek Cz., Walkowiak W. Applied Thermodynamics – internal combustion engine Laboratory, Printpap Łódź 2011
Kułazyński M. Green Fuels, Printpap Łódź 2011
Lackner M., Winter F., Agerwal K.A. Handbook of Combustion, Willey Edition, Indianapolis 2010

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W04, K2MBM_AE_W09	C1	Lec1; Lec2; Lec3	N1, N2
PEK_W02	K2MBM_AE_W01, K2MBM_AE_W05	C2	Lec4; lec5; lec6; Lec7	N1, N2
PEK_W03	K2MBM_AE_W09	C2	Lec5; Lec6; Lec8; Lec9 to Lec15	N1, N2
PEK_U01	K2MBM_AE_U10, K2MBM_AE_U17	C2, C3	Lab2; Lab3; Lab7 to Lab9	N3, N4, N4
PEK_U02	K2MBM_AE_U04, K2MBM_AE_U10, K2MBM_AE_U17, K2MBM_AE_U19	C3	Lab1; Lab2; Lab 4 to Lab6; Lab9 to Lab15	N3, N4, N5
PEK_U03	K2MBM_AE_U02, K2MBM_AE_U03, K2MBM_AE_U23	C1, C2	Lab1; Lab2; Lab14; Lab15	N2, N3, N4, N5
PEK_K01	K2MBM_AE_K01	C1, C3	Lab1 to Lab15	N2, N3, N5
PEK_K02	K2MBM_AE_K06	C2, C3	Lab1 to Lab15	N1, N3
PEK_K03	K2MBM_AE_K04, K2MBM_AE_K05, K2MBM_AE_K10	C3	Lab1 to Lab15	N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie dla inżynierów**
Name in English: **Management for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041425**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Lack of prerequisites

SUBJECT OBJECTIVES

C1. Understanding fundamentals of project management.
C2. Learning basic principles of being a leader.
C3. Gaining skills to raise funds for projects.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Fundamental knowledge of project management.
PEK_W02 - Knowledge of how to create and manage a project team.
PEK_W03 - Knowledge in raising funds for projects.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The project and its phases.	2
Lec2	The importance of leadership - the leader or manager?	2
Lec3	Team building - human resources in the project.	2
Lec4	Description of the problem, the concept and clarifications.	2
Lec5	Planning - Structure Plan.	2
Lec6	The schedule of the project.	2
Lec7	The project realization.	2
Lec8	Monitoring and control?	2
Lec9	Time Management.	2
Lec10	Project Quality Management.	2
Lec11	Risk analysis of the project.	2
Lec12	Budgeting Project - estimating the cost.	2
Lec13	Fundraising mechanisms of the European Union.	2
Lec14	Computer-aided project management.	2
Lec15	Project Management - a case study.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W02	involvement in class (class activity)
F2	PEK_W01; PEK_W02; PEK_W03	Written test
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Lewis J.P.; Fundamentals of Project Management, AMACOM, New York 2002
Lewis J.P.; The Project Planning, Scheduling and Control, McGraw-Hill, New York 2001

SECONDARY LITERATURE
Peter J.; Preface to Marketing Management, Irwin, Homewood 1991
Rolstadas, A., Performance Management: A Business Process Benchmarking Approach. London: Chapman and Hall, 1995.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W15	C1	lec1 to Lec12	N1, N2, N3
PEK_W02	K2MBM_AE_W16, K2MBM_AE_W17	C2	Lec2; Lec3; Lec7; Lec9; Lec15	N1, N2, N3, N4
PEK_W03	K2MBM_AE_W15	C3	Lec1; Lec11; Lec12; Lec13; Lec15	N1, N2, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elektronika pojazdowa**
Name in English: **Electronics in car vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041426**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Based electronics and electrotechnics competence.
2. The ability of self working on laboratories and projects based on an elementary manual performance.
3. Ability of team work.

SUBJECT OBJECTIVES

C1. Explore of electronics systems in a vehicle.
C2. Figure of operation of car fuel control systems.
C3. Obtaining ability of based electronic circuit systems.
C4. Ability of electronic buses characterization.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - To explain of operation of vehicle network protocols.
PEK_W02 - To explain of operation of fuel control systems.
PEK_W03 - Selection of proper sensors for specyfic vehicle circuit.

II. Relating to skills:
PEK_U01 - Making validation of proper control system work.
PEK_U02 - right interpretation of data in vehicle buses.
PEK_U03 - Use a datasheets for electronics circuit.

III. Relating to social competences:
PEK_K01 - Understanding and knowing needs to life long learning, especially in electronics trends.
PEK_K02 - Awarning the importance, responsibility and the consequences of an engineer in mechanical engineering subjects in terms of responsibility for the environment, resulting from the proper operation of power control systems of internal combustion engines, which are a significant threat to the environment.
PEK_K03 - Recognizing needs of improve professional personal skills.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The architecture of electronic systems in vehicles.	4
Lec2	The microprocessor control system power supply systems of internal combustion engines.	2
Lec3	Fundamentals of microprocessor technology in automotive.	4
Lec4	Ethernet.	4
Lec5	CAN bus.	2
Lec6	LIN network and other communication protocols in vehicles.	2
Lec7	Introduction to sensors in vehicles.	2
Lec8	E-e circuit in vehicles.	4
Lec9	Vehicle lighting and HUD system.	2
Lec10	Electronic Applications for the vehicle techniques.	2
Lec11	Recycling electronics originating from vehicles.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Data acquisition of the temperature sensors of the motor vehicle.	2
Lab2	Acquisition of data from pressure sensors of the vehicle.	2
Lab3	Acquisition of data from the controller power supply.	2
Lab4	Dynamic load measurements using OBD.	4
Lab5	Dynamic load measurements via current probes.	4
Lab6	Doppler velocity measurement system.	2
		Total hours: 16

Form of classes – Project		Number of hours
Proj1	Motion sensor network topology for a vehicle.	8
Proj2	The design of the data acquisition-vehicle sensors.	7
		Total hours: 15

TEACHING TOOLS USED
N1. case study N2. laboratory experiment N3. multimedia presentation N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Participation in discussions of problem.
F2	PEK_W02	Test.
F3	PEK_W02	Laboratory reports.
P = 1/4F1+1/2F2+1/4F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Laboratory reports.
F2	PEK_U02, PEK_K02	Laboratory reports.
F3	PEK_U03, PEK_K03	Laboratory reports.
P = 1/3(F1+F2+F3)		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02	Project defense.
F2	PEK_U03	Project defense.
P = 1/2(F1+F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Wróbel R.: Trends in vehicle electronics. Wyd. PWr, Wrocław 2011.[2]Study material in hard copy and electronic version of Module_5 at the European Project Curriculum Development called CarEcology: “New Technological and Ecological Standards in Automotive Engineering”27876-IC-1-2005-1-BE-Erasmus-PROGUC-1, website http://project.iwt.kdg.be/cdcarecology.[3] Martin T.: How to Diagnose and Repair Automotive Electrical Systems. Motorbooks Workshop series.[4] Fraden J.: Handbook of Modern Sensors: Physics, Designs, and Applications. Advanced Monitors Corporation, 2003.[5] Mims F. M. III: Electronic Sensor Circuits & Projects. Master Publishing Inc., 2000.

SECONDARY LITERATURE

[1] http://elenota.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronics in car vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MBM_AE_W09, K2MBM_AE_W10, K2MBM_AE_W11, K2MBM_AE_W12, K2MBM_W04, K2MBM_W10	C4	Lec1 to Lec11	N1 N3
PEK_U01 - PEK_U03	K2MBM_AE_U01, K2MBM_AE_U04, K2MBM_AE_U06, K2MBM_AE_U07, K2MBM_AE_U09	C2 C3	Lab1; Lab2; Lab3; Lab5; Lab6; Proj1; Proj2	N1 N2 N3 N4
PEK_K01 - PEK_K03	K2MBM_AE_K09, K2MBM_AE_K11	C1 C2 C3 C4	Lab1; Lab3; Lab4; Lab5; Lab6; Proj1; Proj2	N1 N2 N3

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy rzeczoznawstwa samochodowego**
Name in English: **Automotive expertises**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041427**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed subjects in Automotive Engineering: Energy Efficiency Design of Powertrain and Body, Developing Engine Technology, Trends in Electronics Vehicles, Alternative Drive Systems, Chemistry and Green Fuels.

SUBJECT OBJECTIVES

C1. Understanding the basic elements of automotive expert opinions.
C2. Awareness of need for lifelong learning due to the rapid development of automotive technology.
C3. Skills of English language in specialist vocabulary from the automotive expert opinions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - An extended knowledge in automotive engineering with particular focus on methods and measurement techniques aimed to determine the technical condition of vehicles and engines, and the cost calculation of repair of the vehicle.
PEK_W02 - A knowledge in mathematics and physics required to describe and interpret the results of studies related to the processes that happen in each vehicle and engine systems and the unusual situations as failures and road collisions.
PEK_W03 - A knowledge in project management, in particular the automotive expert projects, in-depth the legal aspects and presentation of investigation results.

II. Relating to skills:
PEK_U01 - Know how to diagnose the vehicles' systems and internal combustion engine.
PEK_U02 - Skills to use measuring instruments and specialized software applied in the automotive expert opinions.
PEK_U03 - Acquisition of the ability to collect data on the means of transport and skills of interpretation of those data as well as self-expression in native language and English.

III. Relating to social competences:
PEK_K01 - Gaining characteristics of a person working in accordance with the principles of ethics.
PEK_K02 - Awareness of the knowledge relationships from different fields.
PEK_K03 - Acquisition of the ability to properly write technical reports while maintaining the aesthetics and the current form and style.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Automotive Expertise according to the Polish and international regulations and the role of the expert.	2
Lec2	Automotive Engineering - vehicle identification.	2
Lec3	Automotive Engineering – technical scrutiny of vehicle body.	2
Lec4	Automotive Engineering – technical scrutiny of vehicle systems: chassis (including tires), steering and braking.	2
Lec5	Automotive Engineering – technical scrutiny of the crank-piston set in internal combustion engine.	2
Lec6	Automotive Engineering - technical scrutiny of other engine systems.	2
Lec7	Automotive Engineering - technical scrutiny of the vehicle after repair.	2
Lec8	Automotive Technology - determine the scope of damage to the vehicle after the accident, theft, etc.	2
Lec9	Valuation of the vehicle – estimation of the market value, residual and total loss vehicle.	2
Lec10	Calculation repair including spare parts (Directive GVO).	2
Lec11	Traffic - laws relating to vehicles and traffic (selected items).	2
Lec12	Traffic - the safety of road users and the description of the accidents involving pedestrians.	2
Lec13	Traffic - the analysis of time-movement (spatial) incidents.	2

Lec14	Traffic - supporting systems for the reconstruction of road accidents.	2
Lec15	Methodology of preparing experts opinions in Automotive Engineering.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Vehicle identification - identification of vehicle make, model, type, VIN-number identification, registration expiration, definition of equipment, etc.	2
Lab2	Technical scrutiny for pre-registration and vehicle approval - setting requirements, equipment, vehicle inspection stations, power of scrutinizers, etc.	2
Lab3	Test of fuel consumption in the natural operating conditions and on a chassis dynamometer.	2
Lab4	Test of fuel systems for combustion engines including LPG and CNG due to compliance with the approval and technical conditions.	2
Lab5	Technical scrutiny of combustion engine due to environmental protection.	2
Lab6	Analysis of the causes of damage to the components of the crank-piston set.	2
Lab7	Tests of valve timing system.	2
Lab8	Technical scrutiny of the vehicle, together with the assessment of the quality of the paint.	2
Lab9	Finding the causes and assessment of damage to the vehicle chassis.	2
Lab10	Identification of damage to some parts of the drive system.	2
Lab11	Technical scrutiny of tires of a motor vehicle and analysis of tires damages.	2
Lab12	Rating road accident based on the provision of material related to a traffic accident (identification of incident space, setting marks on the road and vehicles, technical scrutiny of vehicles - participants of the accident, the reconstruction of the incident, offering technology repair and vehicle repairs valuation).	8
		Total hours: 30
Form of classes – Seminar		Number of hours
Sem1	Repertory of traffic theory.	2
Sem2	Traffic and safety of the participants in Poland and in the world.	2
Sem3	Today's traffic monitoring systems.	2
Sem4	Approval and evaluation of technical condition of special vehicles.	2
Sem5	Approval and evaluation of the technical condition of sports cars.	2
Sem6	Technical studies of hybrid vehicle and electric cars.	2
Sem7	Technical studies wheelers.	2
Sem8	Giving opinions antique and collector vehicles.	2
Sem9	Giving opinions vehicle SAM type (made by owner).	2
Sem10	The importance of the OBD system in automotive expertise.	2
Sem11	Modern techniques and technologies for vehicle body repairs.	2
Sem12	Modern technology and repair techniques for combustion engines.	2
Sem13	Vehicle repairs valuing systems in the world.	2
Sem14	Construction and operation of roads.	2

Sem15	Driver's psychology and physiology.	2
		Total hours: 30

TEACHING TOOLS USED
N1. multimedia presentation N2. self study - self studies and preparation for examination N3. laboratory experiment N4. self study - preparation for laboratory class N5. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02	involvement in the class (class activity)
F2	PEK_W01; PEK_W02; PEK_W03	Written test
P = 0,2F1+0,8F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U03	entry quiz F1=(W1+…W12)/12
F2	PEK_U01; PEK_U02	activity in the classroom F2=(A1+…+A15)/15
F3	PEK_U01; PEK_K03	Laboratory report (at least a satisfactory rating of each laboratory) F3=(S1+…+S12)/12
P = 0,2F1+0,2F2+0,6F3		

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

F1	PEK_U03; PEK_K01	activity in the classroom F1=(A1+…+A15)/15
F2	PEK_K02; PEK_K03	Presentation (P) plus report (R) F2=(P+R)/2
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Borg K.L. Auto Mechanics: Technology and Expertise in Twentieth-Century America, JHU Press 2007
Eubanks Pedestrian Accident Reconstruction, Tucson 1994
Erjavec J. Automotive Technology: A Systems Approach, Cengage Learning Inc. 2009
Starkes J., Allard F. Cognitive Issues in Motor Expertise, (Advances in Psychology), North-Holland 1993
Kodeks Drogowy, Prawo o Ruchu Drogowym, Dz. U 2012 poz. 113 z pozn. zm

SECONDARY LITERATURE
Jegerman K. Stan nietrzeźwości, Katowice 1987
Kończykowski W. Odtwarzanie i analiza przebiegu wypadku drogowego, SRTSiRD, Warszawa 1993
Pawelec K., Diupero T. Rekonstrukcja wypadku i zdarzenia drogowego, Dom Wydawniczy ABC 2006

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W04, K2MBM_AE_W12	C1, C2, C3	Lec2 to Lec14	N1, N2, N4, N5
PEK_W02	K2MBM_AE_W01, K2MBM_AE_W02, K2MBM_AE_W03, K2MBM_AE_W09	C1, C2, C3	Lec1 to Lec14	N1, N2
PEK_W03	K2MBM_AE_W13, K2MBM_AE_W15, K2MBM_AE_W16	C1, C3	Lec1; Lec15	N1, N2
PEK_U01	K2MBM_AE_U06, K2MBM_AE_U07, K2MBM_AE_U08, K2MBM_AE_U09, K2MBM_AE_U10, K2MBM_AE_U11, K2MBM_AE_U12, K2MBM_AE_U16, K2MBM_AE_U17, K2MBM_AE_U18	C1, C2	Lab1 to Lab12	N1, N3, N4, N5
PEK_U02	K2MBM_AE_U05	C1, C2	Lab3 to lab11	N3, N4, N5
PEK_U03	K2MBM_AE_U01, K2MBM_AE_U02, K2MBM_AE_U03, K2MBM_AE_U22, K2MBM_AE_U23, K2MBM_AE_U24	C1, C3	Sem1; Lab1; Lab2	N1, N2, N3, N4, N5
PEK_K01	K2MBM_AE_K01	C2	Lab1; Lab2; Lab12	N2, N3, N4, N5

PEK_K02	K2MBM_AE_K07	C1, C2	Sem3 to Sem10; Lab1 to Lab12	N2, N3, N4, N5
PEK_K03	K2MBM_AE_K02, K2MBM_AE_K03	C2, C3	Lab12	N2, N3, N4, N5

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komunikacja dla inżynierów**
Name in English: **Communication for Engineers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041428**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Lack of prerequisites.

SUBJECT OBJECTIVES

C1. Study of basic social communication tasks.
C2. Learning basic principle of human resource management.
C3. Getting teamwork skills.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - A fundamental knowledge of working in a team and HR management.
PEK_W02 - Basic knowledge to properly communicate with the human environment, especially in conducting substantive discussions engineering subjects.
PEK_W03 - A knowledge in the field of self-presentation and presentation of work results.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of social communication - the definition, role, division.	2
Lec2	Recruitment and selection - types, forms, documents.	2
Lec3	The introduction of team members in the job place - work and rest.	2
Lec4	Negotiations.	2
Lec5	Motivation of individual employee or groups of people.	2
Lec6	Job evaluation and evaluation of the employee.	2
Lec7	Working with people with disabilities.	2
Lec8	Harassment and stalking.	2
Lec9	Addictions in the workplace.	2
Lec10	The importance of meeting places.	2
Lec11	Meaning non-verbal behaviours - body language.	2
Lec12	International Social Communication - selected examples.	2
Lec13	Elements of the promotion for individual and group (PR).	2
Lec14	Public Speaking - lectures and presentations.	2
Lec15	Human Resource Management - case study.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W03	involvement in the class (class activity)
F2	PEK_W01; PEK_W02; PEK_W03	written test
P = 0,2F1+0,8F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Armstrong M.; Human Resource Management. Strategy and Operation, Kogan Page 1996
Barker L.L.; Listening Behavior, New Orleans, SPECTRA 1990
Donaghy W.C.; The Interview: Skills and Applications, Scott, Foresman 1984
Fast J.; The Body Language, New York 1994

SECONDARY LITERATURE
Lewis S., Cooper C.L.; Work-Life Integration, Wiley, Chichester 2005
Smith M.J.; When I Say No, I feel Guilty, New York, Bantam 1985

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MBM_AE_W16	C1, C2, C3	Lec1 to Lec15	N1, N2, N3
PEK_W02	K2MBM_AE_W17	C2, C3	lec1; Lec11; lec13; Lec14	N1, N2, N3
PEK_W03	K2MBM_AE_W13	C2, C3	Lec1; Lec13; Lec14	N1, N2, N3

SUBJECT SUPERVISOR

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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): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041451, MMM041452**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				2	
Number of hours of total student workload (CNPS)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Getting knowledge in mechanical engineering documented positive grades form all subjects of the first and second semesters in the specialty Automotive Engineering.
2. Getting English language skills to express own opinions and to write a master’s thesis in any automotive engineering subject.

SUBJECT OBJECTIVES

C1. Self design and writing a master's thesis of the research problem in automotive engineering.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Independent realization of master's thesis, using the learned while studying design and research methods.
PEK_U02 - Right interpretation of the research results.
PEK_U03 - Getting skill of composing a thesis with prevailing standards governing the form and style of writing, and presentation of work to a wider audience, including final examination committee.

III. Relating to social competences:
PEK_K01 - Awareness of graduate as a future leader, knowing how to organize the work themselves and others, and manage a team.
PEK_K02 - Gaining features of a person working alone, according to the rules of ethics.
PEK_K03 - Getting attention to style and form of expression of own views in native language and foreign, especially in English.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	About the work must include the issue of vehicle engineering. Themes of Diploma Thesis subject arising from the thesis presented by the supervisor. Diploma thesis must include the issue of automotive engineering.	2
		Total hours: 2

TEACHING TOOLS USED

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Basic literature will result from the thesis subject.

SECONDARY LITERATURE
Chinneck J.W. How to organize your thesis, Ottawa 1999
Kevine J.S. Writing and presenting your thesis or dissertation, Michigan 2005

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MBM_AE_U02, K2MBM_AE_U22, K2MBM_AE_U24, K2MBM_AE_U25	C1	arise the thesis topic	N1, N2
PEK_K01	K2MBM_AE_K01, K2MBM_AE_K02, K2MBM_AE_K03, K2MBM_AE_K08, K2MBM_AE_K10, K2MBM_AE_K11	C1	arise the thesis topic	N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie procesów transportowych**
Name in English: **Transport processes modelling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041501**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students have the knowledge from the course Statistic for Engineers, confirmed with positive grade completing the course.
2. The knowledge of an spreadsheet e.g. Excel.

SUBJECT OBJECTIVES

C1. Learning of modelling processes stages, especially the simulation ones.
C2. Acquiring the knowledge on processes modelling methods (including stochastic processes) and their application to transport cases.
C3. Ability to identify and measure a process, identify process input and output variables, statistical data analysis.
C4. Acquiring the skills of constructing, verifying and testing deterministic and stochastic models of transport processes.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - A course participant knows the modelling methodology and methods applied in modelling of deterministic and stochastic transport processes.
PEK_W02 - A participant can prepare a plan of process measurement, analyze and draw conclusions on the base of real data, develop and test processes models.

II. Relating to skills:
PEK_U01 - A course participant is able to identify modelling goals, process input and output variables, relations in a process.
PEK_U02 - A course participant is able to apply known methods to develop models of real transport processes.
PEK_U03 - A course participant is able to construct a simulation model in the Excel program.

III. Relating to social competences:
PEK_K01 - A course participant can cooperate while group project execution.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to modelling: basic definitions, modelling goals and methodology, models classification, identification of elements and relations in a system, identification of process variables.	2
Lec2	Graphical methods of the transport processes modelling: a block diagram, the Gantt chart, the MAC analysis, the trains movement chart.	2
Lec3	Graphical methods of the transport processes modelling: the CPM, CPM COST, PERT methods, the Decision Tree.	2
Lec4	Stochastic character of transport processes: probability distributions used in the transport process modelling, developing a plan for process measurement, data analysis.	2
Lec5	Pseudorandom numbers. A computer simulation – an introduction.	2
Lec6	Developing a simulation model of a transport process.	2
Lec7	The Monte Carlo simulations – cases discussion.	2
Lec8	Model verification and testing.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organizational issues. Identification of modelling goals, identification and characteristic of variables for a transport process case.	2
Lab2	Observation of a real transport process, identification of input, output variables and relations. Propositions of a measurement system.	2
Lab3	The MAC analysis of the case of an unloading process.	2
Lab4	Developing of the trains movement chart for a given case.	2
Lab5	The Decision Tree application.	2
Lab6	Random variable analysis.	2

Lab7	Simulation algorithm developing for a given transport process.	2
Lab8	Monte Carlo simulation of a transport process.	2
Lab9	Simulation model testing and results analysis.	2
Lab10	Measurement of a real transport process model.	2
Lab11	Development, verification and testing of a real transport process model.	6
Lab12	Presentation of real process modelling results.	2
Lab13	The ending test.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03	partial grades obtained from laboratory exercises
F2	PEK_K01	the grade obtained from a group task
P = F1, F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
•Leszczyński J., Modelowanie procesów i systemów transportowych, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1999
•Filipowicz B., Modele stochastyczne w badaniach operacyjnych, Wydawnictwo Naukowo-Techniczne, Warszawa 1996
•Skoczyński L., Szczepanik I., Modelowanie procesów transportowych. Ćwiczenia projektowe i laboratoryjne. Wydawnictwa Politechniki Wrocławskiej, Warszawa 1991
•Komar Z., Wolek C., Inżynieria ruchu drogowego. Wybrane zagadnienia. Wydawnictwo Politechniki Wrocławskiej, Wrocław 1994
•Żurowska J., Prognozowanie przewozów. Modele, metody, przykłady. Wydawnictwo Politechniki Wrocławskiej. Kraków 2005
•Krawczyk S., Zarządzanie procesami logistycznymi, PWE, Warszawa 2001
•Bozarth C., Handfield R.B., Wprowadzenie do zarządzania operacjami i łańcuchem dostaw, One-press, Gliwice 2007
•Waters D., Zarządzanie operacyjne, PWN, Warszawa 2007

SECONDARY LITERATURE
•Nowakowski T., Niezawodność systemów logistycznych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011
•Filipowicz B., Modele stochastyczne w badaniach operacyjnych, Wydawnictwo Naukowo-Techniczne, Warszawa 1996
•Ruta R., Mazurkiewicz A., Modelowanie symulacyjne systemów eksploatacji, Międzyresortowe Centrum Naukowe Eksploatacji Majątku Trwałego, Radom 1991
•Kukuła K. – red., Badania operacyjne w przykładach i zadaniach, Wydawnictwo Naukowe PWN, Warszawa 2004
•Krawczyk S., Metody ilościowe w logistyce (przedsiębiorstwa) t.II, Wydawnictwo C. H. Beck, Warszawa 2001

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Transport processes modelling
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_ST_W01, K2MBM_ST_W03, K2MBM_ST_W09, K2MBM_ST_W11	C1, C2	Lec1 - Lec8	N1
PEK_U01 - PEK_U03	K2MBM_ST_U01, K2MBM_ST_U06, K2MBM_ST_U07	C3, C4	Lab.1-Lab. 10	N2
PEK_K01	K2MBM_ST_K01, K2MBM_ST_K10		Lab.11-Lab14	N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Intermodalne systemy transportowe**
Name in English: **Intermodal transport systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041502**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge in the field of management, design and research of transport processes and systems
2. Is able to formulate the main logistical problems occurring in a competitive environment; can apply appropriate algorithms for analysis and evaluation of alternative solutions.

SUBJECT OBJECTIVES

C1. To familiarize students with the theoretical and practical aspects of the functioning of the intermodal transport system
C2. Transfer of basic knowledge about features and properties of intermodal transport and transport service, economic and social significance of transport, the structure of the transport process and the transport process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Explains the characteristics of the transport system.
PEK_W02 - It is characterized by parameters for assessing the transport process.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Can think and act in a creative and enterprising.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, Assessment, literature. Definitions, properties and characteristics of transport and the transport service.	2
Lec2	The market of intermodal transport services	2
Lec3	Characteristics of integrated loading units	2
Lec4	The rules of containerization	6
Lec5	Innovative solutions in intermodal transport	3
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	The scope of the lecture, Assessment, literature.	2
Sem2	Presentation, discussion and discussion of vertical reloading techniques	6
Sem3	Presentation, discussion and discussion of horizontal reloading techniques	6
Sem4	Presentation, discussion and discussion of techniques for transporting intermodal loads by rail	4
Sem5	Presentation, discussion and discussion of techniques for transporting intermodal loads by road	2
Sem6	Presentation, discussion and discussion of techniques for transporting intermodal loads by sea	4
Sem7	Presentation, discussion and discussion of techniques related to the automation of intermodal processes	4
Sem8	Application of automatic identification in intermodal processes	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. multimedia presentation
N3. problem discussion

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Kwaśniowski, S., Nowakowski, T., & Zając, M. (2008). Transport intermodalny w sieciach logistycznych. Oficyna Wydawnicza Politechniki Wrocławskiej.
Neider, J., & Marciniak-Neider, D. (1997). Transport intermodalny. Polskie Wydawnictwo Ekonomiczne.
Kutz, M. (2004). Handbook of transportation engineering (Vol. 768). New York, NY, USA:: McGraw-Hill.

SECONDARY LITERATURE

Jacyna, M. (2009). Modelowanie i ocena systemów transportowych. OFICYNA Wydawnicza Politechniki Warszawskiej.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Intermodal transport 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_W01	K2MBM_ST_W09, K2MBM_ST_W11, K2MBM_ST_W14	C1, C2	Wy1-Wy5	N1, N2, N3
PEK_U	K2MBM_ST_U01, K2MBM_ST_U04, K2MBM_ST_U08	C1, C2	sem.1-sem. 7	N1, N2, N3
PEK_K	K2MBM_ST_K02, K2MBM_ST_K03	C1, C2	sem.1-sem. 7	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Europejska polityka transportowa**
Name in English: **European transport policy**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041503**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. No requirements

SUBJECT OBJECTIVES

C1. To acquaint the student with the assumptions of EU transport policy.
C2. Acquiring the ability to use EU documents.
C3. Understanding the methods of applying the strategy of commodality.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know the basic assumptions of the EU transport policy.

II. Relating to skills:
PEK_U01 - Analyze and apply requirements arising from EU documents in the field of transport policy.

III. Relating to social competences:
PEK_K01 - Explain the causes and effects of potential threats.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	The history of European transport policy.	2
Sem2	2001 White Paper "European transport policy 2010: time to make a decision".	2
Sem3	White Paper of 2011: Roadmap to a Single European Transport Area - Towards a competitive and resource-efficient transport system.	2
Sem4	International agreements of AGR, AGC, AGCT, AGN.	2
Sem5	Trans-European Transport Network	2
Sem6	Examples of the development of road transport infrastructure.	2
Sem7	Examples of the development of rail transport infrastructure.	2
Sem8	Examples of development of inland water transport infrastructure.	2
Sem9	Examples of development of air transport infrastructure.	2
Sem10	External costs of transport	2
Sem11	Intermodal transport; advantages and limitations.	2
Sem12	Maritime transport; sea highways.	2
Sem13	European platform of logistic centers.	2
Sem14	Galileo program.	2
Sem15	Safety in transport; AETR, ADR agreements.	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

R. Hickman, D. Bonilla, M. Givoni, D. Banister, International Handbook on Transport and Development. Edward Elgar Publishing, 2015.

SECONDARY LITERATURE

https://ec.europa.eu/transport/themes_en

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
European transport policy
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_ST_U01, K2MBM_ST_U03, K2MBM_ST_U05	C1, C2	Sem 1, Sem 4 - Sem 10, Sem 12 - Sem 14	N1, N2
PEK_K01	K2MBM_ST_K03, K2MBM_ST_K08	C3	Sem 2, Sem 3, Sem 11, Sem 15	N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie systemów transportowych**
Name in English: **Transport system modelling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041504**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic issues of: - technical mechanics, - fundamentals of machine construction, - CAD modeling in terms of transport systems and processes
2. Is able to formulate the main transport problems occurring in a competitive environment; can apply appropriate algorithms for analysis and evaluation of alternative transport solutions.

SUBJECT OBJECTIVES

C1. To familiarize students with the theoretical and practical aspects of functioning of Polish transport system and its components modes of transport.
C2. The transfer of basic knowledge about the characteristics and properties of transport and transport services, economic and social importance of transport, the structure of the transport process and the transport process.
C3. Getting to know the tasks, infrastructure of particular modes of transport: rail, car, air, sea, pipeline and inland waterway

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Explains the characteristics of the transport system.

PEK_W02 - It is characterized by parameters for assessing the transport process.

II. Relating to skills:

III. Relating to social competences:

PEK_K01 - can think and act in a creative and enterprising.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, Assessment, literature. Definitions, properties and characteristics of transport and the transport service.	1
Lec2	Economic and social importance of transport. The functions of transport.	3
Lec3	Definitions of the transport system The transport system in a gałęziowym (rail car, air, sea, inland waterway, pipeline, urban).	2
Lec4	The physical model of transport processes. Classification of transport models	2
Lec5	Main problems related to the modeling of transport systems and processes	2
Lec6	Designing mathematical models of transport processes	4
Lec7	Constructing physical models of transport processes. Analysis of their implementation. Planning distribution points	4
Lec8	Optimization of models of transport processes	4
Lec9	Mathematical and physical models of transport systems and processes in CAx applications	4
Lec10	Integration of systems for modeling and analysis of CAx transport systems and processes	4
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction and discussion of basic concepts related to modeling of transport systems and processes.	2
Proj2	Designing mathematical models of transport processes	8
Proj3	Constructing physical models of transport processes. Analysis of their implementation. Planning distribution points	8
Proj4	Optimization of transport process models	8
Proj5	Passing laboratory classes	4
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. problem discussion

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Jacyna, Marianna, and Konrad Lewczuk. Projektowanie systemów logistycznych. Wydawnictwo Naukowe PWN SA, 2016.

Jacyna, M. (2009). Modelowanie i ocena systemów transportowych. OFICYNA Wydawnicza Politechniki Warszawskiej.

SECONDARY LITERATURE

Szymonik, A. (2013). Ekonomika transportu dla potrzeb logistyka (I): teoria i praktyka. Difin.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Transport system modelling
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, PEKW02	K2MBM_ST_W01, K2MBM_ST_W03, K2MBM_ST_W09	C1, C2, C3	Lec1-10	N1, N2
PEK_U	K2MBM_ST_U04, K2MBM_ST_U05, K2MBM_ST_U06	C1, C2, C3		N1, N2
PEK_K01	K2MBM_ST_K02, K2MBM_ST_K04, K2MBM_ST_K05	C1, C2, C3		N1, N2

SUBJECT SUPERVISOR

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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):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041505**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of engineering statistics.

SUBJECT OBJECTIVES

C1. To acquiant the student with the decision problems occuring during the operation of 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 iference 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.
PEK_W02 - To know the object reliability models.
PEK_W03 - To know the methods of risk analysis

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	Elements of machinery degradation. Characters, causes and effects of the damage	2
Lec3	The model of irreparable component reliability	2
Lec4	The reliability structure of unrecoverable system. Basic and simple structures.	2
Lec5	The reliability structure of unrecoverable system. Complex structures. Suitability path / Cut set. Reserving	2
Lec6	Reliability model of repairable element.	2
Lec7	Reliability model of repairable system. Markov process. Stationary solution	2
Lec8	Markov process. Non-stationary solution	2
Lec9	Maintenace strategies. Optimization of maintenance of facilities.	2
Lec10	Maintenace strategies. Reliability Centered Maintenance.	2
Lec11	Safety of installations and technical systems. The notion of risk	2
Lec12	Risk analysis methods: FMEA / FMECA.	2
Lec13	Risk analysis methods: FTA / ETA	2
Lec14	Fundamentals of risk management methods: PHA, PSA, HAZOP.	2
Lec15	Trends in development of the science of reliability and safety. Terrorism.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, 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_ST_W04	C1	Lec.1	N1
PEK_K01	K2MBM_K10	C3	Lec.15	N1
PEK_W02	K2MBM_ST_W04	C2	Lec.2 - Lec. 10	N1
PEK_W03	K2MBM_ST_W04	C2	Lec.11 - Lec.14	N1

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Organizacja i zarządzanie przedsiębiorstwem transportowym**
Name in English: **Organization and management of the forwarding company**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041507**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Engineering calculations with usage of spreadsheet
2. Operation Engineering

SUBJECT OBJECTIVES

C1. Schooling of planning of the transport task
C2. Schooling of planning of the costs of the transport task
C3. Schooling of the planning of the repairs for realisation of the transport task
C4. Calculation of the final cost of the transport task

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can planned of the costs of the transport task
PEK_W02 - Can planned the work time for the drivers

II. Relating to skills:
PEK_U01 - Knows how calculate the costs of transport task
PEK_U02 - Knows how to planned the tasks for the team

III. Relating to social competences:
PEK_K01 - Improves of the cooperation in the team
PEK_K02 - Knows how to manage of the team

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Functions of the forwarding company, duties of forwarding company for the customer	2
Lec2	Organization of the forwarding company, Law forms of the forwarding companies, scope of the offers	2
Lec3	Transport documents	2
Lec4	The present tools in managing of the fleet of the vehicles. Internet stock exchange of the transport	2
Lec5	Realisation of the transport in the international exchange	2
Lec6	Preparing and control of the realisation of the transport task	2
Lec7	Fundamentals of realisation of the intermodal transport	2
Lec8	Summary	1
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Law fundamentals of establishing of the forwarding company	2
Sem2	Planning of realisation of the transport task	2
Sem3	Planning of work of the drivers	2
Sem4	Planning of technical service of the vehicles	2
Sem5	Plan of repair of the transport fleet	2
Sem6	Planning of costs of repair of the transport fleet	2
Sem7	Summary of costs, calculation of the final price for the transport task	2
Sem8	Summary	1
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. problem exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	Pek W01-08	Exam
P = 1		

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 U01-08	Credit for a grade
P = 1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1.Tadeusz Pusty: Przewóz towarów niebezpiecznych. Poradnik kierowcy. WKiŁ , 2007;
2.Krystyna Szałkowska-Kozyra: Samochody własne i obce w działalności gospodarczej. Wydawnictwo: Twigger , 2006;
3.Jakowski Stefan: Opakowania transportowe Poradnik. WNT, 2007;
4.Górski W. Mendyk E.: Prawo transportu lądowego. WKiŁ, 2005;
5.Izabela Dembińska-Cyran, Marek Gubała: Podstawy zarządzania transportem w przykładach. Wydawnictwo: Instytut Logistyki i Magazynowania, 2005

SECONDARY LITERATURE
W. Rydzykowski, K. Wojewódzka-Król: Transport. PWN,2005;
P. Zalewski, P. Siedlecki, A. Drewnowski: Technologia transportu kolejowego. WKiŁ, 2004;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Organization and management of the forwarding company
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_ST_W01, K2MBM_ST_W14, K2MBM_ST_W18	C1, C2, C3, C4	Lec1-lec8	N1
PEK_U	K2MBM_ST_U08, K2MBM_ST_U11	C1, C2, C3, C4	sem1-sem8	N2
PEK_K	K2MBM_ST_K04, K2MBM_ST_K06, K2MBM_ST_K10	C1, C2, C3, C4	sem1-sem8	N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM041508**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge in the field of traffic engineering, transport processes, modeling of transport processes.
2. Is able to analyze the system and the transport process due to its functioning as well as reliability.

SUBJECT OBJECTIVES

C1. Getting to know the principles of analysis, modeling of complex systems and transport processes.
C2. Acquiring the ability to analyze the functioning of transport systems and processes and to carry out their optimization.
C3. Acquiring the ability to create simple mathematical models of the system and the transport process with restrictions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - W wyniku przeprowadzonych zajęć student powinien być w stanie scharakteryzować zagadnienia związane z projektowaniem i realizacją procesów transportowych w odniesieniu do złożonego systemu transportowego
PEK_W02 - As a result of the course the student has knowledge and is able to propose appropriate measurement methods to determine the basic values characterizing transport processes and systems.

II. Relating to skills:
PEK_U01 - Is able to develop a model of the transport system using methods of system analysis and computer tools

III. Relating to social competences:
PEK_K01 - Acquires the ability to bear responsibility for the work done. Acquires the ability to think and act in a creative way. Acquires the skills of working in a team.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Presentation of the purpose and scope of the transient work, giving suggestions of topics	3
Proj2	Getting to know the functioning of the actual transport system (possible to carry out in the form of field activities).	3
Proj3	Analysis of existing conceptual and model solutions in the field of systems and transport processes.	3
Proj4	Analysis of the concept of transport problem solution, assumption of assumptions, development of measurement protocols.	3
Proj5	Field measurements (quantitative) of the operation of the transport system. Part I.	3
Proj6	Field measurements (quantitative) of the operation of the transport system. Part II.	3
Proj7	Field measurements (quantitative) of the operation of the transport system. Part III.	3
Proj8	Development of an analytical model of the transport system taking into account the adopted restrictions.	3
Proj9	Development of a simulation model of the transport system taking into account the adopted restrictions.	3
Proj10	Development of characteristics obtained from the simulation model and the actual system.	3
Proj11	Analysis of compliance of the analytical and simulation models with real data.	3
Proj12	Sensitivity analysis of the developed model of the transport system.	3
Proj13	Optimization of the transport system model due to the indicated sizes - a review of mathematical tools.	3
Proj14	Implementation of the optimization of the transport system model due to the indicated sizes.	3

Proj15	Presentation of the results obtained.	3
		Total hours: 45

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_U01, PEK_K01	average marks on the implementation of individual project stages
F2	PEK_W01, PEK_W02, PEK_U01, PEK_K01	assessment for the presentation of the project
F3	PEK_W01, PEK_W02, PEK_U01, PEK_K01	activity in discussion during the project implementation
P = 40%*F1+40%*F2+20%*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Marcinkowski J.: Systemy transportowe. Środki transportu. Politechnika Wrocławska, Wrocław 1988.
[2] Tarski I.: Czynnik czasu w procesie transportowym. WKŁ, Warszawa 1976.
[3] Molecki B. (red.): Rola samorządu w kształtowaniu transportu regionalnego w Polsce i w Europie. Politechnika Wrocławska, Wrocław 2010.
[4] Podstawy racjonalnej eksploatacji maszyn. Red. M. Woropay. Biblioteka Problemów Eksploatacji. ITE, Radom 1996.
[5] Poradnik niezawodności, tom I. Red. J. Migdalski. WEMA, Warszawa 1982.
[6] Poradnik Niezawodności, tom II. Red. J. Migdalski. WEMA, Warszawa 1992.
[7] 1. Basiewicz T., Gołaszewski A., Rudziński L.; Infrastruktura transportu. Politechnika Warszawska, 2007
[8] Gaca S., Suchorzewski W., Tracz M.: Inżynieria ruchu drogowego. Teoria i praktyka. Wydawnictwa Komunikacji i Łączności, Warszawa 2008.
[9] M. Leśko – Porty lotnicze, pola wzlotów i urządzenia nawigacyjne, Dział Wydawnictw Politechniki Śląskiej, Gliwice 1987.
[10] R. Krystek, praca zbiorowa – Węzły drogowe i autostradowe, Wydawnictwa Komunikacji i Łączności, Warszawa 2008.

SECONDARY LITERATURE
[1] Korzan B.: Elementy teorii grafów i sieci. Metody i zastosowania. WNT, Warszawa 1978.
[2] Komar Z., Wolek Cz.: Inżynieria ruchu drogowego. Wybrane zagadnienia. Politechnika Wrocławska, Wrocław 1994.
[3] Cormen T. H., Leiserson Ch. E., Rivest R. L.: Wprowadzenie do algorytmów. WNT, Warszawa 1997 i in.
[4] Sysło M. M., Deo N., Kowalik J. S.: Algorytmy optymalizacji dyskretnej. PWN, Warszawa 1995.
[5] Wyrzykowski W.: Ruch kolejowy (tom I - ruch pociągów). WKŁ, Warszawa 1966.
[6] Chwieduk A., Dyr T.: Projektowanie ruchu pociągów. Politechnika Radomska, Radom 1997.
[7] miesięcznik "Transport Miejski i Regionalny".
[8] miesięcznik "Technika Transportu Szynowego".
[9] miesięcznik "Autobusy - Technika, Eksploatacja, Systemy Transportowe".

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_U	K2MBM_ST_U01, K2MBM_ST_U04, K2MBM_ST_U06, K2MBM_ST_U07	C1,C2,C3	Proj1-Proj15	N1-N4
PEK_K	K2MBM_ST_K01, K2MBM_ST_K02, K2MBM_ST_K03	C1,C2,C3	Proj1-Proj15	N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania ruchu drogowego**
Name in English: **Studies of road traffic**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041509**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Required knowledge of issues related to the organization of road traffic.
2. Required skills for making measurements using typical devices.
3. There are no prerequisites in terms of competences.

SUBJECT OBJECTIVES

C1. Familiarization of students with the measurement methods used in road traffic research.
C2. Indication of problems occurring during planning and organization of measurements.
C3. Practicing group work skills.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course, the student will have in-depth and structured knowledge in the field of road traffic.

II. Relating to skills:
PEK_U01 - As a result of the course the student will be able to conduct a detailed analysis and study of the functioning of road transport systems.

III. Relating to social competences:
PEK_K01 - As a result of the course the student will broaden his experience with creative thinking, entrepreneurship and group work.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introductory classes. Familiarization with measurement techniques, discussion of health and safety issues during field measurements.	2
Lab2	Measurement of traffic at the intersection (directional and generic structure).	2
Lab3	Determination of intersection capacity (by analytical method and including traffic intensity studies).	2
Lab4	Measuring the filling of vehicles (determining the average number of passengers in passenger cars).	2
Lab5	Measurement of speed (section mean).	2
Lab6	Measurement of time losses at the intersection without signaling (waiting time for subordinate relations).	2
Lab7	Measurement of time losses at the intersection with signaling (average waiting time).	2
Lab8	Measurement of time losses at the intersection covered by congestion (blocking times).	2
Lab9	Measurement of parking facilities (filling level, rotation rate).	2
Lab10	Measurements of pedestrian traffic (intensity, directional structure of traffic, preferences in route selection).	2
Lab11	Measurement of loss of pedestrians and cyclists' time on crossing and passing (average waiting time).	2
Lab12	Measurement of time losses of pedestrians and cyclists at the intersection with signaling (average waiting time).	2
Lab13	Cordon measurements (determination of the traffic junction).	2
Lab14	Measurements of traffic flow at rail and road level crossing and determination of the crossing category.	2
Lab15	Repeat meeting	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. field measurements
N3. case study
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01	partial grades for measurement reports; consisting (as an average) for the final grade (passing all positive partial grades)
P = P = 100%*F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE
[3] "Transport Miejski i Regionalny"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Studies of road traffic
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_ST_U01, K2MBM_ST_U04	C1		N1-N4
PEK_K01	K2MBM_ST_K04, K2MBM_ST_K10	C2		N1-N4
PEK_K01	K2MBM_ST_K02, K2MBM_ST_K05	C3		N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania transportu zbiorowego**
Name in English: **Studies of public transport**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041510**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Required knowledge of issues related to the organization of passenger transport.
2. Required skills for making measurements using typical devices.
3. There are no prerequisites in terms of competences.

SUBJECT OBJECTIVES

C1. To acquaint students with the measurement methods used in mass transport research.
C2. Indication of problems occurring during planning and organization of measurements.
C3. Practicing group work skills.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course, the student will have deepened and structured knowledge of the functioning of passenger transport.

II. Relating to skills:
PEK_U01 - As a result of the course the student will be able to conduct a detailed analysis and study of the functioning of passenger transport systems.

III. Relating to social competences:
PEK_K01 - As a result of the course the student will broaden his experience with creative thinking, entrepreneurship and group work.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introductory classes. Familiarization with measurement techniques, discussion of health and safety issues during field measurements.	2
Lab2	Measurement of travel time (observers inside vehicles).	2
Lab3	Measurement of time losses at intersections with signaling (observers outside the vehicle).	2
Lab4	Measurement of punctuality (observers at stops).	2
Lab5	Cross-section filling measurements (observers outside the vehicle).	2
Lab6	Measurement of fillings on the route (observers inside vehicles).	2
Lab7	Measurement of passenger exchange time on the interchange node (observers at stops).	2
Lab8	Measuring the filling of landing platforms (observers at stops).	2
Lab9	Measuring the filling of landing platforms (observers at stops).	2
Lab10	Measurement of passenger behavior at the stop using film technique (observers at stops).	2
Lab11	Measurement of movement disturbances with accommodative signaling (observers at the intersection).	2
Lab12	Measurement of traffic disturbances at the end of the route (loops, terminals, observers at stops).	2
Lab13	Research on the quality of passenger information systems (mysterious customer method).	2
Lab14	Qualitative tests of ticket machines (functional analysis).	2
Lab15	Repeat meeting	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. field studies
N3. case study
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01	partial grades for measurement reports; consisting (as an average) for the final grade (passing all positive partial grades)
P = P = 100%*F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Tracz M. (red.): Pomiary i badania ruchu drogowego. WKŁ, Warszawa 1984.
[2] pr. zb.: Organizacja i technika ruchu miejskiej komunikacji zbiorowej. Biuro Wydawnictw MHWiU, Warszawa 1972.

SECONDARY LITERATURE

[3] monthly "Transport Miejski i Regionalny".

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K01	K2MBM_ST_K04, K2MBM_ST_K10	C2	La1-La15	N1-N4
PEK_U01	K2MBM_ST_U01, K2MBM_ST_U04	C3	La1-La15	N1-N4

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Gry dyspozytorskie**
Name in English: **Dispatcher games**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041511**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mastering basic skills in the management of transport systems.
2. Basic teamwork skills.

SUBJECT OBJECTIVES

C1. Familiarizing with the tasks and methods of operation of the current dispatching services
C2. Practical gaining knowledge about operating conditions of the dispatch and the possibilities of its improvement, along with their verification
C3. Acquainting with the conditions of group activities in situations of high stress.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course, the student should be able to identify the needs in the operation of the transport company's dispatch and make recommendations to improve its functioning

II. Relating to skills:
PEK_U01 - As a result of the course the student should get the skills to manage and control the transport system, along with management in crisis situations.
PEK_U02 - As a result of the course, the student should be able to choose the methods of work of the dispatch office and develop auxiliary measures useful in these activities and to verify their suitability in the operations of the current transport company.

III. Relating to social competences:
PEK_K01 - As a result of the course, the student should improve his / her group work skills, assigning tasks among group members (taking into account their capabilities and predispositions). It should also increase his sense of responsibility for entrusted tasks and their personal implementation.

PROGRAMME CONTENT

Form of classes – Classes		Number of hours
Cl1	Introduction to the laboratory. Discussion of issues related to conducted simulation experiments. Discussing the organization of dispatcher services.	2
Cl2	The first game: monorail single-track lines - introductory games (in the tram system using single-track sections, the automatic inter-city signaling has been damaged, therefore the traffic on all sections is directly controlled by the dispatch).	2
Cl3	The first game: group A experiment, observed group B, C, D.	2
Cl4	The first game: group B experiment, observed group A, C, D.	2
Cl5	The first game: group C experiment, observed group A, B, D.	2
Cl6	The first game: group D experiment, observed group A, C, B.	2
Cl7	The second game: collective taxis - introductory games (a relatively small number of residents live in a fairly large area; for public reasons, public transport has been organized - in the form of collective taxis, residents, when they want to take a trip, call to the dispatch office and report: where and from where they have going to go, the dispatcher tries to organize transport with the limited number of available vehicles in the shortest possible time).	2
Cl8	The second game: group A experiment, observed group B, C, D.	2
Cl9	The second game: group B experiment, observed group A, C, D.	2
Cl10	The second game: group C experiment, observed group A, B, D.	2
Cl11	The second game: group D experiment, observed group A, C, B.	2
Cl12	The third game: the network of connections of Low Cost Airlines - introductory games (in the TLL connection grid there are many unplanned events, such as: changes of destination ports, damage to aircraft or cancellation of flights, due to these events and the specificity of TLL functioning there is a high probability occurrence of traffic disturbances - the dispatcher's task is to minimize the effects of disturbances).	2

Cl13	Third game: group A and B experiment, observes group C and D.	2
Cl14	Third game: group C and D experiment, observes group A and B.	2
Cl15	Summary of the results of the experiments carried out. Discussion on the best dispatching strategies and good practices in the organization of dispatching services.	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. laboratory experiment
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02, PEK_K01	average grades from individual laboratory experiments (positive tests are required for all experiments)
P = 100%*F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Adamski A.: Inteligentne systemy transportowe - sterowanie, nadzór i zarządzanie. AGH, Kraków 2003.

SECONDARY LITERATURE
[2] Szkóp Z.: Podręcznik dla dyspozytora ruchu. Wydawnictwa Komunikacyjne, Warszawa 1953.
[3] Banaszkiewicz S., Marszałek S.: Organizacja służby dyspozytorskiej w transporcie samochodowym. WKŁ, Warszawa 1972.
[4] miesięcznik "Transport Miejski i Regionalny"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dispatcher games
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_ST_U01, K2MBM_ST_U02, K2MBM_ST_U04, K2MBM_ST_U07	C1-C3	Cl1-Cl15	N1-N3
PEK_K01	K2MBM_ST_K04, K2MBM_ST_K06	C1-C3	Cl1-Cl15	N1-N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie ruchem kolejowym**
Name in English: **Rail control command and signaling**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041512**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of issues related to railway traffic engineering and the design of transport processes on the railway (timetable construction, infrastructure impact on distribution parameters).
2. Ability to estimate technical time intervals in railway traffic and to determine with them the approximate capacity of routes and network nodes.
3. There are no prerequisites in terms of competences.

SUBJECT OBJECTIVES

C1. Acquainting with various solutions of railway traffic control devices (advantages, disadvantages, costs, operational problems).
C2. Acquainting with the basics of designing rail traffic control devices.
C3. Acquiring the ability to use regulations and railway instructions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course the student should be able to recognize and explain the differences between particular types of railway traffic control devices.

II. Relating to skills:
PEK_U01 - As a result, the student should be able to design the arrangement of traffic control devices on the line and railway station.
PEK_U02 - As a result of the course the student should be able to evaluate different types of railway traffic control devices and choose the most effective ones in the long-term.
PEK_U03 - As a result of the course the student should acquire the ability to use the regulations, standards and instructions in the field of designing railway traffic control devices.

III. Relating to social competences:
PEK_K01 - Ability to work in a group

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the problems of railway traffic control. Discussion of applicable regulations and instructions. Presentation of the scope of the subject and rules for passing.	2
Lab2	Project of the deployment of rail traffic control devices on the line.	2
Lab3	Project of dependencies of railway traffic control devices on the line.	2
Lab4	Project arrangement of railway traffic control devices at the station.	2
Lab5	Project of dependencies of railway traffic control devices on the station.	2
Lab6	Mechanical hand (Key) devices - assumptions.	2
Lab7	Mechanical hand (Key) devices - timing and capacity.	2
Lab8	Mechanical centralized devices - assumptions.	2
Lab9	Mechanical centralized devices - timing and capacity.	2
Lab10	Relay devices - assumptions.	2
Lab11	Relay devices - timing and capacity.	2
Lab12	Traffic Control Center - assumptions.	2
Lab13	Traffic Control Center - timing and capacity.	2
Lab14	Educational trip to a traffic control point.	2
Lab15	Summary discussion, combined with project presentations and discussion of the most interesting elements.	2
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for project class
N3. project presentation
N4. report preparation
N5. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_U01, PEK_U02, PEK_U03	project evaluation based on a presentation and a written report
F2	PEK_W01	assessment of the activity during the discussion on individual stages of the project
P = 80%*F1+20%*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Massel A.: Projektowanie linii i stacji kolejowych. Kolejowa Oficyna Wydawnicza, Warszawa 2010.
[2] Dąbrowa-Bajon M.: Podstawy sterowania ruchem kolejowym. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2002.

SECONDARY LITERATURE
[3] Wytyczne Techniczne Budowy urządzeń sterowania ruchem kolejowym w przedsiębiorstwie PKP (WTB-E10), PKP Warszawa 1996.
[4] Karaś S.: Urządzenia zabezpieczenia ruchu kolejowego. WKŁ, Warszawa 1990.
[5] kwartalnik "Telekomunikacja i sterowanie ruchem".

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Rail control command and signaling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K01	K2MBM_ST_K02, K2MBM_ST_K05	C2, C3	Pr1-Pr15	N1-N5
PEK_U01	K2MBM_ST_U01, K2MBM_ST_U04	C1, C3	Pr6-Pr13	N1-N5

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza ryzyka**
Name in English: **Risk Analysis**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041513**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basics of Operation and Maintenace
2. Statistics

SUBJECT OBJECTIVES

C1. Promotion of technical safety
C2. Ability of hazards identification in technical processes
C3. Know-how of risk analysis and assessment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Acquaintance of systemic analysis
PEK_W02 - Acquaintance of risk analysis and assessment algorithm

II. Relating to skills:
PEK_U01 - Student should know how to use systemic approach to material resources and processes
PEK_U02 - Student should know how to perform risk analysis and assessment

III. Relating to social competences:
PEK_K01 - Student should take care of self and neigbourhood safety

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, description of course contents and basic ideas	2
Lec2	State of art about safety science	2
Lec3	Cause- consequence chain	2
Lec4	Safety models I	2
Lec5	Safety models II	2
Lec6	Hazard and safety concept	2
Lec7	Risk measures	2
Lec8	Risk acceptance	2
Lec9	Concept of ALARP, BATNEC, SIL	2
Lec10	Review of world catastrophes	2
Lec11	Safety measures	2
Lec12	Analysis of analytical methods in safety according to EN-IEC 31010 I	2
Lec13	Analysis of analytical methods in safety according to EN-IEC 31010 II	2
Lec14	Examples of FMEA, HAZOP	2
Lec15	Examples of PHA, FTA, ETA	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_W1, PEK_W2	written exam
P = P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Jaźwiński J., Ważyńska K., Bezpieczeństwo systemów. WNT Warszawa

SECONDARY LITERATURE
Rausand M., Internet lectures

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Risk Analysis
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_ST_W04, K2MBM_ST_W09	C2	Lect6,Lect7, Lect8	n1
PEK_K	K2MBM_ST_K03, K2MBM_ST_K08	C1	Lect1,Lect2, Lect3	n1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie systemu transportu wewnętrznego**
Name in English: **Designing the warehouse operations system**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041514**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has a basic knowledge of management and design processes and logistics systems
2. Has knowledge in the field of logistics

SUBJECT OBJECTIVES

C1. Understanding the issues concerning planownaia and projektownaia transport and storage systems
C2. Acquiring the ability to plan and organize material and information flows in warehouses.
C3. Acquiring the ability to optimize logistics systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Able to define the concept of transport system - storage, explain its construction, calling its individual components.
PEK_W02 - Can describe for selected cases to propose their own solutions for transport and storage, discussing their choices, to indicate the most appropriate having regard to the strategy
PEK_W03 - Able to calculate the sample solution and transport system magayznowego at the operational level.

II. Relating to skills:
PEK_U01 - He can decide and choose the elements of the design process and transport and storage.
PEK_U02 - Has the ability to develop a system of documentation for transportation and storage.
PEK_U03 - Has the ability to estimate the cost of transport and storage system and exploit them.

III. Relating to social competences:
PEK_K01 - Works independently and interact as a team
PEK_K02 - Respects the findings doing the job.
PEK_K03 - Discussed, maintaining openness to other sentence.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introductory lecture: - The content of the lecture. - Assessment and timing tests. - Basic and further reading. - Organization of the course.	1
Lec2	Identification of logistic processes in conveying and storage. -definition Warehouse. Identify the basic processes of transport and storage. Identify the functional-process storage areas. -definition Unit load. -Fronty Handling. -Work Cargo.	2
Lec3	The allocation of the objects in the planning of cargo flows. Metoda Schimigalli. computer Metody Trucking - optimization of cargo flows Problem transport route planning. Podstawowe structural solutions. Przykłady computing	2
Lec4	Designing storage structure. Magazyny: high and low storage. Magazyn the "regime" temperature. Magazyn cross-dock. Magazyn bulk materials. Magazyn liquid materials.	2

Lec5	Selection of equipment for storage. Składowanie static without racking (short repetition). Składowanie static. Składowanie dynamic.	2
Lec6	Wózki widłowe. Charakterystyka wózków widłowych uniwersalnych. Charakterystyka wózków widłowych specjalizowanych.	2
Lec7	Rack Charakterystyka stacking machines. Harmonogramowanie time stacker cranes. Optymalizacja stacker cranes work.	2
Lec8	Dobór środków przepływu informacji. Oznaczanie miejsc paletowych w magazynie. Oznaczanie jednostek ładunkowych w magazynie. Wybór technologii wymiany informacji w logistycznym systemie magazynowym. Dobór urządzeń czytających kody 1D, 2D i RFID. (skanery stacjonarne, radiowe, ze stacją dokującą, kamery) Dobór urządzeń drukujących/ programujących: kody 1D, 2D i RFID.	1
Lec9	test	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Discussion of the organization of classes and examination of project activities. Providing basic and supplementary literature. Development of unit load forming algorithm EURO subjects piece of various dimensions, weight, size and resistance to physical exposure.	1
Proj2	Project deposition distribution of palletised goods in the warehouse, taking into account the classification: areas, zones and places.	2
Proj3	Scheduling transport cycles of selection and evaluation of technical means used in the design magazine - for example a forklift.	2
Proj4	Scheduling transport cycles of selection and evaluation of technical means used in the design magazine - for example rack stacker crane.	2
Proj5	Project completion storage subsystem piece units on the main line and picking bays.	2
Proj6	Analysis and identification of logistics for the storage system adopted in the project storage solutions for process automation.	2
Proj7	Choice concept store, technologies and processes - with diversity dimensions of goods and the size of the line of orders (from single pieces to full pallets on the same SKU).	2
Proj8	Overview of completed projects, a summary of the project activities. Credits.	2
		Total hours: 15

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	evaluation of the computational part of the project
F2	PEK_K01, PEK_K02, PEK_K03	participation in discussions of problem, the report - in the form of presentation of the group their projetów, defense project
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Korzeń Z.: „Logistyczne systemy transportu bliskiego i magazynowania” T. I; Instytut Logistyki i Magazynowania, Poznań, 1998.
2.Korzeń Z.: „Logistyczne systemy transportu bliskiego i magazynowania” T. II, Instytut Logistyki i Magazynowania, Poznań, 1999.
3.Krawczyk S. (red.): „Logistyka. Teoria i Praktyka”, T.1, DIFIN, Warszawa, 2012.
4.Krawczyk S. (red.): „Logistyka. Teoria i Praktyka”, T.2, DIFIN, Warszawa, 2012.
5.Zając P.: „Systemy magazynowe”, Oficyna Wydawnicza NDiO, Wrocław, 2010.
6.Fijałkowski J.: „Transport wewnętrzny w systemach logistycznych”; Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001.

Czasopisma specjalistyczne:
1.Logistyka
2.Nowoczesny Magazyn
3.Eurologistics

SECONDARY LITERATURE

[1]. Gudehus T.: „Logistik” T. I; Grundlagen, Verfahren und Strategien; Springer, Hamburg; 1999;
[2]. Gudehus T.: „Logistik” T. I; Netzwerke, Systeme und Lieferketteen; Springer, Hamburg; 1999;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Designing the warehouse operations system
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_ST_W01, K2MBM_ST_W02, K2MBM_ST_W09, K2MBM_ST_W11	C1, C2, C3	Wy1, Wy2, Wy3, Wy4, Wy5, Wy6, Wy7	N1, N2, N3,
PEK_U	K2MBM_ST_U01, K2MBM_ST_U04, K2MBM_ST_U08	C2	Pr1, Pr2, Pr3, Pr4, Pr5, Pr5, Pr6, Pr7, Pr8	N4, N5
PEK_K	K2MBM_ST_K02, K2MBM_ST_K04, K2MBM_ST_K05	C3	Pr1, Pr2, Pr3, Pr4, Pr5, Pr5, Pr6, Pr7, Pr8	N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy transportu lotniczego**
Name in English: **Airforce transportation systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041515**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of mathematics, the laws of physics and chemistry.
2. Ability to use and retrieve information from the literature and the Internet.
3. He understands the need for education and understanding the role of social engineer.

SUBJECT OBJECTIVES

C1. Understanding the principles of operation and organization of air transport systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can discuss and explain the principles of operation of the air transport system within its limitations (ground handling, maintenance of specific provisions - LAR, DGR, WHA, etc.)

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - He understands the need for continuous training. Recognize the effects of the impact of technology on the environment and related social responsibility techniques. He can think and act in an entrepreneurial manner.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic knowledge of the air transport system	2
Lec2	Fundamentals of traffic engineering	2
Lec3	The role of air carriers and airports in the air transport system	2
Lec4	Ground handling of aircraft	2
Lec5	Maintenance of the aircraft	2
Lec6	The use of the aircraft - the implementation of grid connection	2
Lec7	General information concerning the carriage of goods - law (WHA, DGR, LAR, AHM, CHM, GHM), operating systems (Lufthansa Cargo - Mosaik View, Lot - CargoSpot)	2
Lec8	Technical and legal considerations in the transport of live animals (LAR regulations)	2
Lec9	Technical and legal considerations in the carriage of dangerous goods (DGR regulations)	2
Lec10	Technical and legal considerations in the carriage of other goods (General Cargo, HUM, PER). Restrictions - Embargo. Fixing charges.	2
Lec11	Technical and legal considerations in the carriage of passengers	2
Lec12	Construction of grid connections for different types of flights. General information on the Flight Plan	2
Lec13	The balance of the aircraft	2
Lec14	Incidents and accidents	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_K01	test
P = 100%*F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. W. Rydzykowski, K. Wojewódzka-Król: Transport, PWN, Warszawa 2007.2. I. Szymajda, M. Polkowska: Konwencja montrealska, Liber, 2004.3. IATA: Dangerous Goods Regulation, 2012 4. IATA: Live Animals Regulations, 201 25. Lufthansa Cargo: Cargo Handling Manual, 2012 6. Lufthansa Cargo: Ground Handling Manual, 2012 7. Lufthansa Cargo: Airport Handling Manual, 2012

SECONDARY LITERATURE

1. User Manual - Mosaik View2. User Manual - CargoSpot

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Airforce transportation systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
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_ST_W02, K2MBM_ST_W09, K2MBM_ST_W16	C1	Lec1-Lec15	N1-N2
PEK_K01	K2MBM_ST_K03, K2MBM_ST_K08	C1	Lec1-Lec15	N1-N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy transportu wodnego i rurociągowego**
Name in English: **Water and pipelines transport systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041516**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ordered knowledge of the management of transportation systems.
2. Ordered knowledge of the construction and operation of transport means.

SUBJECT OBJECTIVES

C1. Understanding the principles and organization of the maritime transport, inland navigation and pipeline transportation.
C2. Understanding the relationship between the weather, the hydro conditions and organization's policies of inland navigation.
C3. Transport task scheduling skills using water transport system.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Recognizes factors affecting the operating principles of water transport system.
PEK_W02 - Student is able to recognize the impact of external factors on the operation of water transport systems.
PEK_W03 - Identifies and distinguishes the elements and factors affecting the operation of a pipelines system.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Understands the need for continuous training.
PEK_K02 - Recognizes the effects of the technology impact on the environment and related social responsibility of the technique.
PEK_K03 - Can think and act in an entrepreneurial manner.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role and importance of maritime transport in the global economy. Structure and direction of movement of goods to world trade	2
Lec2	Means of transport and loading units in maritime transport	2
Lec3	Classic systems in maritime transport - tramping, liner shipping	2
Lec4	The development of the maritime transport, integrated transport chains	2
Lec5	Impact of harbor infrastructure on development of maritime transport systems	2
Lec6	The rules of operation and management practices in maritime transport operators	2
Lec7	The principles and criteria for selection the voyage route in maritime transport. The assessment methods of the impact of weather conditions on the cost of shipping	2
Lec8	Maritime transportation system in Poland. Inland navigation, its role in the transport system of Poland	2
Lec9	Inland navigation, its role in the transport system of the EU. Inland transportation system - the pushed system	2
Lec10	Trends in the development of inland water transport systems in the EU and selected worldwide countries	2
Lec11	Effect of hydrotechnical parameters on the system and costs in inland waterway transportation	2
Lec12	Integrated waterway transportation - combined transportation, intermodal transportation, multimodal transportation	2
Lec13	Pipeline transportation and its role in trade	2
Lec14	Pipeline transportation systems, costs and safety in the pipeline transportation	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
W. Rydzykowski, K. Wojewódzka-Król: Transport PWN Warszawa 2007.
B. Wisnicki: Vadwmecum konteneryzacji, Szczecin, 2006.
K. Ficoń: Logistyka morska, Warszawa, 2010.

SECONDARY LITERATURE
K. Wojewódzka -Król, R. Rolbiecki, W. Rydzykowski: Transport wodny śródlądowy, Uniwersytet Gdański, Gdańsk 2007.
Henry Liu: Pipeline Engineering, Lewis Publishers, 2003.
J. Kulczyk, J. Winter: Śródlądowy transport wodny, Politechnika Wrocławska, 2003.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Water and pipelines transport 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_W	K2MBM_ST_W16, K2MBM_ST_W18	C1, C2, C3	Le1-Le14	N1, N2
PEK_K	K2MBM_K01, K2MBM_K06, K2MBM_ST_K01, K2MBM_ST_K03, K2MBM_ST_K06, K2MBM_ST_K08	C1, C2, C3	Le1-Le14	N1, N2

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy teleinformatyczne**
Name in English: **Teleinformatics systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041517**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1. Completed IT Course I or similar.
2. 1. Completed IT Course II or similar.

SUBJECT OBJECTIVES

C1. Understanding the principle of operation of the latest communication technologies, especially used in transport.
C2. Understand the principle of global communication.
C3. Understanding basic teleinformatic protocols, applicable in transport.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It explains the principle of operation of the latest communication technologies, especially used in transport.
PEK_W02 - It explains the principle of operation of the global communication network.
PEK_W03 - Can characterize basic teleinformatic protocols, applicable in transport.

II. Relating to skills:
PEK_U01 - It chooses the right ICT for transport.
PEK_U02 - Uses global network resources.
PEK_U03 - Coordinates the implementation of ICT services for transport.

III. Relating to social competences:
PEK_K01 - He can think and act in a creative and entrepreneurial way, using the latest ICT.
PEK_K02 - He understands the need to formulate and communicate to the public - with use Information and communication technologies - information and opinions on transport achievements.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Servers.	2
Lec2	PTNS network.	2
Lec3	2nd and 2nd generation cellular systems: GSM, UMTS.	2
Lec4	Generation IV systems: LTE, WiMAX.	2
Lec5	IP networking	2
Lec6	Multimedia satellite systems.	2
Lec7	Satellite navigation systems (GLONASS, Galileo, GPS).	2
Lec8	Intelligent urban traffic control systems.	2
Lec9	Security of ICT systems.	2
Lec10	IP counting	12
		Total hours: 30

TEACHING TOOLS USED

N1. case study
N2. calculation exercises
N3. 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	1	Exam
F2	2	Exam
F3	3	Exam
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Silberschatz A., Peterson J. L., Gagne G., Podstawy systemów operacyjnych, Wydawnictwa Naukowo Techniczne, Warszawa 2005.
[2] Stevens W. R., Biblia TCP/IP. Tom 1. Protokoły, Wydawnictwo RM, Warszawa 1998.
[3] Sportack M. A. Podstawy Adresowania IP. Mikom, Warszawa 2008.
[4] Bradford R., Podstawy Sieci Komputerowych. WKiŁ, Warszawa 2009.
[5] Global Positioning System. http://www.gps.gov.
[6] Naval Oceanography Portal. http://www.usno.navy.mil/USNO/time/gps/current-gps-constellation.
[7] Telematyka Transportu, http://www.it.pw.edu.pl/twt/loader.php?page=telematyka.
[8] Jamroz K., Oskarbski J., Zarządzaniem Bezpieczeństwem Ruchu Drogowego w systemi TriStar. Gambit 2006.

SECONDARY LITERATURE
[1] University of Minnesota ITS Institute. http://www.its.umn.edu.
4/4
[2] Bartczak K. Scenariusze rozwoju ITS w polskim transporcie drogowym w latach
2008-2013 cz.1. Przegląd ITS, nr 1

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Teleinformatics 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_W	K2MBM_ST_W17, K2MBM_ST_W18	C1 C2 C3	W2 W3 W6	N3
PEK_K	K2MBM_ST_K06, K2MBM_ST_K10	C1 C2 C3		N1 - N3

SUBJECT SUPERVISOR

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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):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MMM041551, MMM041552**
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)				600	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				20	
including number of ECTS points for practical (P) classes				20	
including number of ECTS points for direct teacher-student contact (BK) classes				20.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge in the field of mechanics and machine building documented with positive pass markings for all subjects including specialty courses Design and Operation of Machines and Vehicles or in the field of transport.
2. He is able to obtain information from the literature. Analyze and conclude on the basis of conducted observations and analyzes.

SUBJECT OBJECTIVES

C1. Individual preparation of the master's thesis, including the analysis of the problem posed for the purpose of work, selection of appropriate methods and techniques, and proposing a method for its solution and defending the results of their work
C2. Expanding the ability to acquire information from various sources, as well as preparing and presenting oral and multimedia presentations, on issues to be solved as part of the diploma thesis
C3. Acquisition and consolidation of independent work skills, defining goals and tasks to be implemented, selection of appropriate methods and techniques, and documenting your work

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is able to diagnose problems related to the design of a transport system, choose the appropriate methods and techniques and plan their implementation
PEK_U02 - Can acquire information from literature, databases and other properly selected sources, also in foreign languages; can also integrate the obtained information, make their interpretation and critical evaluation
PEK_U03 - Is able to analyze and evaluate existing transport systems and suggest ways to reorganize and optimize them due to the optimization criteria

III. Relating to social competences:
PEK_K01 - Is aware of the responsibility for his own work and the implementation of the adopted tasks
PEK_K02 - Is able to properly define priorities for the implementation of a specific task
PEK_K03 - Understands the need to learn throughout life, and also knows the possibilities of continuous learning and raising professional, personal and social competences

PROGRAMME CONTENT

TEACHING TOOLS USED

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Basic literature consistent with the promoter's proposal, specified in the diploma thesis card

SECONDARY LITERATURE
1. Majchrzak J.:Metodyka pisania prac magisterskich i dyplomowych, Wydawnictwo Uniwersytetu Ekonomicznego, Poznań 2009
2. Brycz B.: Przewodnik dla piszących prace magisterskie w zakresie zarządzania, Polskie Wydawnictwo Ekonomiczne, Warszawa 2011

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MASTER THESIS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
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_K07, K2MBM_K10			

SUBJECT SUPERVISOR

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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, full-time**
Kind of subject: **optional**
Subject code: **MMM042151**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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 - is 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.	4
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.	4
Lec11	Construction, principle of operation, working methods, technical characteristics, the base of estimating of material flow of selected machines: C) graders, road rollers, pavers bitumen; D) stationary and mobile cranes.	4
Lec12	MBS for modeling machines, simplifying assumptions, simulation environments.	2
		Total hours: 30

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.	20
		Total hours: 20

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
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_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	prositive mark
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
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

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM042409**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Repetition of the most important news in the field of study
C2. Timely implementation of the diploma thesis.
C3. Skillful presentation of the content of the diploma thesis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - He can answer with the examination questions in the field of study.
PEK_U02 - He is able to discuss the content and achieved resumes of the diploma thesis.

III. Relating to social competences:

PEK_K01 - Understands the need to critically discuss the results of scientific and technical work.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction; rules for writing a diploma thesis; the course of the diploma exam	2
Sem2	Repetition of the material - questions 1 - 20	2
Sem3	Repetition of the material - questions 21 - 40	2
Sem4	Repetition of the material - questions 41- 60	2
Sem5	Repetition of the material - questions 61 - 80	2
Sem6	Repetition of the material - questions 81 - 100	2
Sem7	Repetition of the material - questions 101 -120	2
Sem8	Presentation of the status of the diploma theses - 4 students	2
Sem9	Presentation of the status of the diploma theses - 4 students	2
Sem10	Presentation of the status of the diploma theses - 4 students	2
Sem11	Presentation of the status of the diploma theses - 4 students	2
Sem12	Presentation of the status of the diploma theses - 4 students	2
Sem13	Presentation of the status of the diploma theses - 4 students	2
Sem14	Presentation of the status of the diploma theses - 4 students	2
Sem15	Presentation of the status of the diploma theses - 4 students	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem discussion
N2. multimedia presentation

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Poradnik inżyniera-mechanika. Tom I, II. Wydawnictwa Naukowo - Techniczne. W-wa. 1994

SECONDARY LITERATURE

http://wmech.pwr.wroc.pl/88431,91.dhtml; zalecenia edytorskie pisania pracy dyplomowe

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	K2MBM_U17			
PEK_K	K2MBM_K07			

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Alternatywne układy napędowe**
Name in English: **Alternative Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMR031401L**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of informatics and solving differential equations.
2. Having a knowledge of mechanics.
3. Ability to analyze and design systems in particular hydraulic drive systems.

SUBJECT OBJECTIVES

C1. Gaining skills in modeling and simulation of the systems.
C2. Knowledge of design methodology using a computer simulation system.
C3. Performance analysis of the results of computer simulation in the form of a report and / or a multimedia presentation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Is able to build a simulation model of a selected real object.
PEK_U02 - Understand the purpose and can simplify the actual model and describe it in the form of mathematical equations.
PEK_U03 - Is Able to plan a program of simulation, analyze the results, draw conclusions and present them in an appropriate form.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to Simulink	2
Lab2	Creation of a model and simulation of a harmonic oscillator.	2
Lab3	Creation of a model and simulation of hydraulic bumper..	2
Lab4	Creation of a model and simulation of vehicle entry to the curb (car suspension).	4
Lab5	Creation of a model and simulation of start up of hydrostatic transmission.	4
Lab6	The choice of project for realizing in the second half of the semester. Subject should be related to modeling and simulation of the alternative drive system used in motor vehicles.	2
Lab7	The operation analysis of the structure or process. Real model.	2
Lab8	Simplifying assumptions- physical model.	2
Lab9	Creation of a mathematical model of the object. Implementation of the simulation model.	2
Lab10	Running the simulation model. The simulation research.	4
Lab11	Analysis and study results.	2
Lab12	Presentation of the results	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. problem discussion
N3. The report from the laboratory

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Laboratory report
F2	PEK_U02	Report
F3	PEK_U03	Participation in discussions
P = 0,4F1+0,4F2+0,2F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Matlab Simulink – Handbook, 2010.
2.Cannon R.H. jr: Dynamic of phisical systems. WNT. 1973.
3.BP Zeigler, H Praehofer, TG Kim: Theory of modeling and simulation: Integrating discrete event and continuous complex dynamic systems. 2000.
4.Lennart Ljung: System Identification. 1999.
5. Raymond J. Madachy: The Modeling Process with System Dynamics, 2007.
6. Kulisiewicz M., Piesiak S.: Metodologia modelowania i identyfikacji mechanicznych układów dynamicznych. Oficyna Wydawnicza Politechniki Wrocławskiej, 1995.
6.Nizioł J.: Podstawy drgań w maszynach. Skrypt Politechniki Krakowskiej, Kraków 1996.
7.Szczepaniak C.: Podstawy modelowania systemu: człowiek – pojazd – otoczenie. wyd. Nauk. PWN 1999.

SECONDARY LITERATURE

1.Bekey G.A., Karplus W.I.: Obliczenia hybrydowe. WNT 1976.
2.Kącki E.: Równania różniczkowe cząstkowe w zagadnieniach fizyki i techniki. PWN 1992.
3.Osiński Z.: Zbiór zadań z teorii drgań. PWN. 1988.
4.Budak M., Samerski A., Tichonov V.: Badania i problemy fizyki matematycznej. PWN 1965.
5.Arczyński S.: Mechanika ruchu samochodu. WNT, Warszawa 1997.
6.MitschkeM.: Dynamika samochodu. Tom 1. Napęd i hamowanie. WKiŁ 1987. Tom 2. Drgania. WKiŁ 1988.

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

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

PEK_UO1	K2MBM_AE_U14	c1	Lab1; Lab2; Lab3; Lab4; Lab5	N1, N2, N3
PEK_UO2	K2MBM_AE_U03, K2MBM_AE_U14	c2	Lab6 to Lab10	N1, N2, N3
PEK_U03	K2MBM_AE_U03	c3	Lab11; Lab12	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Alternatywne układy napędowe**
Name in English: **Alternative Drive Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable): **Automotive Engineering**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MMR031401W**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The base knowlege about electricity, definition of DC and AC voltage and electrical current, resistancy, reactancy, impedancy, electrical capacity and inductancy, frequency,active,reactive and apperancy elecrtical power, rules of Ohm and Kirchoff, calculation of simply electrical circuits, unstabil status of circuits,, electrical sources, batteries.
2. The base knowlege about electronics, diodes, transistors,amplifiers,integrated circuits,regulators and supplyers. The base knowlege about theory of regulations.
3. The base knowlage about electrical machines and electrical drives DC and AC.

SUBJECT OBJECTIVES

C1. The knowlege of base sources of electrical energy and their power supply in motor vehickles of convetional, electrical and hybrid types.
C2. The knowlege of basic power electronical circuits applied in motor vehickles of electrical and hybrid types.
C3. The knowlege of basic electrical drives with brushless electrical machines as a main drives of hybrid motor vehickles.
C4. The knowlege of hybrid vehickles with series and paralell drives.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to define the condition for power supply circuits of electrical and hybrid vehickles and calculate the main parameters of batteries and ultracapacitors.
PEK_W02 - The student is able to apply of power electronics systems of control of drives for electrical and hybrid vehickles, describe the main relations of voltage and current,rotation speed,process of dynamical starts,constans drive and braking ststus.
PEK_W03 - The student is able to describe condition of work status of series and paralell hybrid drives.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The repertory of fundamentals of electritechnics	2
Lec2	The description of basic electrical sources supply of hybrid and electrical drives and present applied solutions of vehickles	2
Lec3	The description of different types of batteries and ultracapacitors	2
Lec4	The description base power electronics elements	2
Lec5	The description and analysis status of one and two puls rectifiers	2
Lec6	The description and analysis status of three and six puls rectifiers	2
Lec7	The analysis of status of DC choppers	4
Lec8	The analysis of status of different type of converters	6
Lec9	The analysis of status of different type of electrical machines DC and AC supply	4
Lec10	The analysis of status of brushless machines type BLDC	2
Lec11	The control systems of converters with brushless machines type BLDC	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	oral answer
F2	PEK_W02	test
F3	PEK_W03	problematic talk
P = F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Maciej Pawłowski:Alternative drive systems, Wydawnictwo Polit.Wrocł.Wrocław 2011
2.Ali Emadi: Handbook of Automotive Power Electronics and Motor Drives.T&F Group, Boca Ratan' Illinois 2005

SECONDARY LITERATURE

1.K.Jankowski.Elektrotechnika samochodowa-Ćwiczenia Laboratoryjne.Wyd.Politechn.Radomskiej 2010
2.Czerwiński A.:Akumulatory-baterie-ogniwa.WKiŁ,Warszawa 2005
3.Herner A.,Riehl H-J.:Elektrotechnika i elektronika w pojazdach Samochodowych.WKiŁ,Warszawa 2010

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MBM_AE_W10	C1-C4	Lec1 to Lec11	N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK ZAJĘCIA SPORTOWE**
Name in English:
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **WFW010000.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)		15			
Number of hours of total student workload (CNPS)		30			
Form of crediting		Crediting with grade			
Group of courses					
Number of ECTS points		1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes		1.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Classes		Number of hours
Cl1		15
		Total hours: 15

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 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

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): **Automotive Engineering**
Level and form of studies: **II level, full-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)		15			
Number of hours of total student workload (CNPS)		30			
Form of crediting		Crediting with grade			
Group of courses					
Number of ECTS points		1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes		1.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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PROGRAMME CONTENT

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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_K01	xxxx_AE_K12	wg kart przygotowanych przez SWFiS		wg kart przygotowanych przez SWFiS