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): **Mechatronics**
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
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W05	wg kart opracowanych przez SNH		wg kart opracowanych przez SNH

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYKI OBCE B2+/C1+**
Name in English: **Block of Foreign Languages**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **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

TEACHING TOOLS USED

N1.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Block of Foreign Languages
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2MTR_U15, K2MTR_U16, K2MTR_U18	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO
PEK_K01	K2MTR_K01	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYKI OBCE A1/A2/B1**
Name in English: **Block of Foreign Languages**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **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

N1.

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
Block of Foreign Languages
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U	K2MTR_U15, K2MTR_U16, K2MTR_U20			
PEK_K	K2MTR_K01			

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikroelektronika**
Name in English: **Microelectonics**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD041001**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of physics.
2. Basic knowledge of mathematics.
3. Basic knowledge of chemistry.

SUBJECT OBJECTIVES

C1. Knowledge in the field of technology of microelectronic components
C2. Knowledge in the field of high-tech thin-and thick-film technology
C3. To familiarize students with the current state and development trends of micro-technology and nanoelectronics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student has structured and theoretically founded knowledge of the materials, technology, construction and selected electrical parameters and stability of modern microelectronic components.

PEK_W02 - The student knows and understands the basic processes associated with the production of microelectronic devices. Versed in the current state and development trendsof microelectronic technologies.

II. Relating to skills:

PEK_U01 - Students can make arrangement in thick film and LTCC technology and measure the properties of the elements made thick-film technology.

PEK_U02 - The student can decide on how to learn and implement the process of self-education.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Monolithic and hybrid circuits. Electronic semiconductor device types: integrated circuits (ICs), opto-electronic components, discrete components, solar cells, components for recording and storing information, electro-mechanical devices.	2
Lec2	Semiconductors: intrinsic semiconductors, doped semiconductors, p-n junction, metal semiconductor junction.	2
Lec3	Electronic components: diode, bipolar transistor, FET and the MOS transistor, resistor in integrated circuit.	2
Lec4	Environment of technologylaboratory. The technological process of producing chips: the crystal structure of silicon and crystallization techniques. Substrates, silicon epitaxy manufacturing steps. Measurement of substrates and heterostructures.	2
Lec5	Oxidation, diffusion and implantation of dopants into semiconductor. Technology stations.	2
Lec6	Preparation of the pattern in the process of lithography. Chemical and plasma etching of dielectrics, metals and silicon.	2
Lec7	Deposition of polycrystalline silicon, silicon dioxide and silicon nitride using CVD method. CVD systems used in practice.	2
Lec8	Application of metallization techniques: thermal evaporation, evaporation using an electron beam and sputtering. Ohmic and Schottky contacts to the semiconductor. Metallization systems.	2
Lec9	Fundamentals of thin and thick film technology.	2
Lec10	Principles of design thick film components.	2
Lec11	High temperature thick films - materials, processes, properties, application.	2
Lec12	Polymer thick films - materials, processes, properties, applications.	2
Lec13	Modules MCM (Multichip Module). The assembly methods.	2
Lec14	Technology LTCC (Low Temperature Cofired Ceramics) - materials, processes, properties.	2

Lec15	The use of LTCC in microelectronics and microsystems. Technology development trends of micro-nano.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Modern semiconductor lab	3
Lab2	Etching and passivation technologies	3
Lab3	Techniques for making patterns	3
Lab4	Technological equipment for thick film and LTCC technology	3
Lab5	Measurement of thick-film components	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02,	test
F2	PEK_U01, PEK_U02	laboratory report
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. T. Norio, Nanotechnology: Integrated Processing Systems for Ultra-Precision and Ultra-Fine Products, OUP, England, 2000
2. S. Dimitrijev, Understanding Semiconductor Devices OUP, USA, 2000
3. Ch. P. Poole, F. J. Owens, Introduction to Nanotechnology, John Wiley & Sons, 2003
4. L.J.Maissel, R.Glang, Handbook of Thin Film Technology,Mc Graw Hill Book Comp., New York London, 1988
5. W.Menz, Microsystem Technology, 1999, Albert-Ludwigs University Freiburg, Germany
6 R.R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill, New York, 2001

SECONDARY LITERATURE

Magazines Sensors and Actuaturs, Vacuum, Conference Proceedings (COE, ELTE, IMAPS Poland Chapter, Ceramic Microsystems).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microelectonics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W09	C1-C3	Lec1-Lec15	N1-N5
PEK_W02	K2MTR_W09	C1-C3	Lec1-Lec15	N1-N5
PEK_U01	K2MTR_U09	C1-C3	Lab1-Lab5	N1-N5
PEK_U02	K2MTR_U17	C1-C3	Lab1-Lab5	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikromechanizmy i mikronapędy**
Name in English: **Micromechanisms and microdrives**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD041003**
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		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED
N1. N2.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Micromechanisms and microdrives
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W17	C1		N1
PEK_U01	K2MTR_U27	C2		N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji aparatury elektronicznej**
Name in English: **Foundations of electronic apparatus construction**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD041004**
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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1		1
Lec2		3
Lec3		3
Lec4		3
Lec5		4
Lec6		4
Lec7		3
Lec8		3
Lec9		3
Lec10		2
Lec11		1
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		4
Lab3		4
Lab4		2
Lab5		2
Lab6		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 test
N4. self study - preparation for laboratory class
N5. Short, 10-minutes introduction and evaluation of students knowledge (at the beginning of labs)

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
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	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_W02, PEK_U02; PEK_K02; PEK_K03	Evaluation of work performed within lab 1
F2	PEK_W02, PEK_U02; PEK_K02; PEK_K03	Evaluation of work performed within lab 2
F3	PEK_W02, PEK_U02; PEK_K02; PEK_K03	Evaluation of work performed within lab 3
F4	PEK_W02, PEK_U02; PEK_K02; PEK_K03	Evaluation of work performed within lab 4
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Foundations of electronic apparatus construction
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W, PEK_U	K2MTR_U25, K2MTR_U26, K2MTR_W14, K2MTR_W15, K2MTR_W16			

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy RT i embedded**
Name in English: **Real-time and embedded systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE001001**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about modern 8-, 16- and 32-bit and DSP microcontrollers
C2. Gaining knowledge of basic blocks peripheral of microcontrollers
C3. Gaining knowledge of the architecture and operation of real-time systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Can explain the principle of operation of microcontrollers and digital signal processors.
PEK_W02 - Can explain the principle of operation of the major peripheral blocks.
PEK_W03 - Able to characterize the main features of real-time systems

II. Relating to skills:

PEK_U01 - Is able to select the right processor for a particular application.
PEK_U02 - Is able to select the right peripheral block for a particular application.
PEK_U03 - Is able to use, if necessary, real-time operation system

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Definitions	2
Lec2	Embedded systems - introduction. Basic components of embedded systems	2
Lec3	8-bit microcontrollers	2
Lec4	16-bit microcontrollers	2
Lec5	32-bit microcontrollers	4
Lec6	ADC and DAC converters	2
Lec7	DSP and DSC processors	4
Lec8	Serial interfaces	2
Lec9	Real Time Operating Systems - introduction, basic parameters	2
Lec10	Real Time Operating Systems - queuing, queuing algorithms	2
Lec11	Examples: FreeRTOS	2
Lec12	Examples: WinCE	2
Lec13	Test	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the lab. Introduction to the development environment	3
Lab2	Programming Principles of 32-bit processors based on ARM core	3
Lab3	Interrupts	3
Lab4	ADC and DAC converters	3
Lab5	Serial and parallel interfaces	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-03	Written exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-03	discussions, written reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

•Furber S., “ARM System On-Chip Architecture”, Pearsons Educated Limited, 2000
•Franklin M., “Network Processor Design: Issues and Practices”, Elsevier, 2003
•Yui J., “The Definitive Guide to the ARM Cortex-M3”, Newnes, 2007

SECONDARY LITERATURE

•Lane J., “DSP Filter Cookbook”, Prompt, 2008
•WWW pages: www.atmel.com, www.ti.com, www.arm.com, www.analog.com

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Real-time and embedded systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W07	C1	Wy1-Wy5	N1,N2,N4
PEK_W02	K2MTR_W07	C2	Wy6-Wy8	N1,N2,N4
PEK_W03	K2MTR_W07	C3	Wy9-Wy12	N1,N2,N4
PEK_U01	K2MTR_U07	C1	La1-La2	N2,N3,N4,N5
PEK_U02	K2MTR_U07	C2	La3-La5	N2,N3,N4,N5
PEK_U03	K2MTR_U07	C3	La1	N2,N3,N4,N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Data Mining**
Name in English: **Data Mining**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCE001003**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15			15	
Number of hours of total student workload (CNPS)	30			30	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.3	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows basic principles of probabilistics and statistics
2. Is able to use a selected programming language

SUBJECT OBJECTIVES

C1. The student who has completed the course should know the purpose and application areas of the most prominent methods of data mining in business and scientific problems (such as predictive modelling, clustering, association rules mining, time series analysis).
C2. The student who has completed the course should know the most important statistical and/or machine learning algorithms used in data mining.
C3. The student who has completed the course is able to use a selected data mining tool to build and fine-tune classification or regression models.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows application areas of most prominent methods of data mining in business and science (including predictive modelling, clustering, association rules mining).
PEK_W02 - Knows the most important algorithms used by various methods of data mining.
PEK_W03 - Knows the data mining methodology applied in business problems (CRISP-DM, SEMMA).

II. Relating to skills:

PEK_U01 - Is able to select appropriate methods of data mining for a given data analysis problem.
PEK_U02 - Is able to implement predictive modelling task using a selected data mining tool.
PEK_U03 - Is able to fine-tune classification models in terms of sensititivity and specificity.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Purpose and application areas of the most important methods of data mining in business and science (methods considered: predictive modelling, clustering, association rules mining, time series analysis).	2
Lec2	Predictive modelling algorithms: regression. Fundamentals of the statistical learning theory, goodness-of-fit, feature selection in regression.	2
Lec3	Predictive modelling algorithms: classification. Theoretical foundation, Bayes classifier, Bayes error. Discriminant analysis (LDA, QDA).	2
Lec4	Linear methods in classiification - perceptron algorithm. Neural networks. SVM - general concept of the method.	2
Lec5	Decision trees - most important learning algorithms.	2
Lec6	Dimensionality reduction, PCA algorithm. Measures of predictive performance, ROC curve.	2
Lec7	Algorithms of clustering, kNN, hierarchical algorithms, SOM.	2
Lec8	Algorithms of association rules mining.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction to the selected data mining software tool.	4
Proj2	Building classification models based on different algorithms (decision trees, neural nets, logistic regression, non-parametric models). Estimation of predictive performance of the baseline models in terms of sensitivity and specificity, estimation of the ROC curve.	4
Proj3	Fine-tuning the models using different approaches to feature selection / dimensionality reduction (e.g. using the PCA method).	2
Proj4	Estimation of the classification error as a function of compexity/simplicity settings of different classifiers.	2
Proj5	Improving performance of classification using metalearning - boosting, bagging, model ensembles.	3

	Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	evaluation of the project results, presentation of the project
P = 0.5*F1_W + 0.5*F1_P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

J. Han, M. Kamber, Data Mining: Concepts and Techniques, Elsevier 2012
D. Larose: Data Mining Methods and Models, Wiley 2006

SECONDARY LITERATURE

T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Data Mining
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MTR_W06	C1, C2	Lec1 - Lec8	N1,N4
PEK_U01-PEK_U03	K2MTR_U06	C3	Proj1 - Proj5	N2,N3,N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Identyfikacja**
Name in English: **System identification**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE001004**
Group of courses: **yes**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows foundations of probability theory and statistics
2. Knows foundations of control theory and typical descriptions of dynamical systems

SUBJECT OBJECTIVES

C1. Learning of methods of generation and analysis of random processes (inversion method, rejection method, correlation analysis)
C2. Study of typical models of dynamic systems, and the methods (parametric and nonparametric) of their identification (least squares method, kernel method)
C3. Knowledge of LabView for the system identification purposes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows the methods of computer modeling of random environment

PEK_W02 - Knows parametric and nonparametric algorithms of linear and nonlinear model synthezis on the basis of uncertain data

PEK_W03 - Knows computer realizations of typical methods in system identification

II. Relating to skills:

PEK_U01 - Can use measurement data for building and testing the linear and nonlinear models under various prior knowledge

PEK_U02 - Is able to select appropriate model

PEK_U03 - Can perform experiments and use dedicated software

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Classes of identification problems and methods. Random number generation, inversion method, rejection method	2
Lec2	Foundations of estimation theory, estimation quality assesment. Limit theorems. Types of random convergence	2
Lec3	Estimation of cumulative distribution and probability density function. Parametric and nonparametric methods	2
Lec4	Estimation of the regression function. Parametric and nonparametric methods	2
Lec5	Linear system excited by the random process. Identification of linear dynamic systems by the least squares method, correlation method and maximum likelihood method	3
Lec6	Inverse filterring. Gauss-Markov method. Instrumental variables method. Numerical aspects. Spectral analysis. LU and SVD decomposition	2
Lec7	Nonlinear system identification. Hammerstein and Wiener systems. Summary. Final test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, used computer environment, simple experiments	2
Lab2	Generation and analysis of random processes. Trend analysis. Correlation analysis	2
Lab3	Dynamical system excited by random or deterministic signal	2
Lab4	Parameter identification of linear systems (AR, ARX, MA, ARMA, ARMAX) by the least squares method	2
Lab5	Model-type and model-order selection on the basis of empirical data	2
Lab6	Kernel estimation of nonlinear characteristics	2
Lab7	Real data analysis. Physical example. Summary	3

	Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01..PEK_U03	Written tests, computer excersises, reports.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] L. Ljung. System Identication. Wiley Online Library, 1999.
[2] T. Söderström and P. Stoica. System Identication. NJ: Prentice
Hall, Englewood Cli¤s, 1989.
[3] D.R. Kincaid and E.W. Cheney. Numerical Analysis: Mathematics of
Scientic Computing, volume 2. Amer Mathematical Society, 2002.
[4] K.J. Keesman. System Identication: an Introduction. Advanced Textbooks In Control and Signal Processing. Springer, 2011.

SECONDARY LITERATURE

[1] Y.S. Chow and H. Teicher. Probability Theory: Independence, Interchangeability, Martingales. Springer Verlag, 2003.
[2] G. Strang. Introduction to Linear Algebra. Wellesley Cambridge Pr, 2003.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
System identification
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MSW_W07	C1, C2	Lec1..Lec7	N1, N3, N5
PEK_W02	K2MTR_MSW_W07	C1, C2	Lec4..Lec7	N1, N3, N5
PEK_W03	K2MTR_MSW_W07	C1, C2	Lec1..Lec7	N1, N3, N5
PEK_U01	K2MTR_MSW_U09	C3	Lab1..Lab3	N2, N3, N4
PEK_U02	K2MTR_MSW_U09	C3	Lab4..Lab7	N2, N3, N4
PEK_U03	K2MTR_MSW_U09	C3	Lab1..Lab7	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technika laserowa**
Name in English: **Laser techniques**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE001005**
Group of courses: **yes**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability of independent learning
2. Ability of teamwork

SUBJECT OBJECTIVES

C1. Introduction into laser technique basics. The mostly used lasers types and their parametres.
C2. Presentation of the basic applications of laser techniques in technology, metrology, medicine, and telecommunications.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has a broader and deeper knowledge of the physics necessary to understand the physical phenomena in the field of laser techniques.

PEK_W02 - Understands quantum mechanics principles of lasers operation. Knows the basic parameters of lasers, their types and applications.

II. Relating to skills:

PEK_U01 - Can carry out experiments in the field of laser technology and fiber optics. Is able to interpret the results.

PEK_U02 - To think and act in a creative way. Able to prioritize appropriately to fulfill the given task.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Physical basics of laser operation.	2
Lec2	Gas and solid state lasers.	2
Lec3	Semiconductor lasers.	1
Lec4	Modulation, detection and stabilisation of laser radiation.	2
Lec5	Laser metrology	2
Lec6	Basics af optical fibers.	2
Lec7	Fiber amplifiers and lasers.	2
Lec8	Lasers in medicine and telecommunications.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, safety isues in the laboratory, organising matters.	1
Lab2	He-Ne lasers. Modes of radiation, light diffraction, holography.	2
Lab3	Modulation of laser radiation.	2
Lab4	Michelson interferometer.	2
Lab5	Semiconductor lasers.	2
Lab6	Pulsed fibre laser.	2
Lab7	Laser micromachining 1 (galvo system with fiber laser).	2
Lab8	Laser micromachining 1 (plotter system with CO2 laser).	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
P = Średnia ocen z kolokwium i zaliczenia laboratorium		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	report from laboratory exercise
F2	PEK_U02	report from laboratory exercise
P = Średnia ocen ze sprawozdań		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] B. Ziętek, Optoelektronika, Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 2011
[2] Koichi Shimoda, Wstęp do fizyki laserów, PWN,Warszawa, 1993
[3] Franciszek Kaczmarek, Wstęp do fizyki laserów, PWN, Warszawa, 1878
[4] M Szustakowski Elementy techniki światłowodowej, WNT Warszawa 1992r

SECONDARY LITERATURE

[1] Z. Bielecki, A. Rogalski „Detekcja Sygnałów Optycznych”, WNT, Warszawa 2001
[2] A. Kujawiński, P. Szczepański, Lasery. Fizyczne podstawy, Oficyna Wydawnicza Politechniki Warszawskiej, 1999
[3] J.E.Midwinter Światłowody telekomunikacyjne, WNT Warszawa 1983

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser techniques
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MSW_W03	C1, C2	Wy1 - Wy8	N1, N2, N3
PEK_W02	K2MTR_MSW_W03	C1, C2	Wy1 - Wy8	N1, N2, N3
PEK_U01	K2MTR_U13	C1, C2	La1 - La8	N4, N5
PEK_U02	K2MTR_U13	C1, C2	La1 - La8	N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane sterowanie**
Name in English: **Advanced control engineering**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE001006**
Group of courses: **yes**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows basic concepts of control theory.
2. Has an elementary knowledge in system identification.

SUBJECT OBJECTIVES

C1. Acquiring knowledge of basic linear, adaptive and robust control algorithms. Acquiring knowledge about construction of fuzzy and predictive control techniques.
C2. Acquiring ability to tune controllers for different types of controlled objects.
C3. Acquiring ability to apply LabView software for implementation of advanced control algorithms.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows theoretical basis and working ideas of linear controllers. Knows basic tuning algorithms for PID controllers.

PEK_W02 - Knows formal system's description in state space. Knows the main concepts of adaptive and predictive controllers.

PEK_W03 - Knows basic architectures of robust and fuzzy control algorithms.

II. Relating to skills:

PEK_U01 - Is able to select and tune linear controllers for different types of plants/objects.

PEK_U02 - Is able to select control strategy (adaptive, robust or predictive) appropriate for given task.

PEK_U03 - Applying LabView is able to construct control system equipped with fuzzy logic controller.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Discrete time-invariant and time-variant systems. Linear and nonlinear systems.	2
Lec2	Linear controllers. Stability analysis. Selected tuning algorithms for PID controllers.	2
Lec3	State space description of linear systems.	2
Lec4	Adaptive control - selected topics.	2
Lec5	Predictive control - selected topics.	2
Lec6	Robust control. Model Following Control.	2
Lec7	Fuzzy logic control.	2
Lec8	Summary. Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Discrete time-invariant and time-variant systems. Linear and nonlinear systems. Superposition principle.	2
Lab2	Linear controllers. Stability analysis. Tuning.	2
Lab3	Analysis of systems described in state space.	2
Lab4	Adaptive control.	2
Lab5	Predictive control.	2
Lab6	Robust control.	2
Lab7	Fuzzy control.	2
Lab8	Summary. Final marks.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Brzózka, Regulatory i układy automatyki, Mikom 2004
W. Greblicki, Teoretyczne podstawy automatyki, Oficyna Wydawnicza PWr, 2001

SECONDARY LITERATURE
https://dyplomy-10.pwr.wroc.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced control engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MSW_W07	C1, C2		N1, N2
PEK_W02	K2MTR_MSW_W07	C1, C2		N1, N2
PEK_W03	K2MTR_MSW_W07	C1, C2		N1, N2
PEK_U01	K2MTR_MSW_U09	C3		N2, N3, N4
PEK_U02	K2MTR_MSW_U09	C3		N2, N3, N4
PEK_U03	K2MTR_MSW_U09	C3		N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka powierzchni**
Name in English: **Surface Diagnostics**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE041001**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge, skills & competences due to courses of Physics.

SUBJECT OBJECTIVES

C1. Mastering of problems connected with physical interpretation of phenomena occuring at solid state surface.
C2. Practical application of surface analysis methods in surface characterisation & surface structures diagnostics.
C3. Ability of authoritative evaluation of parameters determining the nature of solid state surface.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge in a domain of physics necessary to understand physical effects occuring in semiconductor surface structures.

II. Relating to skills:
PEK_U01 - He is able to determine physico-chemical parameters of real surface by means of available diagnostic methods.

III. Relating to social competences:
PEK_K01 - He is able to properly identify & effectively solve dilemmas connected with his profession.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Preliminary information, lecture programme. The role of surface & semiconductor surface structures in micro- & nanoelectronics of semiconductors.	2
Lec2	Solid state surface, differences between surface & bulk crystal, ideal surface, real surface, surface reconstruction & relaxation.	2
Lec3	Structural & surface defects, technology of atomically flat surface.	2
Lec4	Real surface characterisation: geometrical & physico-chemical parameters, atomic structure (surface crystallography), electron structure (band structure).	2
Lec5	Methods of surface analysis, classification criteria, diagnostic methods for semiconductor nanotechnology.	2
Lec6	Investigation of surface atomic structure by means of electron diffraction techniques LEED, RHEED.	2
Lec7	Selected spectroscopic methods for qualitative & quantitative evaluation of chemical composition & surface purity (AES, SIMS, ESCA).	2
Lec8	Final test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with transparencies, slides & discussion.
N2. Tutorials.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.A. Szaynok, S. Kuźmiński, Podstawy fizyki powierzchni półprzewodników, WNT Warszawa 2000,
2.J. Szuber, Powierzchniowe metody badawcze w nanotechnologii półprzewodnikowej.

SECONDARY LITERATURE

1.A. Oleś, Metody doświadczalne fizyki ciała stałego, WNT Warszawa 1998,
2.M. Dąbrowska-Szata, Spektroskopia głębokich poziomów w strukturach półprzewodnikowych, OW PWr, Wrocław 2009,
3.M. Dąbrowska-Szata, Dyfrakcja odbiciowa elektronów o dużej energii w badaniach powierzchni ciała stałego, OW PWr, Wrocław 2000.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Surface Diagnostics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W09	C1, C2	Lec01 - Lec08	1, 2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria Kwantowa**
Name in English: **Quantum Technology**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCE041002**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge, skills & competences due to courses of Physics.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge dealing with the rules of quantum theory and new technologies determining civilsation shape of XXI century.
C2. Practical application of quantum effects in nanostructures.
C3. Acquisition of knowledge connected with the newest achievements of quantum technology in nanoelectronics & computer science.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He understands quantum description of physical reality.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - He is able to properly identify & effectively solve dilemmas connected with his profession.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Quantum theory - new phenomena, new rules. Quantum description of physical reality, basic definitions of quantum technology.	2
Lec2	Superconductivity as an example of quantum effect.	2
Lec3	Nanostructures, low-dimensional structures QWs, QWws, QDs, SLs, heterojunctions, heterostructures.	2
Lec4	Technology of low-dimensional structures, epitaxial techniques (revue).	2
Lec5	Tools for quantum technology STM, AFM, DLTS. New technologies of quantum engineering.	2
Lec6	The newest achievements & applications of quantum technology, carbon nanoelectronics - graphen, carbon nanotubes.	2
Lec7	Logic operations with using quantum devices - quantum computer, molecular (biological) computer.	2
Lec8	Final test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with transparencies & slides.
N2. Tutorials.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.G. Milburn, Inżynieria kwantowa, Wyd. Prószyński i S-ka, Warszawa 1999
2.E. Regis, Nanotechnologie – narodziny nowej nauki, czyli świat cząsteczka po cząsteczce, Wyd. Prószyński i S-ka, Warszawa 2001.

SECONDARY LITERATURE

"American Scientific" - selected issues.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Quantum Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W12	C1, C2, C3.	Lec1-Lec8	1, 2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Statystyka i rachunek prawdopodobieństwa**
Name in English: **Statistics and Probability**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041001**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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		3
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		2
Proj6		2
Proj7		3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Statistics and Probability
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W03	C1		N1
PEK_U01	K2MTR_U03	C2, C3		N2, N3
PEK_U02	K2MTR_U11	C2, C3		N2, 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): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041002**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He can define a discrete mechanical holonomic system and its possible and virtual displacements. He knows the fundamental problem of dynamics. He knows the classification of dynamical systems in respect of the constrain types. He knows the general equation of dynamics and the principle of virtual work.
PEK_W02 - He knows the notion of generalized coordinates and configuration space of a dynamical system. He knows the concept of generalized forces (active and inertia). He knows the Lagrange's equations of the second kind.
PEK_W03 - He knows the vibration theory of linear systems with many degrees of freedom in the free vibration range.

II. Relating to skills:
PEK_U01 - He is able to apply the virtual work principle and d'Alembert's principle for holonomic systems
PEK_U02 - It can derive the differential equations of motion of discrete dynamical systems by using Lagrange's equations and by using the energy conservation law for conservative holonomic systems.
PEK_U03 - He can calculate the spectrum of natural frequencies and can determine the modal matrix for discrete conservative linear systems.

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

PROGRAMME CONTENT

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

Lec3	The dynamic general equation for the rotational and planar motion of a rigid body (examples)	2
Lec4	Generalized coordinates. Derivation of differential equations of motion by using the energy conservation law expressed in generalized coordinates (examples).	2
Lec5	Generalized forces. Configuration space. Lagrange's equations (of II type).	2
Lec6	Linear systems with a finite number of degrees of freedom, matrix notation, conservative systems.	1
Lec7	Free vibrations of conservative systems: natural frequencies, modal matrices, mode shapes.	2
Lec8	Test	2
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Introduction. Derivation of equations for possible velocities and virtual displacements.	2
Cl2	Solving of static problems by using a principle of virtual work	2
Cl3	Solving of dynamic problems for discrete systems by using a dynamic general equation (d'Alembert's principle).	2
Cl4	Solving of selected dynamic problems of a rigid body in plane motion by using a dynamic general equation.	2
Cl5	Derivation of motion differential equations based on the energy conservation law and Lagrange's equations (comparison of methods and results) for systems with one and two degrees of freedom	2
Cl6	Determination of the natural frequencies and modal parameters for conservative systems with two degrees of freedom	2
Cl7	Final test	2
Cl8	Credits. Improvement of marks	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

P = F1

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analytical Mechanics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_W01, K2MTR_W04	C1	Lec 1 to Lec 8	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K2MTR_U01	C2	Cl 1 to Cl 8	N2, N3, N4

PEK_K01, PEK_K02, PEK_K03	K2MTR_K01, K2MTR_K06	C3	Lec 1 to Lec 8, Cl 1 to Cl 8	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Synteza mechanizmów**
Name in English: **Synthesis of Mechanisms**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041006**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowlege of topology, kinematics and kinetostatics of mechanisms
2. Knowledge of mathematical analysis, analytical geometry
3. Skill in mechanism analysis: drawing schemes, velocity and acceleration determination, kinetostatics

SUBJECT OBJECTIVES

C1. Acquire developed knowledge in topolog of kinematic systems
C2. Acquire of modern methods of dimensional synthesis of chosen mechanisms
C3. Getting skills in designing of chosen mechanisms

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has developed knowledge on mechanisms' topology - rationality, topology modification methods
PEK_W02 - Has the knowledge of linkage dimensional synthesis methods (with elements of optimization)
PEK_W03 - Has the knowledge of cam mechanisms design methods

II. Relating to skills:

PEK_U01 - Is able to modify topology of a mechanism to achieve rational solutions
PEK_U02 - Is able to synthesise geometry of some linkages
PEK_U03 - Is able to synthesise cam mechanisms

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Rattionality of mechanism topology - essence, modification methods	2
Lec2	Dimensional synthesis of linkages - tasks classification, some general problems	2
Lec3	Synthesis methods of chosen linkages	2
Lec4	Synthesis methods of chosen linkages, cont	2
Lec5	Cam mechanism synthesis - law of motion of a follower	3
Lec6	Cam mechanism synthesis - determination of basic dimensions and cam profile	2
Lec7	Synthesis of mechanisms with linear actuators	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Redundant constraints elimination (project)	2
Proj2	Linkages dimensional synthesis using SAM (project)	2
Proj3	Linkages dimensional synthesis using SAM (project)	2
Proj4	Dimensional synthesis of a chosen linkage (project)	2
Proj5	Dimensional synthesis of a chosen linkage (project)	2
Proj6	Synthesis of a cam mechanism ((project)	2
Proj7	Synthesis of a cam mechanism cont.	3
		Total hours: 15

TEACHING TOOLS USED

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Miller S.: Kinematic systems. Basics of design (in Polish). WNT Warszawa 1988; Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; Gronowicz A., Miller S.: Mechanisms (in Polish). Oficyna Wyd. PWr. 1996; Gronowicz A. et al: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE

Eckhardt H. D.: Kinematic Design of Machines and Mechanisms. McGraw-Hill 1998; Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999; Norton R.: Design of Machinery. An Introduction to the Synthesis and Analysis of Mechanisms and Machines. McGraw-Hill 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Synthesis of Mechanisms
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MTR_W02	C1, C2	Lec1 - Lec7	N1, N4, N5
PEK_U01- PEK_U03	K2MTR_U02	C2, C3	Pr1 - Pr7	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka i niezawodność w mechatronice**
Name in English: **Diagnostics and reliability of mechatronic systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041008**
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. Fundamentals of engineering statistics.

SUBJECT OBJECTIVES

C1. To acquaint the student with the decision problems occurring during the operation of a technical object
C2. The acquisition of basic skills of modeling processes in the operation phase object
C3. The acquisition of basic skills assessment of the technical state of the system / facility

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He knows the basic methods of solving problems occurring in the decision-making phase eksplaotacji technical object.

II. Relating to skills:

PEK_U01 - He analyzes performance data and assess key indicators and characteristics of reliability

PEK_U02 - He analyzes the diagnostic information and assess the state of the object

III. Relating to social competences:

PEK_K01 - He explains the causes and effects occurring and the potential damage / disaster / hazard

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts of operation, diagnostics, reliability and security of objects and technical systems. The scope of the theory and engineering operations	2
Lec2	Tasks diagnostics of machines and equipment. Modeling the dynamics of linear features - the equations of motion.	2
Lec3	Vibration measurements - Configuration of measuring circuits. Elements of diagnostic signals	2
Lec4	Problems sort of diagnostic symptoms. Operational experience - instability and evolution of diagnostic signals	2
Lec5	Degradation processes mechatronic objects. Causes, characters, effects and ways to remove damage.	2
Lec6	Modeling of reliability irreparable object. The structure of the reliability of the system.	2
Lec7	Modeling of repairable system reliability. Markov process.	2
Lec8	Summary. Control of knowledge	1
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Analysis of diagnostic signals for selected mechatronic assemblies. Laboratory conditions.	2
Cl2	Analysis of diagnostic signals for selected mechatronic assemblies. Operating conditions.	2
Cl3	Statistical analysis of the signals. Inference about the state of the object.	2
Cl4	Analysis of the structure of mechatronic objects. Construction of functional and structural models.	2
Cl5	Construction of the reliability structure of the object / system. Estimating indicators of reliability.	2
Cl6	Creating models of repairable system reliability. Solution Markov models.	2

Cl7	The use of Markov models and diagnostic models to make decisions in the process of operation - maintenace strategies of objects. The conservator problem .	3
		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	Test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01	Quiz, oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Blischke W. R., Prabhakar Murthy D. N., Reliability. Moideling, Prediction and optimization. John Wilry & Sons, Inc. 2000.

SECONDARY LITERATURE

Marques de Sa J. P., Applied Statistics Using SPSS, STATISTCA and MATLAB. Springer-Verlag, Berlin, Heidelberg, 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diagnostics and reliability of mechatronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W09	C1	Lec 1 - Lec8	N1
PEK_U02	K2MTR_MMP_U07	C2	Cl1 - Cl3	N2
PEK_U01	K2MTR_MMP_U10	C3	Cl4 - Cl7	N2
PEK_K01	K2MTR_K02	C1	Lec1 - Lec8	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza MES układów mechatronicznych**
Name in English: **FEM analysis of mechatronic systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041020**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of finite element method.
2. He has expertise in modeling of mechatronic systems to virtual prototyping (CAD).
3. He can design a mechatronic device, system or process technology using appropriate methods, techniques and tools or develop new tools

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the conduct of FEM analysis of mechatronic systems.
C2. Learning how to use the pre-processor and post-processor system, the construction of FEM models, mesh generation and creation of boundary conditions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - FEM advanced techniques known in the field of non-linear problems and contact simulation of electro-thermal-mechanical, electromagnetic, thermal and mechanical, piezoelectric and optimization methods using FEM,

PEK_W02 - FEM simulation method known MEMS, electronics and mechanical,

PEK_W03 - have knowledge of the methods of optimization techniques FEM technology of mechatronic components.

II. Relating to skills:

PEK_U01 - can handle pre-processor and post-processor, build FEM models, generate a grid and determine the boundary conditions

PEK_U02 - can choose the constitutive equations and material models used in FEM simulation of mechatronic systems.

PEK_U03 - can perform complex finite element analysis for mechatronic systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to finite element analysis of mechatronic systems. Constitutive equations and material models used in FEM simulation of mechatronic systems.	2
Lec2	Advanced FEM techniques for nonlinear problems, and contact information. Methods for solving nonlinear FEM.	2
Lec3	Simulations electro-thermal-mechanical MEMS. Performance criteria and the merits of the application in remeshing simulation.	2
Lec4	Simulations electromagnetic and piezoelectric mechatronic systems.	2
Lec5	Simulations of thermo-mechanical electronic and mechanical systems.	2
Lec6	FEM modeling techniques micromechanisms and micromachines.	2
Lec7	FEM optimization technology of mechatronic components.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Support pre-processor and post-processor. Construction of FEM models. Mesh generation and boundary conditions.	4
Lab2	The use of non-linear FEM and contact in the design of mechatronic systems.	2
Lab3	Numerical modeling of MEMS.	4
Lab4	Modeling of electromagnetic problems, piezoelectric used in mechatronic systems.	4
Lab5	Numerical modeling of thermo-mechanical electronic and mechanical systems.	4
Lab6	FEM modeling techniques micromechanisms and micromachines.	4
Lab7	Examples of optimization MES technology of mechatronic components.	2

Lab8	Modeling of selected mechatronic system.	6
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Documentation MSC.Marc Volume IV, 2012, USA.

SECONDARY LITERATURE
Tomasz Zagrajek, Grzegorz Krzesiński, Piotr Marek: Finite element method in structural mechanics. 2006, Warszawa.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
FEM analysis of mechatronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MTR_W13	C1	Lec1-Lec7	N1
PEK_U01-PEK_U03	K2MTR_U05, K2MTR_U14, K2MTR_U24	C2	Lab1-Lab8	N2-N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **MES w modelowaniu układów mechatronicznych**
Name in English: **FEM in modeling of mechatronic systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041021**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1		1
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		4
Proj2		2
Proj3		2
Proj4		2
Proj5		4
Proj6		6
Proj7		6
Proj8		4
Proj9		2
		Total hours: 32

TEACHING TOOLS USED
N1. self study - preparation for project class N2. problem exercises N3. multimedia presentation N4. project presentation N5. problem discussion

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

F1	PEK_W01, PEK_W02, PEK_W03	
P = F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
FEM in modeling of mechatronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W01, K2MTR_W13	C1		N3
PEK_W02	K2MTR_MMP_W01, K2MTR_W13	C2		N3, N2, N5
PEK_W03	K2MTR_MMP_W01, K2MTR_W13	C3, C2		N1-N5
PEK_U01	K2MTR_MMP_U01, K2MTR_U24	C3, C3		N2
PEK_U02	K2MTR_MMP_U01, K2MTR_MMP_U04, K2MTR_U24	C3		N1, N2, N5, N5
PEK_U03	K2MTR_MMP_U01, K2MTR_MMP_U04	C2, C3		N2, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie termiki i przepływów**
Name in English: **Modeling termal and mass flow**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041022**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		6
Proj5		2
Proj6		2
Proj7		2
Proj8		2
Proj9		2
Proj10		2
Proj11		2
Proj12		2
Proj13		2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2.
N3. laboratory experiment
N4. self study - preparation for project 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	
P = F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modeling termal and mass flow
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W13	C1		N1
PEK_U01	K2MTR_U24	C1		N2, N4
PEK_U02	K2MTR_U24	C1, C2		N2, N5
PEK_U03	K2MTR_U24	C1, C2		N2, N5
PEK_K01	K2MTR_K01	C2		N1, N2
PEK_K02	K2MTR_K01	C2		N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sztuczna inteligencja i uczenie maszynowe**
Name in English: **Artificial Intelligence and Machine Learning**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041023**
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

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		1
Lec6		1
Lec7		2
Lec8		2
Lec9		1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		3
		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,PEK_W02	
P = P		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Artificial Intelligence and Machine Learning
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W06	C1		N1
PEK_W02	K2MTR_W06	C2		N1
PEK_U01,PEK_U02,PEK_U03	K2MTR_U06, K2MTR_U14	C3		N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Interdyscyplinarny projekt zespołowy**
Name in English: **The interdisciplinary team project**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041027**
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. It has a basic understanding of the integration of mechanics, electronics and computer science.
2. He has expertise in the design and testing of control systems. He can choose a microcontroller or a dedicated system for the implementation of control or measurement.
3. Able to model systems, mechatronic systems in virtual design and carry out static and dynamic calculations for linear and non-linear problems.

SUBJECT OBJECTIVES

C1. Acquiring the ability self-solving tasks as part of an interdisciplinary mechatronic design.
C2. Teamwork and the ability to integrate multi-disciplinary tasks.
C3. The acquisition of social skills including the ability to work in a group of students with a view to effective solving mechatronics problem.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - able to select units mechatronic and mechanical solution to write algorithma of computer program;
PEK_U02 - can analyze the system, and the synthesis of solutions of a system implementing a specific function key;
PEK_U03 - able to optimize the selection of variants solution.

III. Relating to social competences:

PEK_K01 - search for information and the critical review;
PEK_K02 - team cooperation on methods for the selection strategy to deal with the problem of allowing the selection of the optimal solution;
PEK_K03 - objectively examine the arguments and justify their point of view.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Analysis of the resulting design task for the application of different variants of mechatronic solutions.	3
Proj2	Choosing a solution for mechatronic design task.	3
Proj3	The division interdisciplinary class group and assign specific tasks to perform.	3
Proj4	The term co-operation between the two groups zajęciowymi - input and output data.	3
Proj5	Working in interdisciplinary groups on assigned tasks.	18
Proj6	Inegracja interdisciplinary work groups to perform a task design.	6
Proj7	Evaluation of project tasks and look for better solutions.	3
Proj8	Optimization methods for solution design task.	3
Proj9	Evaluation and conclusions on the implementation of the final variant of the design task.	3
		Total hours: 45

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. case study
N3. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Marek Gawrysiak: Mechatronics and Mechatronic Design, Białystok 1997.

SECONDARY LITERATURE

Given by the lecturer in accordance with the theme of the project.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The interdisciplinary team project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 PEK_U02 PEK_U03	K2MTR_MSW_U07, K2MTR_U10	C1,C2	Proj1-Proj9	1,2,3
PEK_K01 PEK_K02 PEK_K03	K2MTR_K03, K2MTR_K06	C3	Proj1-Proj9	1,2,3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Interdycyplinarny projekt zespołowy**
Name in English: **The interdisciplinary team project**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041027**
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 design of mechatronic and electronic
2. Has the knowledge and basic skills associated with controlling the construction machines and vehicles
3. Has the knowledge and ability to analyze and synthesize drive systems working machines

SUBJECT OBJECTIVES

C1. To acquaint the student with the methodology controls the work of construction machines and vehicles
C2. Methodological approach to the design and control of construction machines and vehicles
C3. To acquaint with practical applications to automate systems drives working machines and vehicles
C4. To acquaint the student with the market analysis and account costs of introducing a new solution

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - He can design various structures controlling the working machine
PEK_U02 - He can choose or design elements of control
PEK_U03 - He can to program certain functions of machinery control systems work and work vehicles

III. Relating to social competences:

PEK_K01 - He can interact and work in a group, assuming different roles in it
PEK_K02 - He can appropriately prioritize designed to meet specific targets

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Analysis of design problems - operating principle working machine or vehicle	4
Proj2	Generating solutions design task. Evaluation and selection of the destination variant	4
Proj3	Laying a mathematical model (simulation) and to determine its nominal value	10
Proj4	Performing calculations and selection of elements catalog. Simulation tests	5
Proj5	The selection and evaluation of the type of control. The choice of the type of controller	3
Proj6	Development of functional model control	3
Proj7	Development of control algorithm and software design selected control functions	4
Proj8	Market analysis of the selected group of machines or vehicles. Estimating the cost of planned equipment	4
Proj9	Development of technical documentation and report preparation	6
Proj10	Presentation and defense of project	2
		Total hours: 45

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U10 - PEK_U03, PEK_K01 - PEK_K03	Defense project
P = P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Craig J.J .: Introduction to robotics. Mechanics and Control

SECONDARY LITERATURE
Drives and Controls

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The interdisciplinary team project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2MTR_MMP_U10, K2MTR_U10	C1, C2, C3, C4	Pr1-Pr10	N1 N2
PEK_K01, PEK_K02	K2MTR_K03, K2MTR_K04	C1, C2, C3, C4	Pr1-Pr10	N1 N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Dynamika układów elektromechanicznych**
Name in English: **Dynamics of electromechanical systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041028**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the theory of vibrations.
2. Has a knowledge of design of mechatronic systems.
3. Has a knowledge of control in mechatronic systems.

SUBJECT OBJECTIVES

C1. Gaining knowledge of the modeling of electromechanical systems.
C2. Acquiring the ability to carry out the experimental research of electromechanical systems.
C3. Gaining skills in determining the dynamic characteristics of electromechanical systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows the methods of formulating equations describing the dynamics of electromechanical systems.
PEK_W02 - Knows the ways of determining the dynamic characteristics of electromechanical systems.
PEK_W03 - Knows the principles of modeling of electromechanical systems.

II. Relating to skills:

PEK_U01 - Can formulate equations describing the dynamics of electromechanical systems.
PEK_U02 - Can determine the dynamic characteristics of electromechanical systems.
PEK_U03 - Can model the dynamic properties of electromechanical systems.

III. Relating to social competences:

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues.	1
Lec2	Vibrations of systems with one degree of freedom with damping and without damping.	2
Lec3	The vibrations of multi degrees of freedom systems. The equations of motion - Lagrangian method.	2
Lec4	Modal analysis in the study of the dynamics of mechanical systems.	2
Lec5	Modelling of electromechanical systems.	2
Lec6	Determination of the dynamic characteristics of electromechanical systems.	2
Lec7	Models of DC motors - coupling between the electrical and mechanical part.	2
Lec8	Credit	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Organizational issues.	1
Lab2	Determination of the natural frequencies of a mechanical system.	2
Lab3	Modal analysis method on the example of the plate.	2
Lab4	The study of dynamic characteristics of a mechatronic device.	2
Lab5	Investigation of the vibration resistance of a mechatronic device.	2
Lab6	Determination of damping coefficients in a mechatronic system.	2
Lab7	Modelling of mechatronic system using the AMESim software.	2
Lab8	Credit.	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	oral answers
F2	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	report form laboratory classes
P = 0,4F1+0,6F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Canon R.H.: Dynamics of physical systems
2. Szklarski L.: Dynamika układów elektromechanicznych, 1982
3. Kaźminkowski M.: Automatyka napędu elektrycznego

SECONDARY LITERATURE

1. M. Gawrysiak: Mechatronika i projektowanie mechatroniczne, Białystok 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Dynamics of electromechanical systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_W01, K2MTR_W04	C1-C3	Wy2 - Wy3, Wy5	N1. - N5.
PEK_U01, PEK_U02, PEK_U03	K2MTR_U01, K2MTR_U03, K2MTR_U04, K2MTR_U05, K2MTR_U11	C1-C3	La1-La7	N1. - N5.
PEK_K01, PEK_K02, PEK_K03	K2MTR_K01, K2MTR_K03	C1-C3	La3-La5	N1. - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie małą firmą**
Name in English: **Small Enterprise Management**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041030**
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

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. problem lecture N2. multimedia presentation

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Small Enterprise Management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2MTR_W10	C1, C2, C3		N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie przedsięwzięciem**
Name in English: **Enterprise management**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041031**
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	2.1				

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. multimedia presentation
N2. problem discussion
N3.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Enterprise management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2MTR_W10	C1		N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowa diagnostyka pojazdów**
Name in English: **The computer diagnosis of cars vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041101**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Introduction to mechatronics 1.
2. The elements and lectronics circuits.

SUBJECT OBJECTIVES

C1. Presentation of the requirements necessary to identify appropriate diagnostic system.
C2. Presentation of automotive diagnosis.
C3. Perform the diagnostic process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Identifies appropriate diagnostic systems.
PEK_W02 - Explanation of principles of diagnostic systems.
PEK_W03 - Explains the principles of operation of the testing diagnostics.

II. Relating to skills:

PEK_U01 - One supports diagnostic systems.
PEK_U02 - One coordinates the diagnostic process.
PEK_U03 - One interprets test results.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The introduction to computerized vehicle diagnostics.	2
Lec2	Modes of transmission of sensor bus.	2
Lec3	OBD, OBDII and EOBD systems.	2
Lec4	Reading data obtained from EOBD system.	2
Lec5	The vibroacoustic engine diagnostics.	2
Lec6	Motor handle based on the diagnostic signals.	2
Lec7	The sensing and measurement of non-electrical signals.	2
Lec8	Load diagnostic systems of motor vehicles.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Analog measurement of the speed of the crankshaft the engine.	2
Lab2	Digital measurement of thecrankshaft speed.	2
Lab3	Diagnosis on a chassis dynanometer.	2
Lab4	Load diagnostic measurement.	5
Lab5	Vehicle fault codes based on the EOBD interface.	2
Lab6	The vibroacoustic engine diagnostics.	2
		Total hours: 15

TEACHING TOOLS USED

N1. case study
N2. multimedia presentation
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Exam.
F2	PEK_W02	Exam.
F3	PEK_W03	Exam.
P = F1+F2+F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Laboratory report
F2	PEK_U02	Laboratory report
F3	PEK_U03	Laboratory report
P = F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Basztura C.: Komputerowe systemy diagnostyki akustycznej. Warszawa, Wyd. Politechniki Warszawskiej 1996.[2] Bocheński C., Janiszewski T.: Diagnostyka silników wysokoprężnych. Warszawa, WKŁ 1996.[3] Cempel C.: Diagnostyka wibroakustyczna maszyn. Poznań, Wyd. Politechniki Poznańskiej 1985.[4] Cempel C., Tomaszewski F.: Diagnostyka maszyn. Radom, Wyd. Techniczne 1992.[5] Czujniki w pojazdach samochodowych. Warszawa, WKŁ 2002, Informatory Techniczne Bosch.[6] Merkisz J., Mazurek S.: Pokładowe systemy diagnostyczne pojazdów samochodowych. Warszawa, WKŁ 2007.[7] Wróbel R.: Trends in vehicle electronics. Wyd. PWr, Wrocław 2011.

SECONDARY LITERATURE

[1] Moczulski W.: Diagnostyka techniczna metody pozyskiwania wiedzy. Gliwice, Wyd. Politechniki Śląskiej 2002.[2] Myszkowski S.: Diagnostyka Pokładowa. Warszawa, Instalator Polski 2001.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The computer diagnosis of cars vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MTR_MMP_W05, K2MTR_MMP_W06	C1	lec1-lec7	N1, N2
PEK_U01	K2MTR_MMP_U02, K2MTR_MMP_U04, K2MTR_MMP_U07	C3	La1 La2 La5	N3
PEK_U02	K2MTR_MMP_U02, K2MTR_MMP_U06	C2 C3	La1 La2 La3 La4 La5 La6	N1 N3
PEK_U03	K2MTR_MMP_U07, K2MTR_MMP_U08	C1 C3	La2 La4 La5	N1 N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechatronika w pojazdach samochodowych**
Name in English: **Mechatronics in automotive vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041102**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in mathematics, physics, and write in the art,
2. Knowledge and skills in the field of electrical engineering, electronics and optoelectronics, sensors and actuators,

SUBJECT OBJECTIVES

C1. Knowing the main mechatronic systems in motor vehicles
C2. Ability synergy of knowledge in the areas: mechanics, electronics and computer science
C3. Learning basic concepts of mechatronics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He can call the individual components and mechatronic systems of a motor vehicle

PEK_W02 - He has knowledge of the techniques of measurement of physical quantities in the study and control of mechatronic systems in vehicles

PEK_W03 - He has knowledge of modern mechatronic systems car driver assistance systems, engine management and on-board diagnostic

II. Relating to skills:

PEK_U01 - Can formulate the principle of operation of sensor bus and car diagnostic systems

PEK_U02 - He knows the rules for the integration of different disciplines (electronics, automation, sensing and hudrauliki) in hydrotroniczne systems.

PEK_U03 - It can analyze the structure and operation of various mechatronic systems for use in vehicles

III. Relating to social competences:

PEK_K01 - Understand the need for continuous training

PEK_K02 - The awareness level of security in terms of mechatronic solutions used in vehicles

PEK_K03 - Appreciating the need to raise their professional skills, personal and social

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts related to construction vehicles and the role of mechatronic systems in modern vehicles	2
Lec2	Intelligent vehicle	2
Lec3	Data bus in the car.	1
Lec4	On-board diagnostic systems and station	2
Lec5	Sensors measured values and drivers for use in vehicles	2
Lec6	Systems of comfort and travel (parking, cruise control, ambient identification, navigation, vehicle security)	2
Lec7	Passive safety of vehicles and pedestrians.	2
Lec8	Driver assistance systems (ABS, ABC, ASR, ESP, DISTRONIC etc.)	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Select the type of vehicle	1
Proj2	Select the type of vehicle system	1
Proj3	Design assumptions - term limits	1
Proj4	Finding solutions	2
Proj5	Choosing a solution for the preliminary design	2
Proj6	Design of mechanical	2
Proj7	Design of electronic	2
Proj8	Design of information	2

Proj9	Design drawings and diagrams. Description of the solution	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. project presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
F3	PEK_W03	test
P = F1+F2+F3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Schmid D. Mechatronics REA Warsaw 2002
Turowski, J. Basics of mechatronics AHE, Lodz 2008

SECONDARY LITERATURE
Magazines: among others. Measurement, Automation and Robotics, Drives and Controls

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronics in automotive vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W11	C1	Wy1 - Wy8	N1, N2
PEK_W02	K2MTR_MMP_W03	C2	Wy1 - Wy8	N1, N2
PEK_W03	K2MTR_MMP_W03	C1, C2	Wy1, Wy3, Wy4	N1, N2
PEK_U01	K2MTR_MMP_U06	C1, C2	Pr1 - Pr9	N1
PEK_U02	K2MTR_MMP_U06	C1, C2	Pr1 - Pr9	N1, N2
PEK_U03	K2MTR_MMP_U04, K2MTR_MMP_U09	C1, C2, C3	Pr1 - Pr9	N1, N2
PEK_K01	K2MTR_K01	C1, C2, C3	Pr1 - Pr9	N1, N2
PEK_K02	K2MTR_K01	C1, C2, C3	Pr1 - Pr9	N1, N2
PEK_K03	K2MTR_K01	C1, C2, C3	Pr1 - Pr9	N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikroprocesorowe układy pomiarowe**
Name in English: **Microprocessor-based measurement systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041103**
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	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	1		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		1
Lec2		3
Lec3		3
Lec4		2
Lec5		3
Lec6		1
Lec7		2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		3
Lab6		2
Lab7		2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, W03	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W03, PEK_U01, PEK_U02, PEK_U03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microprocessor-based measurement systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W07	C1		N1-N4
PEK_W02	K2MTR_MMP_W07	C2		N1-N4
PEK_U01	K2MTR_MMP_U08	C1, C2		N1-N5
PEK_U02	K2MTR_MMP_U08	C2, C3		N1-N5
PEK_U03	K2MTR_MMP_U08	C2, C3		N1-N5
PEK_W03	K2MTR_MMP_W07	C1, C2		N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy hydrotroniczne i pneumotroniczne**
Name in English: **Hydrotronic and pneumotronic systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041104**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has a basic knowledge of machine power systems with particular reference to their requirements. The student understand the define depending the power flow in the power system and the equations describing the load impact on the physical parameters present in the power system.
2. The student has a basic knowledge of the control system of machines and equipment. The student be able to define the role and functions of the control system, and propose a preliminary concept of the control system based on the requirements.
3. The student is able to analyze and interpret the observed effects of a number of known power systems and identify their advantages and disadvantages.

SUBJECT OBJECTIVES

C1. The acquisition of basic knowledge about the pneumotronic hydrotronic systems, the analysis of the construction, principle of operation, structure, desirability of the application.
C2. Acquiring the ability to conduct its own analysis of the pneumotronic and hydrotronic systems. Acquiring skills indication of the benefits of using these systems, with particular emphasis on the comparative analysis performed with the classic solutions hydrostatic and pneumatic systems.
C3. Acquiring the ability to create a conception of the pneumotronic or hydrotronic system, based on the required motion parameters and transfered knowledge, in the form of examples of the already existing systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to describe the principle of operation, the individual elements and benefits of the hydrotronic and pneumotronic systems. Student can define differences in the operation of the pneumotronic and hydrotronic systems for classical hydrostatic and pneumatic power system.
PEK_W02 - The Student identifies the role of individual hydrotronic and pneumotronic components in the system, their impact on the operation of the system and is able to carry out preliminary selection of system components based on the operation requirements.
PEK_W03 - The student defines the role of the control system, is able to describe and explain its mode of action and identify the system desired features which, in combination with the parameters of the power transmission system formed the hydrotronic or pneumotronic system with the favorable working parameters or allows the new applications.

II. Relating to skills:
PEK_U01 - The student analyzes the principle of operation and determines the impact of sample components to the hydrotronic and pneumotronic systems. Students draw graphs of variation of components selected parameters, based on laboratory experiment.
PEK_U02 - The student analyzes and evaluates the work of the sample hydrotronic and pneumotronic systems. The student plans and carries out the system laboratory experiment, the results of which are the subject to analysis.
PEK_U03 - The Student plans the laboratory experiment, performs independently combining each elements of the system, is responsible for the proper installation and performs a series of laboratory experiments, the results of which are analyzed and reported together with its own interpretation.

III. Relating to social competences:
PEK_K01 - The student takes part in the work of the group of students, the goal of which is the joint planning and perform of a laboratory experiment.
PEK_K02 - The student acquires skills to present the results of their work in the written form report supplementing them orally during classes with the teacher.
PEK_K03 - The student independently searches for information and analyzes them based on the knowledge acquired during the course.

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Introducing students to with the scope of the course, the conditions of crediting and the course literature. The hydraulic and pneumatic modular connecting system.	2
Lec2	Comparative analysis of hydrostatic systems with the hydrotronic systems, the comparison of the example parameters.	2
Lec3	The hydraulic and pneumatic actuator speed control systems.	2
Lec4	Systems with multiple energy sources, accumulate energy of the liquid, example parameters.	2
Lec5	Stop and lock actuator movement, diagrams, method of implementation, examples of solutions.	2
Lec6	Synchronization of the actuators on the example hydrotronic systems, description and control functions.	2
Lec7	Adaptive control, overview, principle of operation, applications.	2
Lec8	Completion of the course.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	The series and parallel connection of the system actuators.	2
Lab3	The use of the hydraulic rectifier.	2
Lab4	The sequencer with the pressure switch.	2
Lab5	The tandem arrangement of the pneumatic actuators.	2
Lab6	The testing of the parameters of hydrostatic system with the Load-Sensing valve.	2
Lab7	Sequencer systems controlled by the course of time.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

F1	PEK_W01÷PEK_W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U03 PEK_K01÷PEK_K03	the written report, the verbal response, the preliminary presentations to the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. W. Kollek: Fundamentals of hydraulic drive. SINH Wrocław 1989. (in Polish)
2. W. Kollek: Basics of the designing hydraulic drives and controls. Oficyna Wydaw. Polit. Wroc. Wrocław 2004. (in Polish)
3. Z. Szydelski: Car vehicles. The drive and hydraulic control. WKŁ Warszawa 1999. (in Polish)
4. W. Szejnach: Pneumatic drive and control. WNT 1992. (in Polish)

SECONDARY LITERATURE

1. L. T. Wrotny: Designing machine tools. General problem and examples. WNT 1980. (in Polish)
2. W. Kollek, E. Palczak: Optimization of the hydraulic system components. Wydawnictwo Ossolineum, Wrocław 1994. (in Polish)
3. A. Pizoń: Hydraulic and electro-hydraulic control and regulation systems. WNT 1987. (in Polish)
4. Catalogues of the typical hydraulic and pneumatic components.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrotronic and pneumotronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W02	C1	Lec1÷Lec2	N2, N5
PEK_W02	K2MTR_MMP_W02	C1	Lec3÷Lec5	N2, N5
PEK_W03	K2MTR_MMP_W02	C1, C3	Lec6÷Lec7	N2, N5
PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	K2MTR_K03, K2MTR_K04, K2MTR_MMP_U04	C2, C3	Lab1÷Lab7	N1, N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy mechatroniczne maszyn roboczych**
Name in English: **Mechatronic systems of working machines**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041105**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. To gain knowledge of construction and principles of operation of typical mechatronic systems commonly used in working machines and industrial vehicles
C2. To gain skills in planning and conducting experimental research and diagnosis of mechatronic systems in working machines and industrial vehicles. To gain skills in analysis of construction and principles of operation of various automatic systems used in working machines
C3. To gain and consolidate competence in determining appropriate priorities to achieve the specific purpose

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - has knowledge of mechatronic systems of vehicles and working machines used in construction, mining, and transhipments
PEK_W02 - has knowledge of mechatronic systems for use in vehicles and agricultural machines
PEK_W03 - has knowledge of mechatronic systems used in cranes and warehouses

II. Relating to skills:
PEK_U01 - is able to carry out experimental studies, analyze the structure and operation and perform diagnostics of mechatronic system of industrial vehicle
PEK_U02 - is able to carry out experimental studies, analyze the structure and operation and perform diagnostics of crane mechatronic system

III. Relating to social competences:
PEK_K01 - has expanded and well established competence in determining priorities to achieve the specific purpose

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Introduction to mechatronic systems in vehicles and working machines	1
Lec2	Mechatronic systems in drive systems of vehicles and working machines	2
Lec3	Mechatronic systems for support of the positioning process of manipulator of industrial vehicle	2
Lec4	Automatic systems for excavating and loading of crushed material	2
Lec5	Mechatronic safety and diagnostic systems in industrial vehicles	2
Lec6	Selected mechatronic systems used in agricultural machines	2
Lec7	Automation of storage and transhipment processes	2
Lec8	Overview of mechatronic systems used in cranes	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Experimental studies of an electric power transmission system start-up controlled process	2
Lab2	Testing of an automatic control system for overhead travelling crane work cycles	2
Lab3	Examination of jib crane monitoring system	2
Lab4	Experimental research of control system of robot for diagnostics of guy ropes	2
Lab5	Experimental studies of stability monitoring and improvement system for industrial wheeled vehicle	2
Lab6	The investigation of the new generation's mechatronic steering system for articulated vehicle	2
Lab7	Experimental studies of an automatic scooping system of industrial vehicle	2

Lab8	Testing of a laser positioning system of transhipment vehicle manipulator	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U02, PEK_K01	laboratory reports, short tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki iMagazynowania, 1998r. [2] Piątkiewicz A., Sobolski R.: Dźwignice. Tom I i II. WNT, Warszawa 1977r

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronic systems of working machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W03	C1	Lec1÷Lec5	2, 5
PEK_W02	K2MTR_MMP_W03	C1	Lec2, Lec5, Lec6	2, 5
PEK_W03	K2MTR_MMP_W03	C1	Lec2, Lec5, Lec7, Lec8	2, 5
PEK_U01	K2MTR_MMP_U04	C2	La4÷La8	1, 2, 3, 4
PEK_U02	K2MTR_MMP_U04	C2	La1÷La3	1, 2, 3, 4
PEK_K01	K2MTR_K04	C3	Lec1÷Lec8, La1÷La8	1, 2, 3, 4, 5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane układy sterowania maszyn roboczych**
Name in English: **Advanced control systems of working machines**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041107**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. To gain knowledge of the methods of synthesis, methods programming and design of control systems of working machines and industrial vehicles
C2. To gain skills of completion, programming and testing of control systems of working machinery and industrial vehicles
C3. To gain competence in the appropriate setting priorities to achieve the set by yourself or other tasks
C4. Consolidation of awareness and understanding of non-technical aspects of mechanical engineering, such as health and safety and environmental impact

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - has knowledge of elements and programming of controllers of typical mechatronic systems of working machines and industrial vehicles

PEK_W02 - has knowledge of methods of synthesis of advanced control systems for use in working machines and industrial vehicles

PEK_W03 - has knowledge of possibilities of using fuzzy control and neural networks in working machines and industrial vehicles

II. Relating to skills:

PEK_U01 - is able to program selected types of controllers and operator panels for use in control systems of industrial vehicles

PEK_U02 - is able to rationally choose the components for control systems of working machines and industrial vehicles

PEK_U03 - is able to test the correctness and efficiency of the applied control algorithms

III. Relating to social competences:

PEK_K01 - is able to properly identify priorities to realize tasks specified by him or others

PEK_K02 - is aware of and understand the non-technical aspects of mechanical engineering, such as safety and hygiene at work, environmental impact

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Presentation of the range of issues discussed in the course. Background information.	2
Lec2	Programmable controllers in control systems of industrial vehicles and their programming	2
Lec3	Microcontrollers in control systems of industrial vehicles and their programming	2
Lec4	Operator panels for industrial vehicles and their programming	2
Lec5	Actuators and adjusting devices used in control systems of working machines and vehicles	2
Lec6	Communication interfaces used in control systems of working machines and vehicles	2
Lec7	Standardized arrangements for addressing messages on the CAN bus of the vehicle. Creating and sending messages on the CAN bus, acquisition and processing of such reports using a sample controlers.	2
Lec8	Navigation systems used in control systems for working machines and industrial vehicles	2
Lec9	Vision systems in control systems of working machines and industrial vehicles	2
Lec10	The control systems of autonomous vehicles	2
Lec11	Control systems of devices for active vibration isolation	2
Lec12	Methodology for the synthesis of robust control algorithms on examples from field of the working machinery and industrial vehicles	2
Lec13	Methodology of synthesis of adaptive control algorithms with examples from the field of working machines and industrial vehicles	2

Lec14	Synthesis and applicability of fuzzy control and neural network in mechatronic systems of working machines and industrial vehicles	2
Lec15	Layers control on examples from field of warehouses and transshipment terminals	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Programming of the CAN bus communication between the components of the control system	2
Lab2	Creation and programming of the visualization system of operating parameters of the control system	2
Lab3	Choosing the components and programming of control system of industrial vehicle manipulator	2
Lab4	Choosing the components and programming of system to improve operational safety for exemplary working machine	2
Lab5	Programming of control unit of drive of industrial vehicle which is cooperating with the engine control unit	2
Lab6	Programming and testing of various advanced algorithms of excavator's manipulator control including those based on fuzzy logic	2
Lab7	Selection of components and programming of the control system of servo motor in the machine drive system	2
Lab8	Programming and testing of control system of hydrostatic vibration exciter	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

[1] Korzeń Z.: Logistyczne systemy transportu bliskiego i magazynowania. Tom I i II. Instytut Logistyki i Magazynowania, 1998r. [2] Piątkiewicz A., Sobolski R.: Dźwignice. Tom I i II. WNT, Warszawa 1977r. [3] Bishop R. H.: The Mechatronics Handbook. CRC PRESS 2002r. [4] Vlacic L., M. Parent, F. Harashima: Intelligent Vehicle Technologies – Theory and Applications. Butterworth- Heinemann, 2001r. [5] Skoczkowski S., R. Osypiuk, K. Pietrusewicz: Odporna regulacja PID o dwóch stopniach swobody w praktyce. PWN 2006r. [6] PLUS+1 GUIDE - User Manual. Sauer-Danfoss 2012r. [7] W. Zimmermann, R. Schmidgall: Magistrale danych w pojazdach. WKiŁ, 2008r. [8] Piegat A.: Modelowanie i sterowanie rozmyte. Exit, Warszawa 1999r. [9] Nguyen H. T., Prasad N. R., Walker C. L.: A First Course in Fuzzy and neural control. Chapman and Hall/CRC, 2002r. [10] Brzózka Jerzy: Regulatory i układy automatyki. Wydawnictwo MIKOM, Warszawa, 2004r. [11] Niederliński A., J. Mościński, Z. Ogonowski: Regulacja adaptacyjna. PWN, 1995r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced control systems of working machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W04	C1	Lec1÷Lec7	2, 5
PEK_W02	K2MTR_MMP_W04	C1	Lec8÷Lec13, Lec15	2, 5
PEK_W03	K2MTR_MMP_W04	C1	Lec14	2, 5
PEK_U01	K2MTR_MMP_U05	C2	La1÷La8	1, 2, 3, 4
PEK_U02	K2MTR_MMP_U05	C2	La1÷La8	1, 2, 3, 4
PEK_U03	K2MTR_MMP_U05	C2	La1÷La8	1, 2, 3, 4

PEK_K01	K2MTR_K04	C3	Lec1÷Lec15, La1÷La8	1, 2, 3, 4, 5
PEK_K02	K2MTR_K02	C4	Lec1÷Lec15, La1÷La8	1, 2, 3, 4, 5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Energooszczędne układy napędowe maszyn i pojazdów**
Name in English: **Energy-saving driving systems of earth moving machines and vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041108**
Group of courses: **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	X				
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of the construction of vehicle propulsion systems and machines. Is aware of the impact of the solutions on the environment. It has an advanced knowledge of mathematics and physics.
2. Student has a basic knowledge of the design of control algorithms. He knows the proper terminology. It has a basic knowledge of the principles of operation of electronic components.
3. Can use measuring devices and systems. Able to work in groups in various roles, and to develop and formulate conclusions.

SUBJECT OBJECTIVES

C1. The aim of the course is to acquire the practical knowledge needed to design energy-efficient vehicles and powertrains in mechatronic systems working machines. Has the need to continue to receive information and the solutions on the environment.
C2. The aim of the course is the acquisition of knowledge in the construction and principles of operation of the various propulsion components and the ability to conduct experimental studies. Is able to perform functional analysis of various propulsion systems and their control. Able to model the selected items propulsion systems and their control systems. He has developed the ability to work in groups.
C3. The aim of the course is to acquire practical knowledge in the design and optimization of control systems for machines working. It can make a plan and carry out his experiment. Has the ability to publish the results and solutions applied.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - familiar with the terminology and can explain the rules of individual vehicle propulsion components and working machines
PEK_W02 - able to define the problems of the flow of energy in the propulsion system and identify work areas with impaired mechanisms of action
PEK_W03 - can choose the elements of traditional propulsion systems and hybrid and identify energy losses

II. Relating to skills:
PEK_U01 - can perform mathematical calculations determining the parameters of the test object
PEK_U02 - able to design a propulsion system so as to obtain its objective action
PEK_U03 - is able to specify a path for power and estimate the power dissipation in the proposed drive system

III. Relating to social competences:
PEK_K01 - student looking for information in the literature expanding their knowledge and skills
PEK_K02 - student communicates effectively with others solvers together specific issue
PEK_K03 - student proposes and devises a new possible solutions for applications in engineering

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of the propulsion system, hybrid types and propulsion systems, single and multi-source power systems. The principle of operation of the powertrain.	2
Lec2	Primary and secondary sources of energy: electrical, mechanical and electro-hydraulic, fuel-calorie concept.	2
Lec3	Fuel cells. The efficiency of energy processed. Power converters for AC and DC operated from vehicles.	2
Lec4	A detailed overview of the energy storage. The problems and limitations associated with it. Resistance and power consumption while moving.	2
Lec5	Structure parallel hybrid powertrain. The efficiency of transmission.	2

Lec6	The structure of serial and mixed hybrid propulsion systems. The efficiency of transmission.	2
Lec7	Construction of propulsion of "mild".	2
Lec8	Computational method for selecting the individual components of hybrid powertrains. Problems associated with the delivery of energy recovered to the source. The amount and efficiency of energy recovery based on the cycle of the vehicle.	2
Lec9	Recuperating and energy storage. Fine-tune the structure of the fuel to the vehicle drive cycle. Analysis of the possibility of reducing gas share of energy sources in the energy transfer.	2
Lec10	Analysis of the possibility of reducing engine power and efficiency of the transmission.	2
Lec11	The recuperative braking wheeled vehicles. Problems with receiving energy and preserving the direction of motion. Construction of hybrid brakes.	2
Lec12	The braking of ground working vehicles. The methodology and energy.	2
Lec13	The use of electronic circuits for controlling the earth working machines.	2
Lec14	Traction characteristics of hybrid vehicles. Unconventional methods of transmission.	2
Lec15	Modeling of hybrid drive systems for wheeled vehicles. Modeling of sources and receivers of energy.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Study the possibility of accumulation of energy in the hydrostatic drive system wheel loader working system.	2
Lab2	Performance testing of the propulsion system overhead traveling crane winch.	2
Lab3	Accumulation and recuperation of energy in the inertial propulsion system.	2
Lab4	Energy efficiency of the filling process of bucket i earth working vehicles	2
Lab5	Hydrostatic test drive of earth working machine.	2
Lab6	Accumulation and energy recuperation mechano-electrical and electrical drive systems.	2
Lab7	Modelling of vehicle propulsion systems and machines in an MBS.	2
Lab8	Research centers granular mining process. Effect of tool selection process for energy efficiency.	2
		Total hours: 16

TEACHING TOOLS USED

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.„Propulsion Systems for Hybrid Vehicles”, John Miller, IEE Power and Energy Series 45, 2004
2.“Odnawialne źródła energii i pojazdy proekologiczne”, Grażyna Jastrzębska, WNT, 2009
3.„Akumulacja energii w pojazdach”, Antoni Szymanowski, WKŁ, 1984
4.„Alternatywne napędy pojazdów”, Jerzy Merkisz, Wydawnictwo Politechniki Poznańskiej, 2006
5.„Modern Electric Vehicle Tehnology”, C. Chan, Oxford Universtity Press, 2001
6.“Electric vehicle technology explained”, James Larminie, West Sussex, England ; Hoboken, N.J. : J. Wiley, cop. 2003
7.„Maszyny elektryczne pojazdów samochodowych”, Eugeniusz Koziej, WNT, 1984

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Energy-saving driving systems of earth moving machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W03, K2MTR_MMP_W08	C1	Lec1-Lec7	N1,N3
PEK_W02	K2MTR_MMP_W08, K2MTR_MMP_W09	C1, C3	Lec8-Lec10	N1, N3
PEK_W03	K2MTR_MMP_W02, K2MTR_MMP_W03	C3	Lec11-Lec15	N1, N3
PEK_U01	K2MTR_MMP_U02, K2MTR_MMP_U04	C2	Lab1-Lab8	N2
PEK_U02	K2MTR_MMP_U05	C2	Lab1-Lab8	N2
PEK_U03	K2MTR_MMP_U01	C2	Lab1-Lab8	N2
PEK_K01	K2MTR_K01	C1, C2, C3	Lec11-Lec15	N1,N3
PEK_K02	K2MTR_K03	C2	Lab1-Lab8	N2
PEK_K03	K2MTR_K06	C1, C2	Lec11-Lec15, Lab1-Lab8	N1,N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie optyczne i laserowe**
Name in English: **Optical and Laser Technologies**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041109**
Group of courses: **yes**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of optics, electronics, computer science
2. Is able to design algorithms and program in selected high-level language

SUBJECT OBJECTIVES

C1. Explain the principle of operation and performance of the measuring apparatus
C2. Explain the principle of operation and construction of machine vision systems
C3. Explain the principle of operation and applications of laser technology

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can discuss the operation and performance of the optical research equipment
PEK_W02 - Can discuss the operation and performance of the individual components of the vision system
PEK_W03 - Can discuss the parameters of the laser beam and its industrial applications

II. Relating to skills:
PEK_U01 - Can choose and optical apparatus for testing and interpret results
PEK_U02 - Is able to determine and analyze the parameters of image quality, and test the algorithm for measurement and machine vision inspection
PEK_U03 - He can adjust the parameters of the laser beam uses

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Strengthening the basic concepts of optics. Machine vision systems examples	2
Lec2	Cameras and Lenses	2
Lec3	Lighting and algorithms for image processing and analysis	2
Lec4	Optical Metrology (2D, 3D, spectrometry, thermography, skaterometria)	2
Lec5	Basics of laser technology	2
Lec6	Applications of laser technology	2
Lec7	Diagnosis of the laser beam, the laser treatment process monitoring	2
Lec8	Written assessment	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Vision systems for production quality control	2
Lab2	Methods of image analysis	2
Lab3	Methods for image classification	2
Lab4	Optical measurements (microscopy 2D / 3D, interferometry, spectroscopy, etc.)	2
Lab5	Implementation of vision measurement program	2
Lab6	Implementation of vision inspection program	2
Lab7	Applications of laser technology	2
Lab8	Additional term	1
		Total hours: 15

TEACHING TOOLS USED

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Hornberg A., Handbook of Machine Vision, Wiley-Vch, 2006 Louban R., Image Processing of Edge and Surface Defects
Hagop Injeyan & Gregory Goodno, High-Power Laser Handbook, McGrawHill, 2011
Reinhart Poprawe, Tailored Light 2: Laser Application Technology, Springer 2011

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Optical and Laser Technologies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

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

PEK_W01	K2MTR_MMP_W10	C1	Lecture 4, Lecture 7	N1
PEK_W02	K2MTR_MMP_W10	C2	Lecture 1-, Lecture 5-7	N1
PEK_W03	K2MTR_MMP_W10	C3	Lecture 5, Lecture 6	N1
PEK_U01	K2MTR_U11	C1	Laboratory 1, 4	N2, N3
PEK_U02	K2MTR_U11	C2	Laboratory 2,3,5,6	N2, N3
PEK_U03	K2MTR_MMP_U02, K2MTR_U11	C3	Laboratory 6, 7	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): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041110**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

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

III. Relating to social competences:

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

PROGRAMME CONTENT

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

TEACHING TOOLS USED

N1. problem discussion
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

F1	PEK_U01, PEK, K01	Problem discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Students' own notes and the literature on the degree I and II subjects.
2. Poradnik inżyniera mechanika. Tom I-II, WNT 1968,1969, 1970

SECONDARY LITERATURE

1. http://www.wmech.pwr.wroc.pl/88431,91.dhtml (Instructions for the authors of diploma works)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2MTR_U15, K2MTR_U19, K2MTR_U20, K2MTR_U22	C1, C2	Se2-Se5	N1, N2
PEK_K01	K2MTR_K07	C1, C2	Se1-Se7	N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie i symulacja komputerowa zespołów mechatronicznych**
Name in English: **Modeling and computer simulation of mechatronic assemblies**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041111**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		3
Lec2		3
Lec3		2
Lec4		2
Lec5		1
Lec6		3
		Total hours: 14
Form of classes – Laboratory		Number of hours
Lab1		5
Lab2		2
Lab3		2
Lab4		2
Lab5		4
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		6
Proj2		6
Proj3		6
Proj4		6
Proj5		6
		Total hours: 30

TEACHING TOOLS USED

N1. problem discussion
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	
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 = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modeling and computer simulation of mechatronic assemblies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K2MTR_MMP_U01, K2MTR_MMP_U03, K2MTR_MMP_U04	C1		N1-N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza modalna**
Name in English: **Modal Analysis**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041120**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. linear ordinary differential equations, differential and integral calculus
2. dynamics of mechanical systems (in range of Mechanics II stage 1 of study
3. Lagrange’s equation (in range of Analytical Mechanics)

SUBJECT OBJECTIVES

C1. Knowledge of vibration theory of linear systems with many degrees of freedom using the Laplace operator technique: transmittance matrix, Duhamel's formula, frequency response function, spectrum of natural frequencies, modal model, mode shapes, modal matrices, modal constants.
C2. The ability to measure dynamic signals and their analysis with the use of professional software for Fourier analysis of signals. Ability to use measuring apparatus and sensors in order to determine the mode shapes and modal parameters of real systems.
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the basic notions of vibration of discrete linear dynamic systems: generalized mass and generalized stiffness matrices, natural frequencies, modal parameters and modal matrices, mode shapes.
PEK_W02 - He knows the theory of linear systems in depiction of the Laplace transform: transmittance matrix, frequency response function, the Duhamel's formula. He knows the harmonic analysis applied to the vibration analysis of mechanical systems from a theoretical as well as practical (filters, spectral windows).
PEK_W03 - He knows the theoretical basis and application problems of experimental modal analysis .

II. Relating to skills:
PEK_U01 - He can determine the signals spectrum of displacements, velocities and accelerations and excited forces for real mechanical systems in laboratory environment and by computer simulation techniques
PEK_U02 - He can apply the Fourier and Laplace transform to vibration analysis of linear mechanical systems.
PEK_U03 - He can use a professional testing apparatus to measure and analysis of dynamic mechanical systems vibration in order to create a modal model of the real structure by using experimental modal analysis method.

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Harmonic oscillations. Harmonic analysis of signals. Fourier transforms.	2
Lec2	Laplace operator and its application in vibration theory of linear systems on the example of an oscillator with viscous damping	2
Lec3	Vibration theory of linear discrete conservative multi-degree-of-freedom systems. Free vibrations, modal parameters, mode shapes.	2
Lec4	The generalization of the theory of modal analysis on systems with proportional viscous damping	2

Lec5	Forced oscillations. Transmittance matrix. Frequency response functions	2
Lec6	The problem of modeling and identification of the real system using modal analysis. Modal model.	2
Lec7	Basis of experimental modal analysis	1
Lec8	Test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Getting familiar with the software Matlab, Simulink and Mathematica.	2
Lab2	Applications of harmonic analysis for nonlinear systems subjected to some non-periodic load (eg, shock loads).	2
Lab3	Computer analysis and by means of Laplace operator technique the free and forced vibration of a linear degenerate system (e.g. Maxwell type). Determination its frequency response function.	2
Lab4	Analysis the free and forced vibration of a linear two-mass and two-degree-of-freedom system using Simulink software. Determination of modal model of the system.	2
Lab5	Introduction to the professional test apparatus used in the experimental modal analysis method (sensors, vibration analyzers, specialized software, exciters, impact hammers) as an example of the selected system	2
Lab6	Determination of the spectrum of natural frequencies and mode shapes of any selected real system using experimental modal analysis	2
Lab7	Derivation of a modal model of a dynamical system selected in the laboratory: natural frequencies, modal mass, modal damping, modal matrix.	2
Lab8	Evaluating the reports and effects of activities. Credits.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. HM Irvine, Structural Dynamics, Allen & Unwin Ltd. 1986;
2. M. Kulisiewicz St. Piesiak, Methodology of modeling and identification of mechanical dynamical systems", WUT. , 1994;, House Publ. Wrocław University of Technology, 1994;
3. J. Ewins, Modal Testing: Theory and Practice, Research Studies Press Ltd., Reading 1984

SECONDARY LITERATURE

1. Dynamic Signal Analyzer HP 35665A, Concepts Guide, Hewleet-Packard Company, Washington 1991,
2. Ole Dossing, Structural Testing: Part 1 (Mechanical Mobility Measurements), Part 2 (Modal Analysis and Simulation), Bruel & Kjaer, 1988

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modal Analysis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03,	K2MTR_W01, K2MTR_W04	C1	Lec 1 to Lec 8	N1, N4, N5
PEK_U01, PEK_U02, PEK_U03,	K2MTR_MMP_U01	C2	Lab 1 to Lab 8	N2, N3
PEK_K01, PEK_K02, PEK_K03	K2MTR_K01, K2MTR_K03, K2MTR_K06	C3	Lab 1 to Lab 8	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza obrazów**
Name in English: **Digital images analysis**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041121**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student knows the basics of structured programming in C / C + +

SUBJECT OBJECTIVES

C1. Familiarizing with computer image analysis algorithms for filtering, segmentation and spatial modeling
C2. Introduction to the implementation of digital image analysis algorithms
C3. The introduction to the latest trends in the field of digital image analysis, decision support, virtual and augmented reality

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has structured knowledge of digital image formats, methods of image acquisition, image compression and digital image interpretation

PEK_W02 - Student has a basic knowledge of the methods of digital image filtering and segmentation of objects on digital images

PEK_W03 - Student has an elementary knowledge of new trends in the analysis of digital images, virtual and augmented reality.

II. Relating to skills:

PEK_U01 - Student can implement selected algorithms of filtering and image analysis (including quantitative analysis) and can
solve the problems in the area of filtration and analysis stand-alone

PEK_U02 - Student can analyze medical data in DICOM format using packaged applications

PEK_U03 - Student can prepare a dossier with a discussion of the results of image analysis

III. Relating to social competences:

PEK_K01 - Student can work on tasks stand-alone and in a group

PEK_K02 - Student can think and act creatively

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Saving digital images, methods of image acquisition, image compression and interpretation of digital images	1
Lec2	Saving digital images, methods of image acquisition, image compression and interpretation of digital images	2
Lec3	Computer analysis of digital images. Algorithms of image interpretation. Artifacts origin in digital images (including medical images). Methods of noise filtration.	2
Lec4	Algorithm of object recognition on digital images	2
Lec5	Examples of the use of image analysis in medicine and technology	2
Lec6	Algorithms for object recognition in images recorded in real time (video sequences)	2
Lec7	Virtual and augmented reality. New trends in the analysis of digital images.	2
Lec8	New trends in the analysis of digital images. Examples of systems for decision support based on the analysis of images.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Familiarizing with the basics of programming environment.	1
Lab2	Methods to load digital images in the following formats: BMP, JPEG, DICOM, other	2
Lab3	Methods of filtering of digital images	2

Lab4	Object recognition algorithms on digital images	2
Lab5	Quantitative analysis of digital images	2
Lab6	Application of the selected customized software for image analysis and spatial modeling	2
Lab7	Evaluation project / Visit to the laboratory of laparoscopic simulation	2
Lab8	Evaluation project	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	report of the exercises laboratory
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	report
P = 0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Ryszard Tadeusiewicz, Mariusz Flasiński, Image recognition, National Scientific Publisher, Warsaw, 1991 (in Polish).
[2] Ryszard Tadeusiewicz, Przemysław Korohoda: Computer Analysis and
image processing, Telecommunications Advancement Foundation Publisher, Kraków 1997 (in Polish).

SECONDARY LITERATURE

[1] Jasjit S. Suri, David L. Wilson, Swamy Laxminarayan: Handbook of Biomedical Image Analysis. Kluwer Academic / Plenum Publishers, New York, Boston, Dordrecht, London, Moscow, 2005.
[2] Isaac Bankman: Handbook of Medical Imaging: Processing and Analysis Management (Biomedical Engineering), Academic Press; 1 edition (October 13, 2000)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Digital images analysis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_W11, K2MTR_W12	C1	Wy1, Wy2	N1, N2
PEK_W02	K2MTR_W11, K2MTR_W12	C2	Wy3, Wy4, Wy5, Wy6	N1, N2
PEK_W03	K2MTR_W11, K2MTR_W12	C3	Wy7, Wy8	N1, N2
PEK_U01	K2MTR_U11, K2MTR_U12, K2MTR_U13, K2MTR_U17	C2	La1, La2, La3, La4, La5	N3, N4
PEK_U02	K2MTR_U11, K2MTR_U12, K2MTR_U13, K2MTR_U17	C1, C3	La6	N3, N4
PEK_U03	K2MTR_U11, K2MTR_U12, K2MTR_U13, K2MTR_U17	C1, C2, C3	La1, La2, La3, La4, La5, La6, La7, La8	N3, N4
PEK_K01	K2MTR_K01, K2MTR_K02	C1, C2, C3	La1, La2, La3, La4, La5, La6, La7, La8	
PEK_K02	K2MTR_K01, K2MTR_K04, K2MTR_K06	C1, C2, C3	La1, La2, La3, La4, La5, La6, La7, La8	

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania układów mechatronicznych**
Name in English: **Investigation of mechatronic systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041122**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge and skills that allow them to carry out measurements of the basic physical parameters
2. kinematic structure of mechanical parts knowledge
3. overall structure of control system knowledge

SUBJECT OBJECTIVES

C1. Knowing the general structure of mechatronic measurement and control systems, particularly mobile
C2. familiar with the methods of sensory data acquisition and analysis in mechatronics systems
C3. Learn how to design a conceptual structure of the measurement systems, particularly for mobile applications

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has knowledge of the design and carrying out experimental research in mechatronics systems
PEK_W02 - Has knowledge of how to use sensory systems and the data acquisition systems
PEK_W03 - Has knowledge of programming selected controllers of the mechatronic systems

II. Relating to skills:

PEK_U01 - He can design a measurement system and carry out measurements of selected parameters of the mechatronic system
PEK_U02 - He can program selected controllers of measurement mechatronic system
PEK_U03 - Able to interpret measurement data, perform analysis and prepare a report on the research

III. Relating to social competences:

PEK_K01 - Has awareness of the importance and responsibility of proper and fair conduct of experimental research
PEK_K02 - It has a sense of responsibility for the consequences of the process of preparing the experimental research
PEK_K03 - Able to interact and work in a group, taking the various roles

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechatronic systems - problems, methods, and examples of research in mechatronics	2
Lec2	Interfaces, transmission standards and data flow in mechatronic systems	2
Lec3	Getting, processing and data acquisition in mechatronic systems	2
Lec4	Converters and analysis of image data in mechatronics systems	2
Lec5	Control of the mobile mechatronic systems - general characteristics	2
Lec6	Algorithms and control systems in mechatronics - types, standards, functions and data processing	2
Lec7	Technology acquisition and processing of environment data	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the study of mechatronic systems, safety training	1
Lab2	The sensory systems investigation (report)	3
Lab3	Design and testing of linear drive control systems (report)	3
Lab4	serial or parallel manipulator research (report)	3
Lab5	Design and programming of image analysis system (report)	3
Lab6	Budowa and programming of the control unit - MCU or PLC (report)	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Heimann B., Gerth W., Popp K.: Mechatronika. Komponenty, metody, przykłady. Wydawnictwo PWN , Warszawa 2001.2. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne. Wydawnictwo Politechniki Białostockiej. Rozpr. Naukowe nr 44. Białystok 1997.3. Denny K. Miu: M. Springer –Verlag, Nowy York 1993.4. Craig J.: Wprowadzenie do robotyki. WNT 1993.5. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003.6. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007

SECONDARY LITERATURE

1. Bolton W.: Mechatronics. Longman, Nowy York 19992. Roddeck W.: Einfurung in die Mechatronik. B

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Investigation of mechatronic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_W11	C1,C2	Wy1-Wy3	N1-N4
PEK_U01 - PEKU03	K2MTR_MMP_U02	C2, C3	La1-La6	N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Drgania układów mechanicznych**
Name in English: **Vibration of Mechanical Systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041123**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. linear ordinary differential equations, differential - integral calculus
2. dynamics of mechanical systems (in range of degree I of Mechanics II)
3. Lagrange's equations (in range of Analitical Mechanics)

SUBJECT OBJECTIVES

C1. Achieving basic knowledge in range of discrete mechanical system vibrations: linear and nonlinear systems, conservative, dissipative with different kinds of model damping, free and forced vibration- the frequency characteristics.
C2. The ability of a computer analysis of linear and nonlinear vibratory systems. Ability to apply basic analytical approximate methods in nonlinear oscillations theory.
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He knows the analytical methods of vibration in terms of free and forced vibrations of a linear model with one degree of freedom with viscous damping. He knows the harmonic analysis of periodic and non-periodic signals (Fourier's operators).

PEK_W02 - He knows the fundamental notions of nonlinear dynamical systems analysis (phase space, phase trajectory, singular points, steady-state, the stability of solutions, the frequency characteristics)

PEK_W03 - Knows the basic methods of search of approximate steady solutions of nonlinear systems (a small parameter method, harmonic balance method).

II. Relating to skills:

PEK_U01 - Can set and calculate the dynamic response of linear systems with one degree of freedom for any excitations and for arbitrary initial conditions. Can use shock absorption method with applying this model.

PEK_U02 - He can determine the spectrum of complex time signals measured at any point of the real dynamic systems using analytical methods and professional vibration analyzers. He can set the frequency characteristics of dynamic systems.

PEK_U03 - He is able to build computer models for the analysis of linear and nonlinear dynamical systems and perform the simulation studies of vibration of such systems.

III. Relating to social competences:

PEK_K01 - He can search information and is able to critical review

PEK_K02 - He can objectively evaluate the arguments and rationally explain and justify own point of view.

PEK_K03 - He can observe the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. The mechanical vibratory systems. Kinds of vibration.	2
Lec2	Complex form of harmonic signals. Harmonic analysis of periodic and non-periodic signals (discrete and continuous spectrum).	2
Lec3	Vibration Analysis of a linear model with one degree of freedom with viscous damping: brief reminder of the mechanics of the second degree and studies, follow-up of the energy balance equation, the dynamic hysteresis loop and vibration absorption problems.	2
Lec4	Vibration of the systems with a larger number of degrees of freedom for conservative linear system with two degrees of freedom example.	2
Lec5	Basic methods of vibration analysis in nonlinear systems. Phase space. Topological methods. Stability of solutions.	2
Lec6	The small parameter and perturbations methods in non-linear systems. The method of harmonic balance. Frequency characteristics in non-linear systems on the example of the Duffing system.	2
Lec7	Vibrations of systems with non-linear viscous damping and dry friction.	1
Lec8	Test.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Getting familiar with the software Matlab and Simulink.	2
Lab2	Design in Simulink of a dynamical system with one degree of freedom and computer analysis of the free and forced vibration.	2
Lab3	Analysis of free and forced vibration of a linear two-mass system with two degrees of freedom using Simulink software	2
Lab4	Simulation studies of nonlinear Duffing type system. Study of the effect of the coefficient at non-liner term on resonant frequency.	2
Lab5	Experimental studies of vibration of selected real systems with a finite number of degrees of freedom (1 or / and 2). Introduction to the measuring apparatus, vibration sensors, methods of excitations, vibration analyzers.	2
Lab6	Simulation tests a nonlinear dynamic system proposed by the student and approved by the teacher.	2
Lab7	The simulation studies of systems with dry friction. Effect of dry friction on the forced harmonic vibration	2
Lab8	Evaluating the effects of activities, reports. Credits.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

F1	PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03,	laboratory reports, oral answer
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Z. Osinski, Vibration Theory, PWN, Warsaw, 1978;
2. H. M. Irvine, Structural Dynamics, Allen & Unwin Ltd. 1986;
3. N. O. Myklestad, Fundamentals of Vibration Analysis, McGRAW-Hill Book Comp. , 1956

SECONDARY LITERATURE

1 M. Kulisiewicz, St. Piesiak, Methodology of Modeling and Identification of Mechanical Dynamical Systems, House Publ. Wrocław University of Technology, 1994;
2 C. Hayasihi, Nonlinear Oscillations in Physical Systems, WNT, Warsaw, 1968;
3 Z. Osinski, Damping of Mechanical Vibrations, PWN, Warsaw, 1979;
4 RA Struble, Nonlinear Differential Equations, PWN, Warsaw, 1965;
5 N. Minorski, Nonlinear Oscillations, PWN, Warsaw 1967

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Vibration of Mechanical Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03,	K2MTR_W04	C1	Lec 1 to Lec 8	N1, N4, N5
PEK_U02, PEK_U03,	K2MTR_MMP_U01, K2MTR_U05, K2MTR_U12	C2	Lab 1 to Lab 8	N2, N3, N5
K2MTR_K01, K2MTR_K03, K2MTR_K06	K2MTR_K03, K2MTR_K04, K2MTR_K06	C3	Lab 1 to Lab 8	N1, N2, N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie oraz badania mechatronicznych układów maszyn roboczych i pojazdów**
Name in English: **Modeling and virtual tests of mechatronic systems of working machines and vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041124**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the mechanics area
2. Has basic knowledge in the area of mechatronic systems
3. Has basic knowledge of working machines and industrial vehicles

SUBJECT OBJECTIVES

C1. To gain knowledge of methods of modeling of mechatronic systems working machines and vehicles
C2. To gain skills in modeling and virtual testing of mechatronic systems of working machines and vehicles
C3. To gain and consolidate competence in determining appropriate priorities to achieve the specific purpose

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - has knowledge of methods and means that can be used for modeling and virtual testing of working machines and vehicles

PEK_W02 - has knowledge of the modeling methods of industrial vehicles

PEK_W03 - has knowledge of how to take into account in the models: friction, stiffness of links of kinematic chains and properties of tires

II. Relating to skills:

PEK_U01 - is able to choose the rational submodels to achieve the final effect research

PEK_U02 - is able to modeling and carry out virtual tests of systems containing hydraulic, electrical and mechanical components

III. Relating to social competences:

PEK_K01 - has well established competence in determining priorities to achieve the specific purpose

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mathematical and simulation models used to describe the interaction of vehicle wheels or tracks with ground	2
Lec2	Mathematical models used to describe vertical vehicle dynamics	2
Lec3	Mathematical models used to describe horizontal vehicle dynamics	2
Lec4	Mathematical models used to describe kinematics and dynamics of typical manipulators of industrial vehicles	2
Lec5	The methods that take into account the stiffness of links in models of working machines	1
Lec6	Modeling of drive systems of working machines. Modeling of the torque converter. Engine model as part of the whole drive system model or model of the vehicle.	2
Lec7	Ways to develop models of mechanical system by introducing the model of the control system in commercial MBS programs	1
Lec8	Friction models in simulation studies of mechatronic systems of machines and working vehicles	1
Lec9	Modeling the behavior of operator (driver) of a vehicle	1
Lec10	Selected numerical methods of solving nonlinear differential equations used in the simulation studies - characteristics, comparison	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Mechatronic system to keep the wheels of field sprayer on the tractor wheel tracks - modeling	2
Lab2	Mechatronic system to keep the wheels of field sprayer on the tractor wheel tracks - simulation tests	2

Lab3	Mechatronic system to stabilize the position of the main beam field sprayer - modeling	2
Lab4	Mechatronic system to stabilize the position of the main beam field sprayer - simulation tests	2
Lab5	Energy recovery in the electric drive system of excavator manipulator rotation - modeling	2
Lab6	Energy recovery in the electric drive system of excavator manipulator rotation - simulation tests	2
Lab7	Modeling and simulation tests of traction control system in the vehicle with hydrostatic drive	3
		Total hours: 15

TEACHING TOOLS USED

N1. problem exercises
N2. laboratory experiment
N3. tutorials
N4. report preparation
N5. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01÷PEK_U02, PEK_K01	laboratory raports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

[1] Geradin M., Cardona A.: Flexible Multibody Dynamics. A Finite Element Approach. Wiley, 2001r. [2] Augustynowicz A.: Modelowanie typu kierowcy samochodu.Oficyna Wydawnicza Politechniki Opolskiej, Opole 2009r. [3] Shabana A. A.: Dynamics of Multibody Systems. Cambridge University Press, 1998r.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modeling and virtual tests of mechatronic systems of working machines and vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W01, K2MTR_MMP_W03	C1	Lec1÷Lec10	3, 5
PEK_W02	K2MTR_MMP_W01, K2MTR_MMP_W03	C1	Lec1÷Lec3	3, 5
PEK_W03	K2MTR_MMP_W01, K2MTR_MMP_W03	C1	Lec1, Lec5, Lec8	3, 5
PEK_U01	K2MTR_MMP_U01, K2MTR_MMP_U04	C2	La1÷La7	1, 2, 3, 4
PEK_U02	K2MTR_MMP_U01, K2MTR_MMP_U04	C2	La1÷La7	1, 2, 3, 4
PEK_K01	K2MTR_K04	C3	La1÷La7	1, 2, 3, 4, 5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie elektrohydrauliczne**
Name in English: **Electrohydraulic control**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041125**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Acquaint students with speed control methods of hydraulic actuator.
C2. Acquaint students with working principle of electrohydraulic components with continous operation (proportional valves and servovalves) and its application in hydraulic drive systems.
C3. Acquaint students with regulations techniques selected parameters of hydraulic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - In the result of lesson student schould be able to describe speed control of hydraulic actuator with use of electric control signal.

PEK_W02 - In the result of lesson student schould be able to explane working principle electrohydraulic valves with continous operation and determine their properties, e.g. dynamic characteristics.

PEK_W03 - In the result of lesson student schould be able to call and describe advanced hydrotronic systems equipped with regulation systems of selected parameters.

II. Relating to skills:

PEK_U01 - In the result of lesson student schould be able to build hydraulic and electrohydraulic systems and analyse their working principle.

PEK_U02 - In the result of lesson student schould be able to prepare to operation hydrotronic device and plan and execute tests of selected parameters. On the basis of tests results student schould be able to formulate appriopriate conclusions.

PEK_U03 - In the result of lesson student schould be able to design hydrotronic devive performing defined functions.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Methods of speed control of hydraulic actuator.	2
Lec2	Proportional valves as control components in systems.	2
Lec3	Hydraulic regulators and proportional directional control valves.	2
Lec4	Logic valves in proportional technique.	2
Lec5	Load-sensing - systems, efficiencies.	2
Lec6	Controllers in hydraulic systems.	2
Lec7	Regulation systems with electrohydraulic servovalves.	2
Lec8	Check.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Reversible systems.	2
Lab2	Fast movement systems.	2
Lab3	Throttle-serial speed control of hydraulic actuator.	2
Lab4	Throttle-parallel speed control of hydraulic actuator.	2
Lab5	Volumetric speed control of hydraulic actuator.	2
Lab6	Hydraulic actuator control with proportional directional control valve.	2
Lab7	Hydraulic actuator control with load-sensing directional control valve.	2
Lab8	Check.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	oral response for practical veryfication of design and buliding of systems.
F2	PEK_U02	report
F3	PEK_U01 PEK_U03	student's activity note
P = P=(2F1+F2+F3)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrohydraulic control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MMP_W02, K2MTR_MMP_W03	C1 C2	Lec1 Lec2 Lec3	N1
PEK_W02	K2MTR_MMP_W02, K2MTR_MMP_W03, K2MTR_W04	C2	Lec2 Lec3 Lec4 Lec7	N1
PEK_W03	K2MTR_MMP_W01, K2MTR_MMP_W02, K2MTR_MMP_W03	C3	Lec5 Lec6 Lec7	N1
PEK_U01	K2MTR_MMP_U03, K2MTR_MMP_U04	C1 C2 C3	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7	N3 N4
PEK_U02	K2MTR_MMP_U02, K2MTR_MMP_U03, K2MTR_MMP_U04, K2MTR_U13	C1 C2 C3	Lab3 Lab4 Lab5 Lab6 Lab7	N2 N3 N4 N5
PEK_U03	K2MTR_MMP_U03, K2MTR_U14	C1 C3	Lab1 Lab2 Lab3 Lab4 Lab6 Lab7	N3 N4 N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy hydrotroniczne w pojazdach**
Name in English: **Hydrotronic systems in vehicles**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041126**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic principles of automation, hydraulic and pneumatic power systems, mechanics on the fields of the statics and dynamics, and industrial electronics.
2. Knowledge of the principles of operation and ability to carry out the analysis of the basic design of mechatronic systems used in the industrial. The ability to determine the benefits of the use of mechatronic systems in relation to the classical mechanical and electrical systems.
3. The ability to formulate the engineering task and its solution based on the present technology level.

SUBJECT OBJECTIVES

C1. Acquaint students with the construction, the principle of operation and benefits of the use the hydrotronic systems in vehicles. Presentation of the students selected hydrotronic systems currently applied in vehicles, describe the operating principle and the purposes of their application.
C2. Present the students a detailed discussion of selected hydrotronic systems used in the vehicles. Presentation of their construction, components, operating parameters and the possibility of them extension and modification.
C3. Strengthening the student's teamwork skills. Acquiring the ability to make their own analysis of the benefits of the use of the hydrotronic systems. Allowing the student to predict the impact of implemented or planned changes on the behavior of the whole system. Learning how the analysis of the entire hydrotronic system based on the parameters of the individual components in relation to working conditions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students can point out the hydrotronic systems aplied in vehicles, and describe their operating principles and basic parameters. The student can explain the benefits of the hydrotronic system applications and justifi whether it is the application well founded . Student is able to identify limits of these systems and the conditions for their exploitation and assembly.
PEK_W02 - The student is able to describe the function of each component of the hydrotronic systems in vehicles. Student is able to determine the impact of the parameters of individual elements to the system as a whole.
PEK_W03 - Student is able to create and describe the concept of the hydrotronic system, select the components of the system and define its operation. Student is able to make informed changes the structure or elements of existing hydrotronic systems to improve their operating parameters.

II. Relating to skills:
PEK_U01 - Student identifies the principle of operation and basic parameters of the selected hydrotronic systems use in vehicles. Students draw graphs showing the variation of the basic parameters of the system.
PEK_U02 - The student performs laboratory experiments. Based on the results of experiments student identifies and describes the physical phenomena whose existence has a significant impact on the operation of hydrotronic systems.
PEK_U03 - Student includes the results of the laboratory in a written report, analyze it and formulate conclusions which presents of the teacher.

III. Relating to social competences:
PEK_K01 - The student takes part in the work of the students group, the objective of which is common to conduct a laboratory experiment.
PEK_K02 - The student practices skills to present the results of their work in the form of a written report. Student participates in the problems discussion.
PEK_K03 - The student independently makes the selection of information, focuses on those that are useful to describe the phenomenas and principle of operation of the examined system which was tested during performance a laboratory experiment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	To acquaint students with the scope of the course, the terms of credit and the subject literature. The properties hydraulic and pneumatic systems in vehicles.	2

Lec2	Circuits with a hydraulic accumulator. Circuits with central power supply network.	2
Lec3	Brake systems, hydraulic and pneumatic. ABS hydraulic system.	2
Lec4	Systems of the hydraulic drive mechanism. Steering servos.	2
Lec5	Hydrokinetic couplings, application, description and parameters.	2
Lec6	Hydrokinetic torque converters, application, description and parameters.	2
Lec7	Hydropneumatic suspensions, vibration damper. Hydraulic systems of the fuel supply.	2
Lec8	Completion of the course.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of crediting.	2
Lab2	The testing of the system with the network of the constant flow or pressure.	2
Lab3	The testing of the system with the hydraulic accumulator.	2
Lab4	The testing of the steering servo.	2
Lab5	The testing of the load-sensing system.	2
Lab6	Volumetric control of the hydraulic systems in vehicles.	2
Lab7	The testing of the crane rotation mechanism.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Stryczek S., Hydrostatic drive, WNT, Warszawa 1984, (in Polish),
2. W. Kollek, E. Palczak: Optimization of the hydraulic system components. Wydawnictwo Ossolineum, Wrocław 1994. (in Polish)
3. Z.Szydelski:The drive and hydraulic control in vehicles and mobile working machines. WNT Warszawa 1980, (in Polish)

SECONDARY LITERATURE

1. Pizon A.,Hydraulic and electro-hydraulic control and regulation systems, WNT, Warszawa 1987, (in Polish),
2. Garbacik A.: The study of the hydraulic systems design. Wydawnictwo Ossolineum 1997, (in Poish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrotronic systems in vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01÷PEK_W03	K2MTR_MMP_W02	C1, C2	Lec1÷Lec7	N2, N4
PEK_U01÷PEK_U03, PEK_K01÷PEK_K03	K2MTR_K03, K2MTR_K04, K2MTR_MMP_U04	C3	Lab1÷Lab7	N1, N2, N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA I, II**
Name in English: **Diploma thesis**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Automotive and Machine Mechatronics**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041151, MCM041152**
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)				540	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				18	
including number of ECTS points for practical (P) classes				18	
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. self study - preparation for project class
N2. self study - self studies and preparation for examination
N3. multimedia presentation
N4. project presentation
N5. report preparation

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma thesis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2MTR_U14, K2MTR_U15, K2MTR_U16, K2MTR_U17, K2MTR_U23	C1-C3		N1-N5
PEK_K01, PEK_K02	K2MTR_K01, K2MTR_K02, K2MTR_K03, K2MTR_K04, K2MTR_K05, K2MTR_K06	C1-C3		N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Robotyka**
Name in English: **Robotics**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041201**
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

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1		1
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		2
Proj6		2
Proj7		2
Proj8		1
		Total hours: 15

TEACHING TOOLS USED
N1. informative lecture N2. self study - preparation for project class N3. problem discussion

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Robotics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MSW_W01, K2MTR_MSW_W02	C1,C2,C3		N1, N3
PEK_W02	K2MTR_MSW_W01, K2MTR_MSW_W02	C1,C2,C3		N1, N3
PEK_W03	K2MTR_MSW_W01, K2MTR_MSW_W02	C1,C2,C3		N1, N3
PEK_U01	K2MTR_MSW_U03, K2MTR_U02, K2MTR_U13, K2MTR_U14	C1,C2,C3		N2
PEK_U02	K2MTR_U02, K2MTR_U13, K2MTR_U14	C1,C2,C3		N2
PEK_U03	K2MTR_U02, K2MTR_U13, K2MTR_U14	C1,C2,C3		N2
PEK_K01	K2MTR_K01	C1,C2,C3		N1, N3
PEK_K02	K2MTR_K03, K2MTR_K04, K2MTR_K05, K2MTR_K06	C1,C2,C3		N1, N3
PEK_K03	K2MTR_K01, K2MTR_K02, K2MTR_K04, K2MTR_K05	C1,C2,C3		N1, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy wizyjne i optyczne**
Name in English: **Optical and Machine Vision Systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041202**
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					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		0.7		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of optics, electronics, computer science
2. Able to design algorithms and program in selected high-level language

SUBJECT OBJECTIVES

C1. Discuss the various methods of optical measurements
C2. Familiar with the design of optical image acquisition systems
C3. Read and test the algorithms for image processing and analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has knowledge of the methods and tools for measurement (microscopy 2D, 3D, interferometry, spectroscopy, infrared, X-ray) and processes monitoring (optical, ultrasound, infrared)

PEK_W02 - Has knowledge of the visual inspection systems design and measurements.

PEK_W03 - Knows the methods and algorithms of image processing and analysis, and classification features.

II. Relating to skills:

PEK_U01 - He can propose image acquisition system for inspection or for the production of video measurements.

PEK_U02 - Able to propose a method for measuring and monitoring processes objects, indicating its limits, interpret the results.

PEK_U03 - Potrafi opracować i zaimplementować algorytm analizy obrazów i klasyfikacji cech. Potrafi walidować system kontrolny zgodnie z MSA

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, examples of vision systems, histogram, image processing point	2
Lec2	Image processing algorithms - filtration	2
Lec3	Algorithms for image analysis - segmentation	2
Lec4	Optical measurement algorithms - fitting	2
Lec5	Surface analysis algorithms - blobs, texture	2
Lec6	Pattern recognition and classification	2
Lec7	Human vision, light detectors - cameras	2
Lec8	Optics - lenses	2
Lec9	The light source and illuminators	2
Lec10	Methods of 3D - triangulation	2
Lec11	Digital microscopy, interferometry, skaterometria	2
Lec12	Colorimetry, spectroscopy, thermography, X-Ray	2
Lec13	Process monitoring	2
Lec14	Verification, validation and integration of optical systems and video	2
Lec15	Final assesment	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the development environment used in the classroom	2
Lab2	Histogram, image processing point	2
Lab3	Image filtration	2
Lab4	Image segmentation	2
Lab5	Machine Vision based gauging	2

Lab6	Morphological operations and blob analysis and textures	2
Lab7	Impleementation and validation of measurement systems	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01- PEK_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	entr-tests, oral answers, reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Hornberg A., Handbook of Machine Vision, Wiley-Vch, 2006

SECONDARY LITERATURE

Davies E.R, Machine Vision Theory Algorithms Practicalities, Elsevier 2005
Hornberg A., Handbook of Machine Vision, Wiley-Vch, 2006
Louban R., Image Processing of Edge and Surface Defects

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Optical and Machine Vision Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2MTR_MSW_W04	C1	Lecture 11 - Lecture 13	N1
PEK_W02	K2MTR_MSW_W05	C2	Lecture 1 - Lecture 10, 14	N1
PEK_W03	K2MTR_MSW_W05	C3	Lecture 1 - Lecture 10, 14	N1
PEK_U01	K2MTR_MSW_U06	C3	Lab. 1 - Lab. 7	N2, N3
PEK_U02	K2MTR_MSW_U06	C3	Lab. 1 - Lab. 7	N2, N3
PEK_U03	K2MTR_MSW_U06	C3	Lab. 1 - Lab. 7	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie laserowe**
Name in English: **Laser Technology**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041203**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He knows the principles of operation and construction of high-power lasers
PEK_W02 - He knows the laser beam forming systems and the interaction of radiation with matter
PEK_W03 - He is familiar with the scope of lasers in manufacturing

II. Relating to skills:

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

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basics of high-power lasers	2
Lec2	Measurements of the laser beam	2
Lec3	Laser beam forming systems and laser safety	2
Lec4	Impact of the laser beam with matter	2
Lec5	Cutting with laser beam	2
Lec6	Use of laser to welding	2
Lec7	Laserl cladding and micromachining	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Overview of laser radiation generators	2
Lab2	Monitoring of the laser beam	2
Lab3	Laser cutting	2
Lab4	Welding using the laser beam	2
Lab5	Laser cladding	2
Lab6	Use of laser scanning head for machining	2
Lab7	Use of laser to hardening	2
Lab8	Evaluation	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser Technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_MSW_W03	C1, C2	Lec1-Lec7	N1- N3, N5
PEK_U01, PEK_U02, PEK_U03	K2MTR_MSW_U03, K2MTR_MSW_U04	C1, C2, C3	Lab1-Lab7	N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zastosowanie urządzeń mechatronicznych w systemach wytwarzania**
Name in English: **Application of mechatronic devices in manufacturing systems**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041204**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of traffic control devices, mechatronic, has knowledge of the regulations, the interpolation and control of CNC and RC.
2. He has knowledge of the methods and tools for the measurement and monitoring of processes objects. He knows the rules on the identification of real objects, principles of design and testing of control systems.
3. He can propose a method for the measurement and monitoring of processes, objects, and interpret the results.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the use of devices mechatroniczych in different production systems.
C2. Learning how productive device control using the latest mechatronic solutions. Learning how to integrate physical microelectronic mechanical parts. Detailed knowledge of the dedicated to these devices: sensors, actuators and mechatronic drives.
Acquiring skills related to designing mechatronic systems manufacturing.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - knows mechatronic systems in the different production technologies, known control devices using the latest generation mechatronic solutions.

PEK_W02 - the methods of physical integration of microelectronics with mechanical parts, dedicated to these devices: sensors, actuators, drives, mechatronics and issues related to the design of such systems, mechatronics,

PEK_W03 - have knowledge of the specific application of mechatronics devices, machining, metal forming and welding.

II. Relating to skills:

PEK_U01 - can choose mechatronic systems for various manufacturing technologies,

PEK_U02 - able to integrate microelectronics with mechanical parts, choose the appropriate sensors, actuators mechatronic drives to different production technologies,

PEK_U03 - can design mechatronic systems used in the production systems used in industrial practice now and in the near future.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Discussion of key issues related to mechatronic systems occurring in different manufacturing technologies.	2
Lec2	Physical integration of microelectronics with mechanical parts.	2
Lec3	Distribution equipment into modules, implementing partial functions.	2
Lec4	Sensors used in manufacturing technologies.	2
Lec5	Actuators used in manufacturing technologies.	2
Lec6	Mechatronic drive technology used in manufacturing.	2
Lec7	Issues related to the design of mechatronic.	2
Lec8	Mechatronics in machining - introduction.	2
Lec9	Examples of applications mechatronics in the machining devices.	2
Lec10	Mechatronics in metal forming - introduction.	2
Lec11	Examples of applications of mechatronics in metal forming devices.	2
Lec12	Mechatronics in welding - introduction.	2
Lec13	Examples of applications of mechatronics in welding equipment.	2
Lec14	The use of mechatronics in assembly processes.	2
Lec15	Recent tendy in mechatronics applications in manufacturing technologies.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Mechatronics in oscillating-tensile-compressive torsion plastometer	2
Lab2	Construction and operation of stamping stations for electromagnetic process.	2
Lab3	Intelligent control system of the split blankholder hydraulic press.	2

Lab4	Measurements of dynamic deformation in the rotation hammer.	2
Lab5	2DArray heads for testing welded joints.	2
Lab6	Mechatronic aspects of welding power sources. Constant and steeply-sloping current-voltage characteristics.	2
Lab7	Welding robots. Programming.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Ganesh R. NaikI: NTELLIGENT MECHATRONICS, Croatia, 2011, Katarina Lovrecic.

Annalisa Milella, Donato Di Paola and Grazia Cicirelli: Mechatronic Systems, Applications, 2010, In-Tech intechweb.org.

SECONDARY LITERATURE

Marek Gawrysiak: Mechatronics and Mechatronic Design, Białystok 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Application of mechatronic devices in manufacturing systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2MTR_MSW_W01	C1-C2	Lec1-Lec15	N1
PEK_U01-PEK_U03	K2MTR_MSW_U01, K2MTR_MSW_U03, K2MTR_MSW_U05	C2	Lab1-Lab7	N2-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie i symulacja w mechatronice**
Name in English: **Modeling and simulation in mechatronics**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041205**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1		3
Lec2		3
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		1
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. traditional lecture with the use of transparencies and slides 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	
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_U03	
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Modeling and simulation in mechatronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MTR_W01	C1 - C2		N1 - N3
PEK_U01 - PEK_U03	K2MTR_MSW_U01, K2MTR_MSW_U02, K2MTR_MSW_U03	C1 - C2		N1 - N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technika ultradźwiękowa**
Name in English: **Ultrasonic Technique**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041206**
Group of courses: **yes**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students know basic of harmonic motion and classical mechanics, electronics and problems of digital signal processing (spectral analysis).
2. Students can explain the phenomenon of piezoelectric and magnetostrictive, can perform amplifier design, the generator and the analog filter.

SUBJECT OBJECTIVES

C1. One of course purpose is to familiarize students with the principles of ultrasonic wave propagation in various media and the use of ultrasounds in industrial practice.
C2. During the course students will learn both the physical aspects of ultrasound waves and practical: passive (material testing, sensors) and active (eg, welding, cleaning) effects of ultrasounds.
C3. Making the students familiar to use ultrasonic measuring devices, the principles of selection of transducers and measuring heads for chosen application.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Students know the rules of propagation of ultrasonic waves in a continuous medium, such as types of waves and phenomena at the medium boundary.

PEK_W02 - Knowing the methods of generation and receiving of ultrasound, can explain the phenomenon of acoustic emission.

PEK_W03 - Drawing an equivalent circuit of the piezoelectric and magnetostrictive transducer, using characteristic impedance of transducer can read and choose the parameters of the head (the resonant frequency, input impedance)

II. Relating to skills:

PEK_U01 - Ability to choose ultrasound devices for specific industrial applications.

PEK_U02 - Ability to interpret ultrasonic flaw detector indications (reading images A, B, C-scan), can calibrate ultrasonic flaw detector, perform ultrasonic testing of welds, spot welds, casts.

PEK_U03 - Ability to perform and interpret measurements of the thickness of materials and layers.

III. Relating to social competences:

PEK_K01 - Students are able to expand their knowledge of the ultrasonic technique using additional aids (books, journal articles, technical manuals).

PEK_K02 - Ability to rationally explain and justify their point of view using the knowledge of the ultrasonic technique

PEK_K03 - Student can work in a group, respecting the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Prerequisites. Assessment rules. Physical fundamentals of ultrasonic wave propagation (types of waves, the phenomenon on the medium boundary). Methods for visualization of the ultrasonic signal (A, B, C-scan).	2
Lec2	Transducers and ultrasonic probes (piezoelectric and magnetostrictive). Normal heads, angle heads and their application.	2
Lec3	Methods of ultrasonic testing in material characterization (reflection method, transmit, TOFD, acoustic emission).	2
Lec4	Methods for assessing the size of imperfections detected by ultrasound (DG, DGS).	2
Lec5	Ultrasonic testing of welds and pot welds. Matrix array for quality assessment of welding joints	2
Lec6	Ultrasonic measurement of the thickness. Active the application of ultrasound (ultrasonic cavitation).	2
Lec7	Scanning acoustic microscopy for material characterization.	3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Prerequisites. Discussion of safety rules. Ultrasonic measurements of materials with using normal longitudinal waves and transversal waves (angled probes).	2
Lab2	Velocity measurements of ultrasonic waves in elastic media.	2

Lab3	Measurements of mechanical properties of spot welds by 2D-Array probe.	2
Lab4	Ultrasonic testing of welding joints I. Measurement of thickness.	2
Lab5	Ultrasonic testing of welding joints part II . Assessing the size of imperfections detected by ultrasound (DG, DGS).	2
Lab6	Ultrasonic testing of constructions using acoustic emission.	2
Lab7	Ultrasonic testing of adhesive joints using B-scan visualization. Test grade.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Śliwiński A., Ultradźwięki i ich zastosowania, WNT Warszawa 2001

SECONDARY LITERATURE

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ultrasonic Technique
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2MTR_MSW_W04	C1 - C3	Lect1-Lect7	N1
PEK_U01 - PEK_U03	K2MTR_MSW_U05, K2MTR_U13	C1 - C3	La1 - La3	N2, N3
PEK_K01 - PEK_K03	K2MTR_K03	C1 - C3	La1 - La3	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zintegrowany rozwój produktów**
Name in English: **Integrated product development**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041207**
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		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		6
Lab3		6
Lab4		1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. case study
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	
P = F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Integrated product development
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2MTR_W02	C1, C2		N1-N3
PEK_U01, PEK_U02, PEK_U03	K2MTR_U14	C3		N4
PEK_K01	K2MTR_K05	C3		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): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **optional**
Subject code: **MCM041210**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

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

III. Relating to social competences:

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

PROGRAMME CONTENT

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

TEACHING TOOLS USED

N1. problem discussion
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

F1	PEK_U01, PEK, K01	Problem discussion
P = f1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma Seminar
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U	K2MTR_U15, K2MTR_U19, K2MTR_U20, K2MTR_U22	C1, C2	Se2-Se5	N1, N2
PEK_K	K2MTR_K07	C1, C2	Se1-Se7	N1, N2

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA I, II**
Name in English: **Diploma thesis**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable): **Mechatronics in the Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM041251, MCM041252**
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)				540	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				18	
including number of ECTS points for practical (P) classes				18	
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. self study - preparation for project class
N2. self study - self studies and preparation for examination
N3. multimedia presentation
N4. project presentation
N5. report preparation

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Diploma thesis
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K2MTR_U14, K2MTR_U15, K2MTR_U16, K2MTR_U17, K2MTR_U23	C1-C3		N1-N5
PEK_K01, PEK_K02	K2MTR_K01, K2MTR_K02, K2MTR_K03, K2MTR_K04, K2MTR_K05, K2MTR_K06	C1-C3		N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK ZAJĘCIA SPORTOWE**
Name in English: **Block of Sports Activities**
Main field of study (if applicable): **Mechatronics**
Specialization (if applicable):
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					

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

N1.

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
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K01	K2MTR_K10	wg kart przygotowanych przez SWFiS		wg kart przygotowanych przez SWFiS