Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria sterowania**
Name in English: **Control theory**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARE001031**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student should know notations used in control system theory, to know types of control systems and characteristics of
control system elements.Student should have the basic knowledge of control systems.
2. Student should know how to analyze simple control systems and arrange and rearrange block diagrams of control systems.
3. Student should have ability to work individually.

SUBJECT OBJECTIVES

C1. Skill in stability analysis of linear and nonlinear control systems.
C2. Skill in designing of control algorithms for models of various type control plants.
C3. Skill in solving linear-quadratic problems.
C4. Skill in formulating and solving optimal control problems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - A student gets the knowledge of feedforward and feedback control systems design.
PEK_W02 - A student gets the knowledge of optimal control systems design.
PEK_W03 - A student gets the knowledge of probabilistic plant control systems design.

II. Relating to skills:

PEK_U01 - A student can analyze stability of linear and non-linear control systems.
PEK_U02 - A student can design control algorithms for static and dynamic plants.
PEK_U03 - A student can find a solution for linear-quadratic optimal control problem.

III. Relating to social competences:

PEK_K01 - A student can act independently working on a complex engineering project.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	An introduction. Classification of control systems.	2
Lec2	Open-loop control system design methods. Feedback control system design methods.	2
Lec3	State controllability.	2
Lec4	Feedback control system design methods. Observability.	2
Lec5	Deterministic optimal control.	2
Lec6	Dynamic programming. Bellman’s equation.	2
Lec7	Pontryagin's maximum principle. Time-optimal control.	2
Lec8	Contol system design based on relative models.	2
Lec9	Optimal control based on probabilistic models. Maximum likelihood method.	2
Lec10	Design of linear control systems operating under stationary random noise. Minimal risk method.	2
Lec11	Design of linear control systems operating under stationary random noise.	2
Lec12	Stability.	2
Lec13	Extremal control.	2
Lec14	Adaptive control.	2
Lec15	Artificial intelligence and knowledge representation in control systems.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Transforms of continous and discrete signals.	3
Cl2	Respose evaluation of continous and discrete systems.	2
Cl3	Stability of continous and discrete systems.	2
Cl4	Evaluation of discrete systems with respect to goal state.	2

Cl5	Evaluation of optimal control for probabilistic systems.	2
Cl6	Evaluation of optimal control for deterministic systems.	2
Cl7	Final test.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction.	1
Lab2	Open-loop control system design methods.	2
Lab3	Feedback control system design methods.	2
Lab4	State observers.	2
Lab5	Feedback control systems based on state observers.	3
Lab6	Time-optimal control with limited magnitude of control signal.	3
Lab7	Complementary classes.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. report preparation
N3. calculation exercises
N4. 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,PEK_W03	final exam,
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03,	ACTIVITY
F2	PEK_W01, PEK_W02, PEK_W03	REPORTS
P = 0.3F1+0.7F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bubnicki Z., Teoria i algorytmy sterowania, PWN, Warszawa 2002.[2] Kaczorek T., Teoria układów regulacji automatycznej, WNT, Warszawa 1977.[3] Kaczorek T., Teoria sterowania, T.1. Układy liniowe ciągłe i dyskretne, PWN, Warszawa 1977.[4] Kaczorek T., Teoria sterowania, T.2. Układy nieliniowe, procesy stochastyczne. oraz optymalizacja statyczna i dynamiczna, PWN, Warszawa 1981.[5] Kaczorek T., Teoria sterowania i systemów. wyd.2 popr., PWN, Warszawa 1996.

SECONDARY LITERATURE

[1] Philippe de Larminant, Yves Thomas., Automatyka-układy liniowe. T. I, II, III.[2] Zbiór zadań i problemów z teorii sterowania. pod red. Zdzisława Bubnickiego, Oficyna Wyd. PWr, Wrocław 1979

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W01, K2AIR_W02	C1	Wy1 - Wy4, Wy8, Wy12 - Wy15	N1
PEK_W02	K2AIR_W01, K2AIR_W02	C2	Wy5 - Wy7	N1
PEK_W03	K2AIR_W01, K2AIR_W02	C3	Wy9 - Wy11	N1
PEK_U01	K2AIR_U01	C1	La2 - La3, La7, Ćw1-Ćw2	N2, N3, N4
PEK_U02	K2AIR_U01	C2	La4, La7, Ćw3-Ćw5	N2, N3, N4

PEK_U03	K2AIR_U02	C3	La5-La7, Ćw6	N2, N3, N4
PEK_K01	K2AIR_K01, K2AIR_K02	C1, C2, C3, C4	La2 - La6,Ćw1-Ćw6	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

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

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

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

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

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

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

SUBJECT SUPERVISOR

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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): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041003**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

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

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

TEACHING TOOLS USED

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

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

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

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie i symulacja procesów**
Name in English: **Modeling and simulation of processes**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041004**
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		2
Lec6		2
Lec7		3
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		4
Proj4		7
		Total hours: 15

TEACHING TOOLS USED
N1. self study - preparation for project class N2. laboratory experiment N3. report preparation N4. problem lecture N5. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 + PEK_W02 + 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	
F2	PEK_U01 + PEK_U02 + PEK_U03	
F3	PEK_U01 + PEK_U02 + PEK_U03	
P = F1 + F2 + F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W01, K2AIR_W02	C.1		N4 - N5
PEK_W02	K2AIR_W01	C.2		N4 - N5
PEK_W03	K2AIR_W01	C.3		N4 - N5
PEK_U01	K2AIR_U01, K2AIR_U02	C.1		N1 - N3
PEK_U02	K2AIR_U01, K2AIR_U02	C.3		N1 - N3
PEK_U03	K2AIR_U01, K2AIR_U02	C.2		N1 - N3
PEK_K01	K2AIR_K04	C.2		N1 - N3
PEK_K02	K2AIR_K07	C.2		N1 - N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy hydrostatyczne w maszynach roboczych**
Name in English: **Fluid power systems in heavy duty machines**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041005**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

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

TEACHING TOOLS USED
N1. informative lecture N2. multimedia presentation

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fluid power systems in heavy duty machines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W05	C1		N1
PEK_W02	K2AIR_W03, K2AIR_W06	C2		N1
PEK_W03	K2AIR_W03	C2		N1, N2
PEK_K01	K2AIR_K05	C4		N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

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

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

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

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

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

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

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

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

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Roboty autonomiczne**
Name in English: **Autonomous Robots**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041009**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

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

TEACHING TOOLS USED
N1. informative lecture N2. problem lecture

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W03, K2AIR_W04, K2AIR_W06, K2AIR_W08	C1,C2,C3		N1,N2
PEK_W02	K2AIR_W03, K2AIR_W04, K2AIR_W06, K2AIR_W08	C2,C3		N1,N2
PEK_W03	K2AIR_W03, K2AIR_W04, K2AIR_W06, K2AIR_W08	C1,C2,C3		N1,N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie przedsiębiorstwami przemysłowymi**
Name in English: **Management of industrial enterprises**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041010**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

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

TEACHING TOOLS USED

N1. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEk_W1, PEK_W2, PEK_W3	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Management of industrial enterprises
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W1, PEK_W2, PEK_W3	K2AIR_W04	C1, C2, C3		N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy mechatroniki**
Name in English: **Basics of mechatronics**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041011**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechatronics - definitions, history. Examples of mechatronic systems. Place of mechatronics in contemporary technique.	2
Lec2	Design of machinery and equipment in terms of mechatronics.	2
Lec3	Basics of actuators - characteristics, applications	2
Lec4	Selected mechatronic drives in machine building - piezoelectric, step motors, servodrives	2
Lec5	Virtual Prototyping - examples of use (Hardware in the Loop, Rapid Prototyping)	2
Lec6	Analysis and image recognition - fundamentals and applications	2
Lec7	Elements of control system : programmable controllers, real-time computers, etc.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the study of mechatronic systems, safety rules	1
Lab2	The test of distance sensors (report)	3
Lab3	Research and programming linear drive (report)	3
Lab4	Research and programming parallel manipulator (report)	3
Lab5	Design and programming of image analysis system (report)	3
Lab6	Design and programming of microcontroller or PLC (report)	2
		Total hours: 15

TEACHING TOOLS USED

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

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

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Diagnostyka i nadzorowanie procesów i maszyn**
Name in English: **Diagnostics and supervision of processes and machines**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable):
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041012**
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 firm knowledge of the structure and operation of the basic machinery of production. Knows the basic principles of design processes typical of machine parts.
2. Has a basic knowledge of calculus and statistics for the engineering signal processing and analysis.
3. Has a a basic understanding of sensory and build measurement systems.

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has knowledge of the basic purposes of diagnosis and monitoring of machines and processes implemented by it.

PEK_W02 - Has knowledge of various sources of interference with the equipment and appropriate research methods.

PEK_W03 - Has knowledge of diagnostic knowledge acquisition, analysis and evaluation of diagnostic signals and methods of applying the accumulated knowledge of the diagnostic.

II. Relating to skills:

PEK_U01 - Provides support for used measurement and control equipment.

PEK_U02 - Able to analyze and evaluate the diagnostic signals.

PEK_U03 - Can choose the right way to measure, depending on the source of the interference of the machine.

III. Relating to social competences:

PEK_K01 - Takes responsibility and integrity in the conduct of laboratory experiments and objective evaluation of arguments.

PEK_K02 - Can think creatively and determine how to implement the research task.

PEK_K03 - Has sense of responsibility for their own work and its impact on the functioning of the company.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, Assessment and literature. Basic issues.	2
Lec2	Elements of the theory of operation.	2
Lec3	The physical aspects of the diagnosis.	2
Lec4	Diagnosis in the life of the machine.	2
Lec5	Modeling of the diagnosis of machines and processes.	2
Lec6	Diagnostic signals and their parameters.	2
Lec7	Processing and analysis of diagnostic signals.	2
Lec8	Construction machinery diagnostic procedures. Diagnostic experiments.	2
Lec9	Monitoring the condition of machinery manufacturing.	2
Lec10	Supervising tools.	2
Lec11	Supervising the machining process.	2
Lec12	Supervising the accuracy of workpieces.	2
Lec13	Artificial intelligence methods for the diagnosis and supervising.	2
Lec14	Diagnosis and supervision of machines and processes in industrial use.	2
Lec15	Summary of lectures, additional explanations. Checking knowledge.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Supervising production process of cast iron.	2
Lab2	Supervising welding processes.	2

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

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

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

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

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

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

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

II. Relating to skills:

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

III. Relating to social competences:

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

PROGRAMME CONTENT

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

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

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bionika w zagadnieniach technicznych**
Name in English: **Bionics in technical issues**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041101**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

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

TEACHING TOOLS USED
N1. informative lecture N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_U02	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Bionics in technical issues
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2AIR_AM_W04, K2AIR_AM_W06	C1, C2		N1, N2
PEK_U01, PEK_U02	K2AIR_U04	C1, C2		N1, N2
PEK_K01	K2AIR_K01, K2AIR_K02, K2AIR_K09	C3		N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

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

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mobility of contours. Forms of mechanisms' structure notation.	2
Lec2	Type synthesis - making of closed link chains	2
Lec3	Methods of type synthesis, set of possible solutions creation. Criteria and selection of optimal solution.	2
Lec4	Introduction to methods of dimensional synthesis of linkages mechanisms.	2
Lec5	Methods of dimensional synthesis of linkages mechanisms.	2
Lec6	Designing of cam mechanisms.	3
Lec7	Designing of planetery gears.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Analysis of topology of kinematics systems (test and project).	2
Proj2	Methods of notation of topology (test and project).	2
Proj3	Type synthesis. Making of possible sets of the solutions (test).	2
Proj4	Type synthesis cont. Criteria and selection for optimal solution (project).	2
Proj5	Dimensional synthesis of linkages mechanisms (test and project).	3
Proj6	Project of cam mechanisms (test and project).	2
Proj7	Project of planetary gear (project).	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_AM_W04	C1-C2	lec1-lec7	N1-N2
PEK_U01- PEK_U03	K2AIR_AM_U04	C1-C2	pr1-pr7	N3-N4
PEK_K01	K2AIR_K05	C1-C2	Lec1-lec7, pr1-pr7	N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie układów elektrohydraulicznych i elektropneumatycznych**
Name in English: **Designing of electro-hydraulic and electro-pneumatic systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041103**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics
2. He has knowledge of hydraulic and pneumatic drive systems
3. It has a basic knowledge of the basics of robotics and automation

SUBJECT OBJECTIVES

C1. To acquaint students with methods to generate patterns of functional systems electropneumatic and electrohydraulic
C2. Mastering the Calculation Procedure
C3. Determining the static characteristics and efficiency of electrohydraulic and electropneumatic systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Determining the static characteristics and efficiency of electrohydraulic and electropneumatic systems
PEK_W02 - He should interpret the characteristics of the system
PEK_W03 - He has knowledge about the current state of the art in the field of electrohydraulic systems and electropneumatic systems

II. Relating to skills:
PEK_U01 - Following the course, the student should propose the structure of an electro-hydraulic or electropneumatic-founded fulfilling functions
PEK_U02 - Should perform basic calculations
PEK_U03 - Select the components to the structure selected

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basics of designing propulsion systems, hydraulic or pneumatic carrying out certain tasks (functions) and meet the desired requirements	2
Lec2	Morphological method of generating structures, systems	2
Lec3	Basic calculations and rules for the selection of basic (catalog) system components: motors and engines, pumps and compressors, valves, pressure valves and flow	2
Lec4	Static characteristics of the hydraulic system.	2
Lec5	The energy balance of the system.	2
Lec6	Proportional technology	2
Lec7	The types of control systems and rules for their selection	3
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Analysis of design problems - how it works and the requirements of a machine or device.	2
Proj2	Determination of criteria for evaluating solutions and choice of the parent company.	2
Proj3	Generating structures, powertrain solutions. Evaluation and selection of options.	2
Proj4	Preliminary calculations and selection of basic elements (directory) to the propulsion system.	3
Proj5	Determining the static characteristics of the system. The energy balance of the system.	3
Proj6	Selection and location of ancillary components to the system. Defense project	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK-K01	Defense project
P = 0,3*Fw+0,7F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Stryczek S.: Napęd hydrostatyczny. t II Układy. WNT Warszawa 19922. Pizoń A.: Hydrauliczne ielektrohydrauliczne układy sterowania i regulacji. WNT 19873. Garbacik A.: Studium projektowaniaukładów hydraulicznych. Wyd. Ossolineum. Wrocław 1997r4. Jędrzykiewicz Z.: Projektowanie układówhydrostatycznych. Podstawy metodyczno-obliczniowe. Skrypt 1313 AGH Kraków5. Kollek W.: Podstawyprojektowania napędów i sterowań hydraulicznych. Oficyna Wydawnicza Politechniki Wrocławskiej.Wrocław 2004r.

SECONDARY LITERATURE

1.Katalogi producentów elementów hydrauliki siłowej i pneumatyki2.Rohatyński R., Domagała Z.,Prokopowicz J.: Wybór koncepcji układu napędu hydraulicznego z wykorzystaniem systemu ekspertowego.Hydraulika i Pneumatyka. 2000r. Nr 43.Jędrzykiewicz Z., Wąsierski K., Łebkowski P., Bober M.:Wprowadzenie do projektowania i komputerowo wspomagane projektowanie elementów i układówautomatyki. Wyd. AGH Kraków

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Designing of electro-hydraulic and electro-pneumatic systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01,PEK_W02,PEK_W03	K2AIR_AM_W02	C1, C2,C3	Lec1-Lec7	N1
PEK-U01,PEK-U02,PEK_U03,PEK_K01	K2AIR_AM_U02, K2AIR_AM_U11, K2AIR_K04	C1, C2,C3	Pr1-Pr1	N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria układów napędowych**
Name in English: **Theory of drive system**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041104, ARM041109**
Group of courses: **yes**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			15	15
Number of hours of total student workload (CNPS)	30			60	60
Form of crediting	Examination			Crediting with grade	Crediting with grade
Group of courses	X				
Number of ECTS points	1			2	2
including number of ECTS points for practical (P) classes				2	2
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			1.4	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		4
Lec3		3
Lec4		2
Lec5		3
Lec6		3
Lec7		2
Lec8		3
Lec9		3
Lec10		4
		Total hours: 30
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		4
Proj4		2
Proj5		2
Proj6		3
		Total hours: 15
Form of classes – Seminar		Number of hours
Sem1		15
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
N3. self study - preparation for project class
N4. multimedia 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 = 0,6F1		

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_K	
P = 0,4F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01,PEK_W02, PEK_W03	K2AIR_AM_W02, K2AIR_AM_W03	C1 C2		1,3

PEK_U01,PEK_U02,	K2AIR_U08	C2, C3		2,3
PEK_U03,	K2AIR_U10	C3		2,3,4,5
PEK_K01	K2AIR_K02	C4		2,3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody i techniki sztucznej inteligencji**
Name in English: **METHODS AND TECHNIQUES OF ARTIFICIAL INTELIGENCE**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041105**
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 – Project		Number of hours
Proj1		4
Proj2		4
Proj3		4
Proj4		3
		Total hours: 15

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
METHODS AND TECHNIQUES OF ARTIFICIAL INTELIGENCE
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W09, K2AIR_K01, K2AIR_K02	C1		N1
PEK_W02, PEK_K	K2AIR_AM_W09, K2AIR_K05, K2AIR_K06	C2		N1
PEK_U01,PEK_U02,PEK_U03, PEK_K	K2AIR_AM_U09, K2AIR_K04, K2AIR_K09, K2AIR_U01, K2AIR_U10	C3		N2,N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

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

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the basics of automation.

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

II. Relating to skills:

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

PROGRAMME CONTENT

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

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

F2	PEK_W02	Test 2
P = F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

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

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

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

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

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

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

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowanie w układach hydraulicznych**
Name in English: **Control of hydraulic systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041110**
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				
Group of courses				X	
Number of ECTS points	1			1	
including number of ECTS points for practical (P) classes				1	
including number of ECTS points for direct teacher-student contact (BK) classes	0.6			0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of fluid mechanics
2. He has knowledge of hydrostatic drive systems
3. It has the ability to design simple electro-hydraulic or electro-pneumatic system

SUBJECT OBJECTIVES

C1. To acquaint students with the methodology of controlling hydraulic drives
C2. Methodological approach to the design of the hydraulic system control
C3. Familiarization with practical applications, automation systems, hydraulic drives in machines working

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can design various control structures
PEK_U02 - Can design a control system
PEK_U03 - Able to select components

III. Relating to social competences:

PEK_K01 - Able to interact and work in a group, assuming different roles in it.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Control and regulation actuators in hydraulic systems. Basic concepts	2
Lec2	Gland control actuators. Sheet. Advantages and disadvantages. Examples	2
Lec3	Volume control actuators. Sheet. Advantages and disadvantages. Examples	2
Lec4	Controlling generators (pumps). Examples. Sheet. The ranges of applicability	2
Lec5	Control of hydraulic motors generators. Examples. Sheet. The ranges of applicability	2
Lec6	Hydrostatic load sensing systems in machine and operating systems. Applications	2
Lec7	Mathematical models and functional control systems in hydraulic systems	3
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Analysis of a design problem - the principle of operation of the machine or device	2
Proj2	Placing a mathematical model of the hydraulic system load and to determine its nominal value	4
Proj3	The selection and evaluation of the type of control	2
Proj4	Development of functional model control	2
Proj5	Selection and location of components for the hydraulic system	2
Proj6	Development of control algorithm	2
Proj7	Defense project	1
		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, PEK_W02, PEK_W03	colloquium
P = F1=Fw		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Stryczek S.: Napęd hydrostatyczny. t II Układy. WNT Warszawa 19922. Pizoń A.: Hydrauliczne ielektrohydrauliczne układy sterowania i regulacji. WNT 19873. Garbacik A.: Studium projektowaniaukładów hydraulicznych. Wyd. Ossolineum. Wrocław 1997r4. Jędrzykiewicz Z.: Projektowanie układówhydrostatycznych. Podstawy metodyczno-obliczniowe. Skrypt 1313 AGH Kraków5. Kollek W.: Podstawyprojektowania napędów i sterowań hydraulicznych. Oficyna Wydawnicza Politechniki Wrocławskiej.Wrocław 2004r.

SECONDARY LITERATURE

1.Katalogi producentów elementów hydrauliki siłowej i pneumatyki

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

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

PEK_W01,PEK_W02,PEK_W03	K2AIR_AM_W12	C1, C2,C3	Wy1, Wy2,Wy3, Wy4,Wy5, Wy6, Wy7	N1
PEK_U01,PEK_U02,PEK_U03,PEK_K01	K2AIR_AM_U02, K2AIR_AM_U12	C1, C2,C3	Pr1, Pr2,Pr3, Pr4,Pr5	N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Urządzenia i układy automatyki**
Name in English: **Equipment and automation systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041113**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the basics of automation.

SUBJECT OBJECTIVES

C1. Understanding the issues of automation equipment.
C2. Understanding the issues of control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student is able to compile and measurement systems to measure various physical quantities.
PEK_U02 - The student is able to program PLCs and SCADA applications perform simple and assemble and operate the pneumatic and electric drive systems.

III. Relating to social competences:

PEK_K01 - The student is able to think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction, organization, training, health and safety	1
Lab2	Instruments for measuring mechanical quantities and measurement of flow, pressure, level, temperature	2
Lab3	Relays, contactors, control elements	2
Lab4	Setting elements and actuators	4
Lab5	Regulators	3
Lab6	Frequency inverters	2
Lab7	PLC	6
Lab8	PLC Programming	6
Lab9	SCADA systems	4
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

1. Instructions to Festo MPS positions.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K01	K2AIR_K04	C1,C2	Lab1-Lab9	N1
PEK_U01, PEK_U02	K2AIR_AM_U01, K2AIR_AM_U05	C1, C2	Lab1-Lab9	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Badania układów mechanicznych i niemechanicznych**
Name in English: **Testing of Mechanical and Non-mechanical Systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041115**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge from basic subjects: physics, mechanics.
2. Student has ordered knowledge of specialized subjects: strength of materials, biomechanics engineering.
3. Student is able to support programs supporting the work of the engineer.

SUBJECT OBJECTIVES

C1. Obtaining the theoretical basis and practical knowledge needed to conduct experimental studies.
C2. Understanding the different experimental methods of research.
C3. Learn how to registration and processing of measurement results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student is able to merge information, obtain information from the literature, interpret then, draw conclusions.

PEK_U02 - Student potrafi zaplanować przeprowadzenie eksperymentu.

III. Relating to social competences:

PEK_K01 - The student is able to think and act creatively.

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

PEK_K03 - Student understands the necessity of lifelong learning.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	The research work of the hydrostatic drive industrial vehicle.	3
Lab2	Analysis of ultrasonic surface wave propagation.	3
Lab3	Error analysis of material thickness measurement by ultrasonic method.	3
Lab4	The project of the hydraulic system of linear simulator hydrostatic drive.	3
Lab5	Commissioning and testing of the selected objects, of the experimental mechatronics sensor characteristics.	3
Lab6	Determination of the mechanical properties of the implant materials.	3
Lab7	Studies of selected structural and mechanical properties of various tissues (eg, bone, skin, blood vessels, the core, the intervertebral disc).	3
Lab8	Measurement of resistance of materials to fracture.	3
Lab9	Investigation of the influence of stabilization on the changes of mechanical characteristics.	3
Lab10	Preparation the measuring setup to analysis of flow phenomena.	3
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Orłoś Z., Doświadczalna analiza odkształceń i naprężeń, PWN, Warszawa 1977 (in Polish).
Szczepiński W., Metody doświadczalne mechaniki ciała stałego, PWN, Warszawa1984.
Będziński R., Biomechanika inżynierska. Zagadnienia wybrane, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997 (in Polish).

SECONDARY LITERATURE

Beckwith T.G., Mechanical Measurements, Prentice Hall, 1995.
Journals

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Testing of Mechanical and Non-mechanical Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K2AIR_AM_U06, K2AIR_AM_U10	C1, C2, C3	La1 - La10	N1, N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K2AIR_K01, K2AIR_K04, K2AIR_K05, K2AIR_K06, K2AIR_K08, K2AIR_K09	C1, C2, C3	La1 - La10	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy hydrotroniki i pneumotroniki**
Name in English: **Hydrotronic and pneumotronic systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041116**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

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

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

F1	PEK_W01÷PEK_W03 PEK_K03	test
P = F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W11	C1	Lec1÷Lec2	N2, N5
PEK_W02	K2AIR_AM_W11	C1	Lec3÷Lec5	N2, N5
PEK_W03	K2AIR_AM_W11	C1, C3	Lec6÷Lec7	N2, N5

PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K2AIR_AM_U02, K2AIR_AM_U11, K2AIR_K04, K2AIR_K08	C2, C3	Lab1÷Lab7	N1, N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma seminar**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041117**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has the knowledge covered by the curriculum of the masters level studies.

SUBJECT OBJECTIVES

C1. Preparation of the students for the diploma examination.
C2. Repetition and strengthening the rules for writing diploma thesis.
C3. Strengthening the skills to present the content of diploma thesis and discuss on professional issues.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student can prepare answers to the diploma examination problems and intelligently answer the questions asked.

PEK_U02 - For the specified diploma thesis goal and range the student can develop a plan of carrying out the diploma thesis, determine its structure and write the thesis on her/his own.

PEK_U03 - The student can prepare a lucid presentation and discuss the progress in carrying out the diploma thesis, and easily discuss topics relating to the main field of study.

III. Relating to social competences:

PEK_K01 - The student understands the need for lifelong learning within the range of automation and robotics engineer activity and improving her/his professional and social competences.

PEK_K02 - The student understands the need for critical discussion of the results of engineering work done as part of team.

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

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	The discussion of the realization form of seminar, the assignment of diploma examination issues to which answers are to be prepared, the determination of the order in which the diploma thesis are to be presented.	2
Sem2	The discussion the rules for writing diploma thesis and anti-plagiarism actions.	2
Sem3	Presentation of preliminary plans for the implementation of diploma thesis and a discussion. Part 1.	2
Sem4	Presentation of preliminary plans for the implementation of diploma thesis and a discussion. Part 2.	2
Sem5	Presentation of preliminary plans for the implementation of diploma thesis and a discussion. Part 3.	2
Sem6	Presentation of preliminary plans for the implementation of diploma thesis and a discussion. Part 4.	2
Sem7	The discussion, by the students, of the diploma examination issues selected from the group A of questions.	2
Sem8	The discussion, by the students, of the diploma examination issues selected from the group B of questions.	2
Sem9	The discussion, by the students, of the diploma examination issues selected from the group C of questions.	2
Sem10	Reporting on the current progress of the diploma thesis and a discussion. Part 1.	2
Sem11	Reporting on the current progress of the diploma thesis and a discussion. Part 2.	2
Sem12	Reporting on the current progress of the diploma thesis and a discussion. Part 3.	2

Sem13	Reporting on the current progress of the diploma thesis and a discussion. Part 4.	2
Sem14	Discussion of formal procedures relating to submission of the diploma thesis and overdue presentations of progress towards diploma theses.	2
Sem15	Summing up and crediting the seminar.	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - self studies and preparation for examination
N2. self study - preparation for diploma thesis
N3. multimedia presentation on the current progress of the diploma thesis
N4. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	grading the presentation of answers to questions for the diploma examination
F2	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	grading the presentation on the current progress of the diploma thesisand the ability to discuss
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K2AIR_U09	C1 - C3	Sem1 - Sem15	N1 - N4
PEK_K01 - PEK_K03	K2AIR_K05, K2AIR_K09	C1 - C3	Sem1 - Sem15	N1 - N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041118**
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 – Project		Number of hours
Proj1		2
Proj2		3
Proj3		3
Proj4		6
Proj5		3
Proj6		6
Proj7		3
Proj8		6
Proj9		8
Proj10		2
Proj11		3
		Total hours: 45

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Pre-final project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2AIR_AM_U04, K2AIR_U04	C1		N1, N3
PEK_U02	K2AIR_AM_U11	C2		N1, N3
PEK_U03	K2AIR_AM_U02	C1		N1, N3
PEK_K01	K2AIR_K01	C1-C3		N1-N3
PEK_K02	K2AIR_K05	C1-C3		N1, N3
PEK_K03	K2AIR_K08	C3		N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy mechatroniczne w pojazdach samochodowych i silnikach spalinowych**
Name in English: **Mechatronic systems of a vehicles and combustion engines**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041119**
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

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		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02 PEK_U03	
F2	PEK_U01 PEK_U02 PEK_U03	
F3	PEK_U01 PEK_U02 PEK_U03	
F4	PEK_U01 PEK_U02 PEK_U03	
F5	PEK_U01 PEK_U02 PEK_U03	
F6	PEK_U01 PEK_U02 PEK_U03	
F7	PEK_U01 PEK_U02 PEK_U03	
P = (F1+F2+F3+F4+F5+F6+F7)/7		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronic systems of a vehicles and combustion engines
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_AM_W03, K2AIR_AM_W07	C1		N1.
PEK_W02	K2AIR_AM_W07	C1		N1.

PEK_W03	K2AIR_AM_W07, K2AIR_AM_W08	C1		N1.
PEK_U01	K2AIR_AM_U03, K2AIR_AM_U07, K2AIR_AM_U10	C2		N2. N3. N4.
PEK_U02	K2AIR_AM_U07, K2AIR_AM_U08	C2		N2. N3. N4.
PEK_U03	K2AIR_AM_U08	C2		N2. N3. N4.
PEK_K01	K2AIR_K01	C3		N3. N4.
PEK_K02	K2AIR_K02	C3		N3. N4.
PEK_K03	K2AIR_K04	C3		N3. N4.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie i symulacja układów**
Name in English: **Modeling and simulation of the system**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041120**
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. Informatics
2. Mechanics II
3. Hydraulic and pneumatic drive system

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

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

II. Relating to skills:

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

III. Relating to social competences:

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The rules for creating mathematical models based on physical models: the separation from the environment and simplifying assumptions	2
Lec2	Simplifying assumptions - working hypotheses: skipping small influences, independent of physical parameters.	3
Lec3	Analogies of systems of different physical structure: mechanical, electrical, hydraulic, pneumatic, thermal, etc.	2
Lec4	Mathematical models creation based on functional models. The use of experimental research of components and assemblies. The structure of dynamical systems.	2
Lec5	The method of bond graphs: flow and effort variable , sources of active and passive components. The structure of dynamical systems.	2
Lec6	Modeling and simulation of complex dynamical systems: e.g. -drive system of the loader	2
Lec7	Example of multi-source mechano-hydraulic drive system	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction to Matlab- Simulink	2
Proj2	Modeling and simulation of hydraulic buffer	2
Proj3	Modeling and simulation of car suspension	2
Proj4	Modeling and simulation of hydrostatic transmission	2
Proj5	Preparing of 4 topics chosen by the student from about 20 available topics.	7
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

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

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA I, II**
Name in English: **MASTER THESIS**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Machine and Process Automation**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041151, ARM041152**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for project class
N3. self study - self studies and preparation for examination
N4. tutorials

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2AIR_U10	C1		N1-N4
PEK_U02	K2AIR_U10	C2		N2, N3
PEK_U03	K2AIR_U07, K2AIR_U09	C2		N2, N4
PEK_K01	K2AIR_K09	C3		N1-N4
PEK_K02	K2AIR_K04	C3		N2, N4
PEK_K03	K2AIR_K01	C3		N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Drgania i hałas maszyn wytwórczych**
Name in English: **Nois and vibration of production machines.**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041200**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	2		1		
Number of hours of total student workload (CNPS)	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		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		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
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_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_W01, PEK_W02, PEK_W03	
F2	PEK_W01, PEK_W02, PEK_W03, PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_02, PEK_K03	
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Nois and vibration of production machines.
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_SP_W02	C1, C2, C3		N3, N5
PEK_W02	K2AIR_W02	C1, C2, C3		N3, N5

PEK_W03	K2AIR_SP_W02, K2AIR_W02	C1, C2, C3		N3, N5
PEK_U01	K2AIR_U03	C1, C2, C3		N1, N2, N4,
PEK_U02	K2AIR_U03	C1, C2, C3		N1, N2, N4
PEK_U03	K2AIR_U03	C1, C2, C3		N1, N2, N4
PEK_K01	K2AIR_K05	C1, C2, C3		N1, N2, N4
PEK_K02	K2AIR_K01	C1, C2, C3		N1, N2, N4
PEK_K03	K2AIR_K04, K2AIR_K05	C1, C2, C3		N1, N2, N4,

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elastyczne systemy wytwórcze**
Name in English: **Flexible Manufacturing Systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041201**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge relating to the design-construction process, the structure, functioning and operation of the main machine elements and assemblies, and the principles of matching and constructing them.
2. The student has sound knowledge of the structure of machine tools and their functionalities.
3. The student has basic knowledge of manufacturing techniques.

SUBJECT OBJECTIVES

C1. The student is to get to know the possibilities of automating the different components of a manufacturing system.
C2. The student is to acquire the skill of designing a flexible manufacturing system for a specified spectrum of workpieces.
C3. The student is to evaluate various solutions of flexible manufacturing automation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows the structure of the flexible manufacturing system and can describe its main components.

PEK_W02 - The student knows the functionalities of the manufacturing system and can propose different automation solutions for this system.

PEK_W03 - The student can distinguish between the flow systems of workpieces, tools, machining fluids and chips and can select their configuration proper for the specific production conditions.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, the notion of a system, the manufacturing system.	2
Lec2	The functional structure of the manufacturing system.	2
Lec3	The conditions for the development of the flexible automation of manufacturing.	2
Lec4	Flexible manufacturing system (FMS) implementation concepts.	2
Lec5	Machine tools used in FMS.	2
Lec6	Equipment for burr removal from workpieces in FMS.	2
Lec7	Coolants, chips disposal and washing workpieces in FMS.	2
Lec8	Tool management system in FMS.	2
Lec9	Part management system in FMS.	2
Lec10	Handling and transport systems in FMS.	2
Lec11	Storage systems in FMS.	2
Lec12	Information systems in FMS.	2
Lec13	The supervision and diagnosis of FMS operation.	2
Lec14	FMS availability.	2
Lec15	Final test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

N2. multimedia presentation

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_SP_W02	C1 - C3	Lec1 - Lec15	N1, N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowalne sterowniki przemysłowe**
Name in English: **Programmable logic controllers**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041202**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PLC controllers

SUBJECT OBJECTIVES

C1. Demonstrate advanced properties of industrial controllers.
C2. Present advanced programming language of industrial controllers
C3. Present selected applications of industrial controllers.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Is able to explain advanced properties of industrial controllers.
PEK_W02 - Can characterize advanced techniques of industrial controllers designing
PEK_W03 - Is able to select suitable control system for desired application.

II. Relating to skills:
PEK_U01 - Is able to use advanced properties and functions of industrial controllers.
PEK_U02 - Is able to prepare the program for advanced application.
PEK_U03 - Is able to use suitable controller for selected application.

III. Relating to social competences:
PEK_K01 - Is able to work in a group.
PEK_K02 - Is able to use technical literature in an independent way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The ST programming language	2
Lec2	The SFC programming language	2
Lec3	Structured programming.	2
Lec4	System functions and interrupt	2
Lec5	Software realization of the PID algorithm	2
Lec6	Control system diagnosis	2
Lec7	Sample applications of control systems	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	Programowanie w języku ST	2
Lab3	Programming in SFC	2
Lab4	The use of system functions and interrupt handling	2
Lab5	Programming the PID algorithm	2
Lab6	Implementation of the discrete process control	2
Lab7	The implementation of a continuous process control system	2
Lab8	Control systems diagnosis	2
		Total hours: 15

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U012, PEK_U03,	average grade
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Kwaśniewski J., Programowalny sterownik S7-300 w praktyce inżynierskiej, BTC 2009

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_W06	C1	Lec4, Lec5, Lec6,	N1

PEK_W02	K2AIR_W06	C2	Lec1, Lec2, Lec3,	N1
PEK_W03	K2AIR_W06	C3	Lec7,	N1
PEK_U01	K2AIR_U10	C1	LA4, LA5	N2, N3
PEK_U02	K2AIR_U10	C2	LA2, LA3	N2, N3
PEK_U03	K2AIR_U10	C3	LA6, LA7	N2, N3
PEK_K01, PEK_K02	K2AIR_K08	C1,C2,C3	Lec1-Lec7, LA1-LA8	N1,N2,N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Robotyka i automatyzacja**
Name in English: **Robotics and Automation**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041204**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15	15		
Number of hours of total student workload (CNPS)	30	30	60		
Form of crediting	Crediting with grade	Crediting with grade	Crediting with grade		
Group of courses					
Number of ECTS points	1	1	2		
including number of ECTS points for practical (P) classes		1	2		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6	0.7	1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		1
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1		2
Cl2		2
Cl3		2
Cl4		2
Cl5		2
Cl6		2
Cl7		2
Cl8		1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
N3. self study - preparation for laboratory class
N4. self study - preparation for project class
N5. tutorials

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

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

EVALUATION OF SUBJECT EDUCATIONAL 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_K02, PEK_K03	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_SP_W02, K2AIR_SP_W04, K2AIR_SP_W07, K2AIR_W04, K2AIR_W06	C1,C2,C3		N1, N2
PEK_W02	K2AIR_SP_W02, K2AIR_SP_W04, K2AIR_W04, K2AIR_W06	C1,C2,C3		N1, N2
PEK_W03	K2AIR_SP_W02, K2AIR_SP_W04, K2AIR_W04, K2AIR_W06	C1,C2,C3		N1, N2
PEK_U01	K2AIR_SP_U02, K2AIR_SP_U04, K2AIR_SP_U07, K2AIR_SP_U09	C1,C2,C3		N4, N5
PEK_U02	K2AIR_SP_U09	C1,C2,C3		N3
PEK_U03	K2AIR_U05, K2AIR_U06	C1,C2,C3		N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologia i automatyzacja montażu**
Name in English: **Technology and automation of assembly**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041205**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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		3
Proj5		2
Proj6		2
Proj7		2
Proj8		2
Proj9		2
Proj10		2
Proj11		3
Proj12		2
Proj13		2
Proj14		2
		Total hours: 30

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K2AIR_SP_W01, K2AIR_SP_W04	C1		N1,N2
PEK_W02 PEK_W03	K2AIR_W06	C1		N1,N2

PEK_U01 PEK_U02	K2AIR_SP_U01, K2AIR_SP_U02, K2AIR_U01, K2AIR_U07	C2		N1,N3
PEK_U02 PEK_U03	K2AIR_U04, K2AIR_U05, K2AIR_U06	C3		N2-N4
PEK_K01 PEK_K02	K2AIR_K02, K2AIR_K03, K2AIR_K06, K2AIR_K08	C2		N4
PEK_K03	K2AIR_K04, K2AIR_K05, K2AIR_K08	C3		N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie obrabiarek sterowanych numerycznie**
Name in English: **CNC machine programming**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041208**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
		Total hours: 16
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		4
Lab4		2
Lab5		2
Lab6		2
Lab7		8
Lab8		8
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises
N2. tutorials
N3. traditional lecture with the use of transparencies and slides
N4.
N5. project presentation

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

F2	PEK_U01 - PEK_U03	
P = F1+F2		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_W04	C1. - C3.		N2, N3
PEK_U01 - PEK_U03	K2AIR_SP_U03	C1 - C3		N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń wytwórczych**
Name in English: **Operation maintenance of manufacturing machines and devices**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041209**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure and operation of machine components and assemblies, as well as principles of their selecting and designing.
2. Basic knowledge about operation, reliability and safety of machines.
3. Well-grounded knowledge about basic manufacturing techniques and role of manufacturing machines.

SUBJECT OBJECTIVES

C1. Getting acquainted with principles of the Total Productive Maintenance (TPM) concept.
C2. Getting acquainted with basic TPM tools and methods allowing to increase efficiency of machine stock maintenance. Getting acquainted with principles of determining indices describing progress at implementing the TPM methodology.
C3. Getting acquainted with possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knowledge of scope and principles of selecting a maintenance strategy of manufacturing machines and devices.

PEK_W02 - Knowledge of basic TPM tools and indices.

PEK_W03 - Knowledge of basic features and possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personel.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic problems related to maintenance of manufacturing machines and devices: service requirements, cause and effect analysis of machine failure, role and significance (benefits) of maintenance organization and planning.	2
Lec2	History and development of the TPM concept (characteristics of basic TMP pillars).	2
Lec3	Characteristics of basic TPM tools – exemplary applications.	2
Lec4	Maintenance strategies – idea of systematic and system-related attitude to maintenance problems.	2
Lec5	Measures and indices determining efficiency of implementing the TPM methodology.	2
Lec6	CMMS-class computer systems supporting maintenance management (requirements and functions of selected systems, system selection criteria).	2
Lec7	Implementing the TPM methodology to industrial practice (role and organization of Maintenance Department). Exemplary solutions of implementing a TPM program.	2
Lec8	Crediting the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides.

N2. Own work – preparation for crediting the lecture.

N3. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Legutko S.: Basics of operation of machines and devices. Editorial Office WSiP. Warsaw, 2007 (in Polish).
Słowiński B.: Engineering of machine operation. Editorial Office of Koszalin University of Technology. Koszalin, 2011 (in Polish).
Kaźmierczak J.: Operation of technical systems. Editorial Office of Silesian University of Technology. Gliwice, 2000 (in Polish).

SECONDARY LITERATURE

Hebda M.: Elements of the theory of technical systems operation. Editorial Office MCNEMT. Radom, 1990 (in Polish).
Żółtowski B.: Basics of machine diagnostics. Editorial Office ATR Bydgoszcz, 1996(in Polish).
Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warsaw, 2000 (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Operation maintenance of manufacturing machines and devices
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K2AIR_SP_W02	C1 - C3	Wy1 -Wy7	N1 - N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane modelowanie i projektowanie procesów wytwarzania w systemach CAD/CAM**
Name in English: **Advanced modeling and design of manufacturing processes in CAD/CAM systems**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041210**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge and skills in the field of courses "Engineering Graphics: Engineering Drawing", "Engineering graphics - descriptive geometry" or similar
2. Knowledge and skills in the field of courses "Engineering Graphics 3D" or similar
3. Basic knowledge about numerically controlled machine tools

SUBJECT OBJECTIVES

C1. Provide students with knowledge on methods and tools for product design and verification
C2. Presentation of modern tools supporting manufacturing
C3. Acquiring knowledge on technologies of design of CNC machines with the use of CAD/CAM systems
C4. Discussion of issues of selection, implementation and integration of CAD/CAM systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows stages of design of products and their manufacturing processes and computer technologies used therein
PEK_W02 - Student has the a basic knowledge on creating and processing 3D models of products
PEK_W03 - Student has ordered knowledge of technological design in CAM systems

II. Relating to skills:
PEK_U01 - Student applies selected methods and computer technology in the development of products and processes for their preparation
PEK_U02 - Student can use the chosen method of creating and processing 3D models of products
PEK_U03 - Student can prepare a technological process for CNC machine tools using selected CAD/CAM system

III. Relating to social competences:
PEK_K01 - Ability to work in a design team

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	2D/3D wireframe and surface CAD models	2
Lec2	Solid CAD models and methods of their representation	2
Lec3	Additional functionality CAD systems. Geometric data exchange.	2
Lec4	Visualization of 3D CAD models. Virtual reality.	2
Lec5	Advanced modeling tools in CAD systems	2
Lec6	Advanced analysis tools in CAD systems	2
Lec7	Methods of designing products according to technological criteria	2
Lec8	Introduction to reverse engineering	2
Lec9	Reverse engineering in CAD design	2
Lec10	Introduction to additive technologies of prototyping and manufacturing	2
Lec11	Selection and implementation of CAD/CAM systems. A review of available solutions.	2
Lec12	Technological design in CAM systems. The steps and tasks performed.	2
Lec13	Technological design in CAM systems. Functions of CAM systems.	2
Lec14	Processes verification through computer simulation. Generating NC code for numerically controlled machines. General information regarding CNC machines.	2
Lec15	Management of design and technological documentation	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Organizational meeting: principles of modeling in selected CAD and CAM rules of grading projects	2

Proj2	Modeling a product in a CAD system using advanced tools - introduction and own work	2
Proj3	Modeling a product in a CAD system using advanced tools - own work and project presentation	4
Proj4	Generating toolpaths for machining in the selected CAM system. Machining simulation. Project management. Introduction and own work.	4
Proj5	Generating technological documentation. NC code generation. Introduction and own work.	2
Proj6	Supplementary classes and crediting	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced modeling and design of manufacturing processes in CAD/CAM systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K2AIR_SP_W05, K2AIR_W05	C1 - C4	Lec1-Lec15	N1, N2, N5
PEK_U01, PEK_U02, PEK_U03, PEK_K01	K2AIR_K04, K2AIR_SP_U05	C1 - C3	Pr1-Pr5	N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane technologie wytwarzania**
Name in English: **Advanced production technics**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041211**
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		3
Lec3		2
Lec4		3
Lec5		2
Lec6		3
Lec7		3
Lec8		2
Lec9		2
Lec10		3
Lec11		3
Lec12		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. 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_W01-PEK_W03	
F2	PEK_U01-PEK_U02	
F3	PEK_K01-PEK_K02	
P = (F1+F2+F3)/3		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W02 PEK_W01-PEK_W03	
F2	PEK_U01-PEK_U02	
F3	PEK_K01-PEK_K02	
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K2AIR_SP_W06	C1-C4		N1-N4
PEK_U01-PEK_U02	K2AIR_U09, K2AIR_U10	C1-C4		N1-N4
PEK_K01-PEK_K02	K2AIR_K04, K2AIR_K06	C1-C4		N1-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane procesy obróbki bezubytkowej**
Name in English: **Advanced processes of chipless forming**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041214**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of the basic techniques of production processing chipless forming methods, ie the welding, casting and plastic forming.
2. The student has ordered knowledge about the types of metallic and non-metallic materials and advanced engineering - their construction, properties, applications and selection rules.
3. The student has an established expertise in robotics and automation.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of advanced manufacturing chipless forming techniques.
C2. Acquiring the skills of critical analysis, from the point of view of the possibility of mechanization and automation, advanced manufacturing technology.
C3. Learn how to search for information and its critical analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He knows the advanced methods of bonding, casting and wrought materials and advanced engineering.

PEK_W02 - He has knowledge of the basic parameters and the possibility of producing chipless forming mechanization and automation of advanced processing of chipless forming.

PEK_W03 - Has knowledge of the possible applications of advanced manufacturing chipless forming products.

II. Relating to skills:

III. Relating to social competences:

PEK_K01 - Search for information and its critical analysis.

PEK_K02 - An objective assessment of the arguments, the rational justification of translation and his own point of view, using knowledge of welding, casting and plastic forming.

PEK_K03 - Students should follow the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Welding concentrated energy: plasma, electron beam and laser beam. Automation of welding processes.	3
Lec2	Vacuum Brazing and gas shielded. February and their properties.	2
Lec3	Advanced welding processes: friction, FSW, diffusion, ultrasonic, explosive and hardening.	3
Lec4	Bonding advanced materials structural adhesives.	1
Lec5	Cutting methods focused energy. Mechanization and automation of cutting.	1
Lec6	The use of modern processes to improve the smelting and processing of metallurgical alloys casting.	2
Lec7	Advanced materials and technologies used in the process of preparation of molding and core.	3
Lec8	Modern, innovative technologies of foundry molds and cores.	3
Lec9	Application of "Rapid prototyping" in foundry.	2
Lec10	Physical modeling of plastic forming processes.	2
Lec11	Manufacture of metal powder.	2
Lec12	The use of modern building materials in plastic forming processes.	1
Lec13	Flexible systems for metal forming (shaping precision).	2
Lec14	The methods of electromagnetic metal stamping.	2
Lec15	Computational methods in the design of forming processes.	1
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01; PEK_W02; PEK_W03PEK_K01; PEK_K02; PEK_K03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced processes of chipless forming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K2AIR_SP_W06, K2AIR_SP_W10, K2AIR_W07	C1; C2; C3		N1; N2; N3
PEK_K01; PEK_K02; PEK_K03	K2AIR_K01, K2AIR_K06, K2AIR_K08, K2AIR_K09	C1; C2; C3		N1; N2; N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma seminar**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041217**
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. The student has the knowledge covered by the curriculum of the masters level studies.

SUBJECT OBJECTIVES

C1. Preparation of the students for the diploma examination.
C2. Repetition and strengthening the rules for writing diploma thesis.
C3. Strengthening the skills to present the content of diploma thesis and discuss on professional issues.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - The student can prepare answers to the diploma examination problems and intelligently answer the questions asked.

PEK_U02 - For the specified diploma thesis goal and range the student can develop a plan of carrying out the diploma thesis, determine its structure and write the thesis on her/his own.

PEK_U03 - The student can prepare a lucid presentation and discuss the progress in carrying out the diploma thesis, and easily discuss topics relating to the main field of study.

III. Relating to social competences:

PEK_K01 - The student understands the need for lifelong learning within the range of automation and robotics engineer activity and improving her/his professional and social competences.

PEK_K02 - The student understands the need for critical discussion of the results of engineering work done as part of team.

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

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	The discussion of the realization form of seminar, the assignment of diploma examination issues to which answers are to be prepared, the determination of the order in which the diploma thesis are to be presented.	2
Sem2	The discussion the rules for writing diploma thesis and anti-plagiarism actions.	2
Sem3	Presentation of preliminary plans for the implementation of diploma thesis and a discussion. Part 1.	2
Sem4	Presentation of preliminary plans for the implementation of diploma thesis and a discussion. Part 2.	2
Sem5	Presentation of preliminary plans for the implementation of diploma thesis and a discussion. Part 3.	2
Sem6	Presentation of preliminary plans for the implementation of diploma thesis and a discussion. Part 4.	2
Sem7	The discussion, by the students, of the diploma examination issues selected from the group A of questions.	2
Sem8	The discussion, by the students, of the diploma examination issues selected from the group B of questions.	2
Sem9	The discussion, by the students, of the diploma examination issues selected from the group C of questions.	2
Sem10	Reporting on the current progress of the diploma thesis and a discussion. Part 1.	2
Sem11	Reporting on the current progress of the diploma thesis and a discussion. Part 2.	2
Sem12	Reporting on the current progress of the diploma thesis and a discussion. Part 3.	2

Sem13	Reporting on the current progress of the diploma thesis and a discussion. Part 4.	2
Sem14	Discussion of formal procedures relating to submission of the diploma thesis and overdue presentations of progress towards diploma theses.	2
Sem15	Summing up and crediting the seminar.	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - self studies and preparation for diploma examination
N2. self study - preparation for diploma thesis
N3. multimedia presentation on the current progress of the diploma thesis
N4. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	grading the presentation of answers to questions for the diploma examination
F2	PEK_U01 - PEK_U03, PEK_K01 - PEK_K03	grading the presentation on the current progress of the diploma thesisand the ability to discuss
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K2AIR_U06, K2AIR_U09	C1 - C3	Sem1 - Sem15	N1 - N4
PEK_K01 - PEK_K03	K2AIR_K05, K2AIR_K06, K2AIR_K09	C1 - C3	Sem1 - Sem15	N1 - N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca przejściowa**
Name in English: **Pre-final project**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041218**
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 – Project		Number of hours
Proj1		2
Proj2		4
Proj3		6
Proj4		6
Proj5		4
Proj6		3
Proj7		3
Proj8		3
Proj9		8
Proj10		3
Proj11		3
		Total hours: 45

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Pre-final project
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K2AIR_U04	C1,C2		N1, N2
PEK_U02	K2AIR_U08	C1, C2		N1, N2
PEK_U03	K2AIR_U05, K2AIR_U10	C3		N2, N3
PEK_K01	K2AIR_K03, K2AIR_K06	C1, C2, C3		N1, N2, N3
PEK_K02	K2AIR_K09	C1, C2, C3		N1, N2, N3
PEK_K03	K2AIR_K02, K2AIR_K04	C1, C2, C3		N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowalne systemy bezpieczeństwa funkcjonalnego**
Name in English: **Programmable systems of Functional Safety**
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041222**
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 on the design and operation of machines, and issues presented on the course "Statistics for engineers ".
2. The ability to use mathematical software and editing of written publications concerning the analyzes.
3. Lack of prerequisites in terms of competence.

SUBJECT OBJECTIVES

C1. Familiarizintion with problems of analysis and evaluation of safety of systems and technical facilities.
C2. Familiarization with the problem of the responsibility for implementing specific solutions in technical systems.
C3. Acquiring the ability to present the proposed analysis. Getting the ability of rational leading of equipment operation.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student understands the relationships and dependencies between processes in operation, failures and operation safety of technical systems.

II. Relating to skills:
PEK_U01 - The student is able to perform safety analysis for the technical system.
PEK_U02 - As a result of the course the student is able to analyze the impact of functional features of technical systems on their safety, and propose organizational and technical changes that improve it.

III. Relating to social competences:
PEK_K01 - As part of the course, the student gains competence on the impact of the implementation of specific technical solutions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts (reliability, safety, the concept of risk, resilience, vulnerability, hazards). Analysis of the construction of the system and the processes occurring in it.	2
Lec2	Sources of information about reliability and safety of the machines. Methodology of statistical studies. Guidelines for the development of research program in terms of reliability. Use of the test results for management of reliability operation and safety.	2
Lec3	The theory of reliability in the safety assessment. Analytical methods in reliability: RBD (Reliability Block Diagram). Complex objects. Analytical methods: FTA (Fault Tree Analysis), ETA (Event Tree Analysis).	2
Lec4	Normative and legal conditions in safety assessment.	2
Lec5	Multi-state system analysis, Markov processes. Risks in the operation of the technical system. PHA (Preliminary Hazard Analysis).	2
Lec6	Analytical methods: FMEA (Failure Mode and Effects Analysis), FMECA (Failure Mode, Effects and Criticality Analysis).	2
Lec7	Diagnostics of a technical objects. Security actions - the use of barriers (safety culture, implementation procedures, use of equipment). Safety integrity levels.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction to the issue. Selection of the system for analysis.	2
Proj2	Decomposition of the system. Identification of system elements, processes and human factors.	2
Proj3	Reliability analysis of the system.	2
Proj4	Fault Tree Analysis, Event Tree Analysis.	2
Proj5	Preliminary Hazard Analysis.	2

Proj6	Failure Mode and Effects Analysis, Failure Mode, Effects and Criticality Analysis	2
Proj7	Introduction of procedures to enhance the reliability and safety of the system. Resilience and vulnerability rating of the system.	2
Proj8	Project summary. Discussion.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for project class
N3. case study
N4. problem discussion
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	Final test
P = 100%*F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_K01	Completion of project task
P = 100%*F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bertsche B., Lechner G.: Zuverlässigkeit im Fahrzeug- und Maschinenbau. Springer 2004.
[2] Lisnianski A., Frenkel I., Ding Y.: Multi-state System Reliability Analysis and Optimization for Engineers and Industrial Managers. Springer 2010.
[3] Pham H.: Safety and Risk Modeling and Its Applications. Springer 2011.
[4] Szopa T.: Niezawodność i bezpieczeństwo. Oficyna Wydawnicza Politechniki Warszawskiej 2009.

SECONDARY LITERATURE

[5] Poradnik niezawodności. Podstawy matematyczne. Red. Migdalski J. Wydawnictwo WEMA, Warszawa 1982.
[6] Inżynieria niezawodności. Poradnik. Red. Migdalski J. Akademia Techniczno- Rolnicza, Ośrodek Badania
[7] Jakości Wyrobów „ZETOM". Bydgoszcz, Warszawa 1992.
[8] The Reliability of Mechanical Systems. Red. Davidson J. Mechanical Engineering Publications Limited
[9] The Institution of Mechanical Engineers. London 1994.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programmable systems of Functional Safety
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_K01	K2AIR_SP_W09	C1, C2	Lec 1 - Lec8	N1, N3, N4
PEK_U01, PEK_U02, PEK_K01	K2AIR_SP_U09	C1, C2, C3	Proj1 - Proj8	N2, N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA I, II**
Name in English:
Main field of study (if applicable): **Control Engineering and Robotics**
Specialization (if applicable): **Manufacturing Systems**
Level and form of studies: **II level, full-time**
Kind of subject: **obligatory**
Subject code: **ARM041251, ARM041252**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. case study
N2. self study - preparation for project class
N3. self study - self studies and preparation for examination
N4. tutorials

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U, PEK_K	K2AIR_K01, K2AIR_K04, K2AIR_K09, K2AIR_U07, K2AIR_U09, K2AIR_U10			

SUBJECT SUPERVISOR

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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): **Control Engineering and Robotics**
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
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K2AIR_W07, K2AIR_W09	wg kart opracowanych przez SNH		wg kart opracowanych przez SNH

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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): **Control Engineering and Robotics**
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

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 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
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K2AIR_U06, K2AIR_U09, K2AIR_U11	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.
PEK_K01 - PEK_K02	K2AIR_K01	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.

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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): **Control Engineering and Robotics**
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
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U	K2AIR_U06, K2AIR_U09, K2AIR_U12	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.
PEK_K	K2AIR_K01	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK ZAJĘCIA SPORTOWE**
Name in English: **Block of Sports Activities**
Main field of study (if applicable): **Control Engineering and Robotics**
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		1.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Classes		Number of hours
Cl1		15
		Total hours: 15

TEACHING TOOLS USED

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
Control Engineering and Robotics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K01	K2AIR_K10	wg kart przygotowanych przez SWFiS		wg kart przygotowanych przez SWFiS