Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fizyka 1.2**
Name in English: **Physics 1.2**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **FZP001058**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	120	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	4	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	4.0	2.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Competence in mathematics and physics at the level of secondary school

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge, taking into account aspects of applications, from the following sections of classical physics: classical mechanics, oscillatory and wave motion, thermodynamics
C2. Acquiring the ability of qualitative understanding, interpretation and quantitative analysis - based on the laws of physics - selected physical phenomena and processes in the field: classical mechanics, oscillatory and wave motion, thermodynamics
C3. Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students aiming to effectively solve problems. Responsibility, honesty and fairness in the proceedings; observance force in academia and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - PEK_W01 Has a basic knowledge of classical mechanics, wave motion and thermodynamics, knows the
importance of discoveries and achievements in physics for technical sciences and the progress of civilization
PEK_W02 Knows the basics and principles of dimensional analysis to estimate the values of physical quantities
PEK_W03 Knows the basics of vector calculus in a rectangular coordinate system
PEK_W04 Has knowledge of kinematics description rectilinear and curvilinear motion (projections: vertical, horizontal, diagonal, circular motion, the angular size of the kinematic relationships with linear kinematic quantities)
PEK_W05 Has knowledge of the fundamentals and applications of dynamics; has detailed knowledge of: a) the reference systems (inertial and non-inertial), b) understanding the importance of the dynamics of physical mass and strength, c) the types of interactions the primary and types of forces observed in nature (conservative, non-conservative, central, friction, inertia) d) the principles of Newton and scope of their application, e) the correct formulation of the equations of motion, f) knowledge and understanding of the physical meaning of the transformation of Galileo g) the dynamics of particles / body in curvilinear motion in the inertial reference system, h) the dynamics of particles / bodies in non-inertial systems reference i) the physical sense of inertia, together with an indication of their manifestations and consequences
PEK_W06 Has knowledge of the conservative and non-conservative forces observed in nature and everyday life; known concepts: a) conservative forces, b) a force field at the field strength conservative c) of the work and power mechanical force, d) the kinetic and potential energy; knows the theorem of work and kinetic energy; has the knowledge to explain the relationship conservative forces of potential energy; knows, with mathematical justification, the principle of conservation of mechanical energy particles / body in the field of conservative forces
PEK_W07 Knows and understands the terms: a) drive strength b) particles and the momentum of the mechanical system of material points; knows the formulation of the second law of dynamics using the concept of momentum; has knowledge concerning: a) the principles of conservation of momentum particles and the material system and the conditions of its applicability, b) elastic collision and inelastic; knows and understands the concept of a system of points and its center of gravity; has knowledge about the dynamics of the center of mass of the material points
PEK_W08 Is familiar with the term: a) with respect to torque / rotation axis, b) the angular momentum of a particle, system of particles and rigid bodies with respect to / axis of rotation, c) moment of inertia: a particle system of particles and rigid bodies with respect to the axis of rotation; he knows the second law of dynamics for rotational motion of a rigid body about a fixed axis of rotation; knowledgeable about. kinetic energy of the rotation, work and power in rotation; knows the correct qualitative and quantitative description of the phenomenon of precession and reciprocating rigid body; has knowledge concerning: a) the principle of conservation of angular momentum of a particle, the system of particles and rigid bodies with respect to a fixed axis of rotation, b) the conditions of applicability of the principle of conservation of angular momentum
PEK_W09 Knows the vector character of the law of universal gravitation; knows the concept: a) current and potential gravitational field, b) the gravitational potential energy of the body and the body; has knowledge concerning: a) the principle of conservation of mechanical energy of the body / the bodies in a gravitational field, b) of the potential of the intensity of the field and the gravitational force of gravitational energy potential, b) Kepler's laws and their justification on the basis of the law of universal gravitation and the law of conservation the angular momentum of the planet; familiar with the concept of I, II and III space velocity
PEK_W10 Knows the basics of statics of solids and elastic properties of liquids and solids
PEK_W11 Know the basics of hydrostatics and hydrodynamics of fluids; has detailed knowledge of: hydrostatic pressure, Pascal's and Archimedes' rights, surface tension and the effects it caused, types of ideal fluid flows and non-ideal, continuity and Bernoulli's equation, viscosity and the effects it caused, the dynamics of motion of bodies in a viscous medium, law Stokes
PEK_W12 Has knowledge on the basics of kinematics and dynamics and oscillating motion applications; has

detailed knowledge of: a) simple harmonic motion oscillating pendulum: mathematical, physical, torsion and the particles subjected to the force potential, and performing small oscillations about the point where the potential energy assumes a minimum value, b) the vibratory motion suppressed, c) forced vibration outer sinusoidal force; He has knowledge of the physics of the phenomenon of mechanical resonance
PEK_W13 Has knowledge on the basics of wave motion and its applications; has detailed knowledge of: a) generating and basic properties of mechanical waves, b) the kinds of waves, c) the wave equation flat monochrome d) the basic physical quantities wave motion (length and frequency of the wave, the wave vector, the frequency circular) and their units of measurement, e) the speed associated with the operation waveform (phase, particles resort, group), f) depending on velocity of longitudinal and transverse of the elastic properties of the medium (units: Young's modulus, shear and elastic volume), g) the transport of mechanical energy by the waves (energy and power average, the intensity, the average energy density wave in the resort) h) depending on the intensity of the wave on the distance from the source
PEK_W14 Has detailed knowledge concerning: a) generating, types and characteristics of acoustic waves (speed of sound in air, the volume / intensity of the wave energy transfer), b) the law of refraction and reflection, c) the pressure and force exerted by the wave incident on the surface d) Doppler e) uses ultrasound, f) the wave interference (superposition), g), standing waves and sound sources, h) beats, s) selected applications of sound and ultrasound
PEK_W15 Has knowledge of the zero and the first law of thermodynamics; knows the basic concepts (macroscopic system, equilibrium thermodynamic parameters, functions of state, thermodynamic processes, gas ideal gas equation of state of ideal and actual); has detailed knowledge of: a) the temperature thermodynamic temperature scale and measurement units in various applicable scales, b) definition of the unit of measure Kelvin, c) the concept of internal energy of the system, d) the value of the elementary work done on the gas the ideal e) the work done over / by and with the environment of said heat in thermodynamic processes ideal gas
PEK_W16 Has a basic knowledge of the second and third law of thermodynamics; has detailed knowledge of: a) reversible and irreversible processes, b) the entropy of a macroscopic system, content II principles and the elementary values of entropy change of the system, c) methods for the quantitative determination of entropy change ideal gas, d) thermodynamic machine / thermal engines and their performance in cycles simple and inverse e) the third law of thermodynamics
PEK_W17 Has knowledge on the basics of statistical thermodynamics; has detailed knowledge of: a) objectives and mathematical formalism (probability and mathematical statistics) statistical thermodynamics, b) macroscopic thermodynamic parameter as a random variable; c) microstate, macrostate and weight statistics, d) statistical interpretation of the Boltzmann-Planck entropy, e) the function of the Boltzmann distribution (barometric formula), f) the distribution function Maxwell velocity of the gas molecules ideal g) the speed of the most probable and the average speed of the square of the gas molecules of ideal , h) of the average particle energy of degrees of freedom, i) microscopic interpretation of temperature and pressure ideal gas, j) rules equipartition heat

II. Relating to skills:

PEK_U01 - PEK_U01 Is able to correctly and efficiently apply the learned principles and laws of physics to qualitative
and quantitative analysis of selected physical problems of engineering. Is able to: a) identify and justify discoveries and achievements in physics, which contributed to the progress of civilization, b) explain the basics of physical activity everyday consumer devices
PEK_U02 Is able to: a) apply the basic principles of dimensional analysis and qualitative analysis; b) The estimated value of the physical quantities of simple and complex
PEK_U03 Is able to: a) to distinguish between scalar of vector b) provide size vector in the Cartesian coordinate system, c) use have met the elements of vector calculus, in particular knows how to set: the vectors, angles between vectors, intersections: scalar, vector, mixed and triple
PEK_U04 Is able to set - using the transformation of Galileo - the size of the kinematic moving relative to each other inertial reference systems
PEK_U05 Is able to identify and determine the kinematic quantities (vectors: position, velocity, acceleration total, tangential acceleration, acceleration of normal) in progressive movements and rotational and quantitative relationships between linear and angular kinematic quantities
PEK_U06 Is able to correctly identify the forces acting on a given particle / body system and identify the resultant force in an inertial and non-inertial set

PEK_U07 Is able to apply principles of dynamics to describe the motion of the body in the inertial frame of reference, in particular, can: a) correctly formulate the equations of motion vector character and his scalar character in the selected coordinate system, b) solve the formulated scalar equations of motion with regard to the initial conditions
PEK_U08 Is able to apply principles of dynamics to describe the motion of the body in non-inertial frame of reference, in particular knows how: a) indicate the forces acting on a given particle / body and properly formulate the equation of motion in a non-inertial set b) explain the observed effects associated with the Earth's rotation
PEK_U09 Is able to properly use the concept of work and energy to the description of physical phenomena, in particular to apply the principle of conservation of energy to solve problems related to kinematics and dynamics of motion of the particles / bodies concerned / a; knows how to determine the value of: a) the mechanical work and the power of fixed and variable force, kinetic and potential energy, b) changes in the kinetic energy of the particle / body with the use of claims about work and kinetic energy, c) the conservative forces on the basis of a particular analytical form of potential energy
PEK_U10 Is able to apply principles of dynamics to describe a system of points, in particular set of values: drive force acting on the body, momentum particles / material system and the position of the center of mass of a system of points and quantitatively analyze the movement of the center of mass of the material points under the influence of the resultant of external forces
PEK_U11 Is able to properly apply the principle of conservation of momentum for quantitative and qualitative analysis of the dynamic properties of the material points, in particular for the quantitative analysis of elastic collision and inelastic
PEK_U12 Is able to apply the concept of torque and momentum to analyze simple problems related to kinematics and dynamics of rotation of rigid body around a fixed axis, in particular knows how to determine the value of: a) the moment of the force about point / axis of rotation, b) the angular momentum of a particle system of particles and rigid bodies with respect to / axis of rotation, c) formulate and solve the equation of motion of a rigid body rotating around a fixed axis of rotation, d) qualitatively describe the phenomenon of precession e) to formulate and solve the equation reciprocating, rotary rigid body
PEK_U13 Is able to apply the principle of conservation of angular momentum to solve selected problems of physical and technical
PEK_U14 Is able to apply the concept of work and kinetic energy of a rigid body to solve the problems associated with rotary motion of the rigid body, in particular, can determine the value of a) the kinetic energy of rotational motion, work and power in rotational motion, b) changes in the kinetic energy of rotation of the particles / body the use of statements about work and kinetic energy to rotational motion
PEK_U15 Is able to a) justify the conservative nature of the gravitational field, b) explain the physical meaning of Kepler's laws, c) properly apply the principle of conservation of mechanical energy of the body / the bodies in a gravitational field, knows how to determine the value of: a) current and potential gravitational field, b) gravity the potential energy of the body and the body, c) I, II and III space velocity
PEK_U16 Is able to analyze and solve simple tasks on hydrostatic and hydrodynamics of fluids, in particular, can calculate the surface tension, the speed and efficiency of fluid flow; able to solve simple tasks related to the dynamics of bodies in fluids, taking into account the forces of resistance
PEK_U17 Is able to properly describe the properties of a periodic movement, and in particular to formulate and solve the differential equations of oscillatory motion for simple cases (pendulum: mathematical, physical, torsion and particles performing small oscillations around the position of stable equilibrium); can analyze kinematic and dynamic properties of harmonic motion in the case of braking forces, and periodic exciting force; can calculate periods of vibration and qualitatively and quantitatively characterize the mechanical resonance phenomenon
PEK_U18 Is able to: a) clarify the relationship of the wave motion of the elastic properties of the medium b) quantitatively characterize the mechanical energy transport by the waves running c) correctly describe quantitatively diffraction, interference, polarization and the pressure exerted by the wave incident on the surface
PEK_U19 Is able to explain, based on knowledge of standing waves, the physical principles generating acoustic waves by the sound source; can explain and determine: a) the frequency of the received wave depending on the traffic source and the receiver (the Doppler effect), b) the frequency beats
PEK_U20 Is able to apply the first law of thermodynamics to the quantitative and qualitative description of the ideal gas transformation and set values: heat mentioned with the environment, the work done on

the gas and the ideal gas, internal energy changes in these changes; knows how to graphically represent the ideal gas conversion, can justify / deduce the formula Mayer and put the adiabatic equation
PEK_U21 Is able to calculate, using the first and second law of thermodynamics, the value of: a) changes in the entropy of a thermodynamic system, in particular ideal gas has undergone a certain transformation thermodynamic b) the efficiency of machines / heat engines working in a series of straight or reverse c) describe quantitatively the thermal transfer
PEK_U22 Is able to: a) calculate the dependence of pressure from the height using the function of the Boltzmann distribution, b) provide statistical interpretation of entropy, c) derived using the distribution function Maxwell, depending on the speed of the most probable and the average speed of a square particle ideal gas of temperature, d) use equipartition principle of thermal energy, e) determine the microscopic interpretation of temperature and pressure ideal gas

III. Relating to social competences:
PEK_K01 - PEK_K01 search for information and its critical analysis,
PEK_K02 team cooperation on improving the methods for the selection of a strategy to optimally solving problems assigned to the group,
PEK_K03 understanding of the need for self-education, including improving the skills of attention and focus on important things, and develop the ability to independently apply their knowledge and skills,
PEK_K04 capacity building self-esteem and self-control and responsibility for the results of actions taken,
PEK_K05 compliance with the customs and rules in academia,
PEK_K06 independent and creative thinking,
PEK_K07 the impact of discoveries and achievements in physics from technical progress, society and the environment through openness and curiosity for knowledge relating to scientific achievements and advanced technologies,
PEK_K08 objectively examine the arguments of rational explanations and justifications own point of view, using the knowledge of physics.

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Organizational matters. The methodology of physics	2
Lec2	Organizational matters. The methodology of physics	2
Lec3	Kinematics. Newton 's laws	2
Lec4	Kinematics. Newton 's laws	2
Lec5	Work and mechanical energy. The principle of conservation of mechanical energy	1
Lec6	Work and mechanical energy. The principle of conservation of mechanical energy	2
Lec7	The dynamics of system of particles and rigid bodies. The principles of conservation of momentum and angular momentum	2
Lec8	The dynamics of system of particles and rigid bodies. The principles of conservation of momentum and angular momentum	2
Lec9	Gravitation	3
Lec10	Oscillatory motion and mechanical waves	2
Lec11	Oscillatory motion and mechanical waves	2
Lec12	Oscillatory motion and mechanical waves	2

Lec13	Phenomenological thermodynamics with elements of classical statistical physics	2
Lec14	Phenomenological thermodynamics with elements of classical statistical physics	2
Lec15	Phenomenological thermodynamics with elements of classical statistical physics	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Organizational matters. A solution for: dimensional analysis; estimating the value of physical quantities; vector calculus and differential-integral	2
Cl2	Application of the principles of Newton to solve the equations of motion; Depending on the time setting values of basic kinematic and dynamic still and moving relative to each other inertial and non-inertial reference systems	2
Cl3	Application of the principles of Newton to solve the equations of motion; Depending on the time setting values of basic kinematic and dynamic still and moving relative to each other inertial and non-inertial reference systems	2
Cl4	Solving selected issues of movement dynamics using concepts of mechanical work, kinetic and potential energy, theorem of work and energy and the principle of conservation of mechanical energy	2
Cl5	Solving selected issues of movement dynamics using concepts of mechanical work, kinetic and potential energy, theorem of work and energy and the principle of conservation of mechanical energy	2
Cl6	Quantitative and qualitative analysis tasks using the concept of center of mass, the law of conservation of momentum applied to the material points, the elastic collision and inelastic	2
Cl7	A solution for kinematics and dynamics of rigid body rotational motion around a fixed axis and the principle of conservation of angular momentum	2
Cl8	A solution for kinematics and dynamics of rigid body rotational motion around a fixed axis and the principle of conservation of angular momentum	2
Cl9	Quantitative and qualitative analysis of selected issues concerning the physics of gravitational field: a) determining the value of the gravitational force, intensity, potential, potential energy; b) motion of bodies in a gravitational field using the principles of behavior (energy orbital angular momentum) and Kepler's laws	2
Cl10	Analysis and problem solving dynamic range of oscillating motion: simple harmonic (various pendulums, particles executing small oscillations around a stable equilibrium position), damped, forced and mechanical resonance	2
Cl11	Solving physics mechanical and acoustic waves. Calculating the values of basic wave motion, energy transport by waves and wave interference	2
Cl12	Solving the physics of acoustic waves and relating to: the speed of sound in solids and fluids, pressure and force exerted by the acoustic wave, standing waves, Doppler, beat and sources of acoustic waves	2

Cl13	Solving problems using the principles of thermodynamics concerning: a) determining values: heat mentioned with the environment, the work done on the gas and the gas, subject to change internal energy in the transformation of ideal gas, b) a graphical representation of the transformations ideal gas, c) the efficiency of thermal machines, d) determining the entropy change of the ideal gas in the thermodynamic conversion, e) thermal conductivity	2
Cl14	Solving problems using the principles of thermodynamics concerning: a) determining values: heat mentioned with the environment, the work done on the gas and the gas, subject to change internal energy in the transformation of ideal gas, b) a graphical representation of the transformations ideal gas, c) the efficiency of thermal machines, d) determining the entropy change of the ideal gas in the thermodynamic conversion, e) thermal conductivity	2
Cl15	Solving problems using the principles of thermodynamics concerning: a) determining values: heat mentioned with the environment, the work done on the gas and the gas, subject to change internal energy in the transformation of ideal gas, b) a graphical representation of the transformations ideal gas, c) the efficiency of thermal machines, d) determining the entropy change of the ideal gas in the thermodynamic conversion, e) thermal conductivity	2
		Total hours: 30

TEACHING TOOLS USED

N1. ND_01 Traditional lecture using transparency and slides ND_02 Tutorials - discussion of solutions jobs ND_03 Tutorials - short 10 min. written tests ND_04 Teaching materials available on the website ND_05 Consultations ND_06 Self - preparation for exercise ND_07 Self - self-study and exam 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_W17;	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_U22 PEK_K03 - PEK_K07	Oral answers, discussions, written tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tom 1. i 2., Wydawnictwo Naukowe PWN, Warszawa 2003
2. J. Walker, Podstawy fizyki. Zbiór zadań, PWN, Warszawa 2005
3. I.W. Sawieliew, Wykłady z fizyki, tom 1 i 2, Wydawnictwa Naukowe PWN, Warszawa, 2003
4. K. Jezierski, B. Kołodka, K. Sierański, Zadania z rozwiązaniami, cz. 1., i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 1999-2003
5. W. Salejda, Fizyka a postęp cywilizacyjny, opracowanie dostępne w pliku do pobrania pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/fizyka_a_postep_cywilizacyjny.pdf
6. W. Salejda, Metodologia fizyki, opracowanie dostępne w pliku do pobrania pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/metodologia_fizyki.pdf

SECONDARY LITERATURE
1. J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1., WNT, Warszawa 2008
2. J. Orear, Fizyka, tom 1., WNT, Warszawa 2008
3. Z. Kleszczewski, Fizyka klasyczna, Wyd. Politechniki Śląskiej, Gliwice 2001
4. L. Jacak, Krótki wykład z fizyki ogólnej, Oficyna Wydawnicza PWr, Wrocław 2001; podręcznik dostępny na stronie Dolnośląskiej Biblioteki Cyfrowej
5. K. Sierański, K. Jezierski, B. Kołodka, Wzory i prawa z objaśnieniami, cz. 1. i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 2005;
6. K. Sierański, J. Szatkowski, Wzory i prawa z objaśnieniami, cz. 3., Oficyna Wydawnicza SCRIPTA, Wrocław 2008
7. W. Salejda, M.H. Tyc, Zbiór zadań z fizyki, Wrocław 2001, podręcznik internetowy dostępny pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/listamechanika.pdf
8. W. Salejda, R. Poprawski, J. Misiewicz, L. Jacak, Fizyka dla wyższych szkół technicznych, Wrocław 2001; dostępny jest obecnie rozdział Termodynamika pod adresem: http://www.if.pwr.wroc.pl/dokumenty/podreczniki_elektroniczne/termodynamika.pdf
9. Witryna dydaktyczna Instytutu Fizyki PWr; http://www.if.pwr.wroc.pl/index.php?menu=studia zawiera duży zbiór materiałów dydaktycznych
10. H.D. Young, R. A. Freedman, SEAR'S AND ZEMANSKY'S UNIVERSITY PHYSICS WITH MODERN PHYSICS, Addison-Wesley Publishing Company, wyd. 10, 2000; wyd. 12. z roku 2007; podgląd do wydania 12. z roku 2008
11. D. C. Giancoli, Physics Principles with Applications, 6th Ed., Addison-Wesley, 2005; Physics: Principles with Applications with MasteringPhysics, 6th Ed., Addison-Wesley 2009.
12.R R. A. Serway, Physics for Scientists and Engineers, 8th Ed., Brooks/Cole, Belmont 2009; Physics for Scientists and Engineers with Modern Physics, 8th Ed., Brooks/Cole, Belmont 2009
13. Paul A. Tipler, Gene Mosca, Physics for Scientists and Engineers, Extended Version, W. H. Freeman 2007

LITERATURA UZUPEŁNIAJĄCA W JĘZYKU ANGIELSKIM
[1] H.D. Young, R. A. Freedman, SEAR'S AND ZEMANSKY'S UNIVERSITY PHYSICS WITH MODERN PHYSICS, Addison-Wesley Publishing Company, wyd. 10, 2000; wyd. 12. z roku 2007; podgląd do wydania 12. z roku 2008.
[2] D.C.Giancoli, Physics Principles with Applications, 6th Ed., Addison-Wesley, 2005; Physics: Principles with Applications with MasteringPhysics, 6th Ed., Addison-Wesley 2009.
[3] R R. A. Serway, Physics for Scientists and Engineers, 8th Ed., Brooks/Cole, Belmont 2009; Physics for Scientists and Engineers with Modern Physics, 8th Ed., Brooks/Cole, Belmont 2009.
[4] Paul A. Tipler, Gene Mosca, Physics for Scientists and Engineers, Extended Version, W. H. Freeman 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Physics 1.2
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02 PEK_W03	K1MTR_W01	C1.1	Lec1,2	N1,N5,N7
PEK_W04, PEK_W05, PEK_W06, PEK_W07, PEK_W08, PEK_W09, PEK_W10, PEK_W11, PEK_W12, PEK_W13, PEK_W14	K1MTR_W02	C1.1, C1.2	Lec2,12	N1,N5,N7
PEK_W15, PEK_W16, PEK_W17	K1MTR_W02, K1MTR_W12	C1.3	Lec13,15	N1,N5,N7
PEK_U01, PEK_U02, PEK_U03, PEK_U04, PEK_U05, PEK_U06, PEK_U07, PEK_U08, PEK_U09, PEK_U10, PEK_U11, PEK_U12, PEK_U13, PEK_U14, PEK_U15, PEK_U16, PEK_U17, PEK_U18, PEK_U19,	K1MTR_U01, K1MTR_U02, K1MTR_U24	C2.1, C2.2, C2.3	Cl1,2	N2,N3, N4,N5, N6,N7
PEK_U20, PEK_U21, PEK_U22	K1MTR_U12, K1MTR_U24	C2.1	Cl13,14,15	N2,N3, N4,N5, N6,N7
PEK_K01 PEK_K08	K1MTR_K01, K1MTR_K02, K1MTR_K07, K1MTR_K12	C3	Lec1,5 Cl1,15	N1,N7

SUBJECT SUPERVISOR

Jan Masajada email: jan.masajada@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fizyka 2.8**
Name in English: **Physics 2.8**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **FZP003002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	2.0		2.0		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Competence in the field of mathematical analysis, algebra and physics in terms of the course Physics 1

SUBJECT OBJECTIVES

C1. The acquisition of basic knowledge, taking into account aspects of applications, from the following sections classical electrodynamics: electrostatics, electric current, magnetostatics, electromagnetic induction
C2. The acquisition of basic knowledge, taking into account aspects of applications, from the following sections of modern physics: special relativity, quantum physics, physics of the atomic nucleus
C3. Learning basic techniques and methods of measurement of selected physical quantities
C4. Acquiring skills: planning and execution experience in the Laboratory of Physics (LPF) consisting of the experimental verification of selected laws / rules of physics and measurement of physical quantities, the development of measurement results, estimation of measurement uncertainty, develop a written report from the measurements using utility software
C5. Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students with a view to effective problem solving, responsibility, honesty and fairness in the proceedings; observance force in academia and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - PEK_W01 Has a basic knowledge of classical electrodynamics (electrostatics, electricity, magnetostatics,
electromagnetic induction, electromagnetic waves, optics), selected elements of modern physics (special theory of relativity, quantum physics, physics: atom, atomic nucleus, elementary particles) and astrophysics. He knows and understands the importance of discoveries and achievements of classical electrodynamics and modern physics for technical sciences and the progress of civilization
PEK_W02 Knows the methods of analysis of vector fields
PEK_W03 Has knowledge of electrostatics and its applications; knows and understands: Basic physical size of the vector and scalar associated with static electricity (current and potential field, the principle of superposition, the quantization of charge, charge conservation electric) charge point, discrete system of charges) Gauss' law; has detailed knowledge of: a) flow field intensity vector and the conservative nature of the field, b) electrostatic potential energy of cargo and the cargo c) field dipole electric potential energy of the dipole and torque acting on the dipole placed in an external field, d) conductor located in the field (field shielding effect), e) the dielectric polarization, f) capacitance and capacitor applications
PEK_W04 Has knowledge of physics DC and its uses, in particular knows and understands a) the concept of voltage and current density vector electrical resistance / electrical conductivity / competent, SEM, work, power, electrical current and heat Joule, b) physical electrical conduction mechanisms, c) Ohm's law (in the form of differential and integral) and Kirchhoff's law, d) the principles of quantitative analysis of simple electric circuits
PEK_W05 Has knowledge of magnetostatics and its uses, knows and understands: a) the term of the magnetic field vector magnetic induction and field intensity, b) the concept of the Lorentz force and its impact on the movement of electric charges in a magnetic field, c) the law of Gauss for the magnetic field d) the physical principles of operation: a cyclotron particle speed selector, mass spectrometer, e) the magnetic field guide and frame with the flow
PEK_W06 Has knowledge about. Electromagnetic induction and its applications; know and understand: a) the concept of magnetic flux, b) Faraday's law and Lenz's law, c) inductance self-inductance
PEK_W07 Knows and understands the concept of displacement current and the physical meaning of Maxwell's equations (in the form of integral and differential)
PEK_W08 Has a basic knowledge of electromagnetic waves and their applications
PEK_W09 Has a basic knowledge of the special theory of relativity and its applications
PEK_W10 Has the knowledge of the foundations of quantum physics and its selected applications; has detailed knowledge of: a) the rights of blackbody radiation, thermal radiation of bodies and its applications, b) the Bohr model of the atom of hydrogen (quantization of energy and angular momentum of an electron), and the quantum energy levels of electrons in atoms c) of the photoelectric and Compton, d) corpuscular-wave duality of light and elementary particles (hypothesis de Broglie waves of matter), e) Heisenberg's uncertainty principle, f) of the Schrödinger equation (temporal and timeless), g) a prohibition Pauli h) spatial quantization of the orbital angular momentum and magnetic moment of electrons in an atom
PEK_W11 Has knowledge of the basic physics of the atomic nucleus and its applications, in particular know the quantities characterizing the nucleus, its isotopes and nuclear forces, have knowledge of: a) the binding energy of nucleons and its importance for nuclear power (fusion of heavy nuclei / isotopes), fusion of light nuclei, stability of heavy nuclei, b) the radioactivity of natural / artificial c) the types of radioactive decay, d) the law of radioactive decay e) radioisotope dating methods, f) nuclear reactions, g) nuclear h) the biological effects of radiation
PEK_W12 Knows the safety rules in force in the Laboratory of Physics
PEK_W13 Knows the methods to perform simple and complex measurements of physical quantities
PEK_W14 Knows the methods of processing the results of measurements and uncertainty estimation of simple and complex measurements

II. Relating to skills:

PEK_U01 - PEK_U01 Is able to: a) independently written or oral expression correctly and succinctly present the issues
discussed in the lectures that are the content of these learning outcomes in the field of knowledge (PEK_W01-PEK_W14), b) use the transferred and described above knowledge to the analysis of selected aspects of engineering and experiment planning, measurement of physical quantities, the development of the results of measurements in the form of a report or presentation and the estimation of measurement uncertainty with the use of computer tools (word processing, office software, computing environments). Is able to: a) identify and justify discoveries and achievements of classical electrodynamics and modern physics, which contributed to the progress of civilization
PEK_U02 Is able to apply knowledge of electrostatics to) the qualitative and quantitative characteristics of the electrostatic field, the source of which there are loads and loads of point systems, in particular, has the skills to determining, based on Gauss' law, electrostatic field strengths of selected distributions of cargo;) Measurements in the Laboratory of Physics (LPF) and the development of measurement results in the form of a written report
PEK_U03 Is able to apply knowledge of physics DC to: a) quantitative characteristics of the current (amperage electric current density vector) in a simple electrical circuits, b) the designation of work, power, electrical current and heat Joule c) determining the resistance of the battery resistors, d) measurement in the LPF and the development of measurement results in a written report. Can explain the physical mechanisms of electrical conductivity and justify the utility nature of electric current, which is to transport electricity
PEK_U04 Is able to identify the source of the magnetic field and apply knowledge of magnetostatics to: a) the qualitative and quantitative characteristics of the magnetic field (determination of vectors of magnetic induction and intensity) originating from different sources (straight and circular guide with the current, coil toroid), b) motion electric charges in the magnetic field and the determination of the force acting on the conductor in a magnetic field
PEK_U05 Has skills to apply the knowledge in the field of electromagnetic induction to: a) the qualitative and quantitative performance characteristics of generators AC and DC, including the determination of the value generated SEM, b) explain the phenomenon of self-induction
PEK_U06 Is able to correctly explain the physical meaning of Maxwell's equations (in the integral form). Moreover unable to correctly define the equations used in physical size and to determine their unit of measure
PEK_U07 Is able to apply knowledge of the foundations of quantum physics to the quantitative interpretation of selected phenomena and physical effects of the microworld, phenomena and effects that occur over distances of the order of nanometers and smaller; in particular, can: a) show, using the appropriate accounts, quantization of energy in the Bohr model of the atom of hydrogen, b) justified, based on experimental facts, corpuscular nature of light, c) to justify the inadequacy of the use of classical physics to describe the phenomena of the microworld and explain the probabilistic nature quantum phenomena d) apply knowledge of basic physics of quantum measurements performed in the LPF selected physical quantities and to develop measurement results in the form of a written statement / report
PEK_U08 Is able to: a) explain, based on the concept of binding energy of nucleons, the physical principles of energy production in nuclear reactors and tokamaks - devices to carry out controlled thermonuclear fusion b) identify and characterize the positive and negative aspects of nuclear power, c) characterize the types of decays of radioactive d) describe the use of radioactivity, biological effects of radiation, e) describe light nuclei fusion reactions occurring inside the Sun
PEK_U09 Is able to use simple measuring instruments for the measurement of physical quantities
PEK_U10 Is able to perform simple and complex measurements of physical quantities using manual measuring station
PEK_U11 Is able to carry out the measurements, analyze uncertainties and edit report / report of measurements on the LPF using computer tools (word processing, office software, computing environments)

III. Relating to social competences:

PEK_K01 - PEK_K01 search for information and its critical analysis,
PEK_K02 team cooperation on improving the methods for the selection of a strategy to optimally solving problems assigned to the group,
PEK_K03 understanding of the need for self-education, including improving the skills of attention and focus on important things, and develop the ability to independently apply their knowledge and skills,
PEK_K04 capacity building self-esteem and self-control and responsibility for the results of actions taken,
PEK_K05 compliance with the customs and rules in academia,
PEK_K06 independent and creative thinking,
PEK_K07 the impact of discoveries and achievements in physics from technical progress, society and the environment through openness and curiosity for knowledge relating to scientific achievements and advanced technologies,
PEK_K08 objectively examine the arguments of rational explanations and justifications own point of view, using the knowledge of physics.

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Mathematical analysis of vector fields, electrostatics	3
Lec2	The electric current and magnetic field	3
Lec3	Electrostatic induction. Maxwell's equations	2
Lec4	Elements of special theory of relativity	2
Lec5	Quantum physics	3
Lec6	Elements of nuclear physics	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Lab Introduction to LPF: issues of organization and conduct of classes, to familiarize students with: a) the safety rules for measurements (short health and safety training), b) how to prepare writing reports, c) the basics of the measurement uncertainty analysis. Carrying out simple measurements	2
Lab2	Making measurements using analog and digital gauges. Statistical processing of simple and complex results of measurements , estimation of measurement uncertainty, graphical presentation of the results of measurements and measurement uncertainty, the development of the report	2
Lab3	Making measurements of selected physical quantities, developing reports	2
Lab4	Making measurements of selected physical quantities, developing reports	2
Lab5	Making measurements of selected physical quantities, developing reports	2
Lab6	Making measurements of selected physical quantities, developing reports	2
Lab7	Making measurements of selected physical quantities, developing reports	2
Lab8	Supplementary classes, crediting, repetitory	1
		Total hours: 15

TEACHING TOOLS USED
N1. ND_01 Using traditional lecture, slides, demonstrations and presentations rights / phenomena ND_01 Self - preparation for laboratory exercises ND_02 Laboratory - discussion of ways to do measurements, analysis of results and the estimation of measurement uncertainty, evaluation reports / reports ND_03 Laboratory - a few minutes prior written tests measurements ND_04 Self - independent measurements ND_05 Self - self-study and exam preparation ND_06 Consultations

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W14	Oral and 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_U11, PEK_K01 - PEK_K08	Oral response, discussions, quizzes and reports for each class
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tomy 1-5, Wydawnictwo Naukowe PWN, Warszawa 2003
2. J. Walker, Podstawy fizyki. Zbiór zadań, PWN, Warszawa 2005
3. I.W. Sawieliew, Wykłady z fizyki, tom 1 i 2, Wydawnictwa Naukowe PWN, Warszawa, 2003
4. R. Poprawski, W. Salejda, Ćwiczenia laboratoryjne z fizyki, Cz. I-IV, Oficyna Wydawnicza PWr; wersja elektroniczna 5. wydania cz. 1. dostępna po kliknięciu nazwy Zasady opracowania wyników pomiarów z witryny Dolnośląskiej Biblioteki Cyfrowej; wersje elektroniczne pozostałych części podręcznika dostępne na stronie internetowej LPF pod adresem http://www.if.pwr.wroc.pl/LPF , gdzie znajdują się: regulamin LPF i regulamin BHP, spis ćwiczeń, opisy ćwiczeń, instrukcje robocze, przykładowe sprawozdania i pomoce dydaktycznych
5. W. Salejda, Fizyka a postęp cywilizacyjny, opracowanie dostępne w pliku do pobrania pod adresem http://www.if.pwr.wroc.pl/dokumenty/jkf/fizyka_a_postep_cywilizacyjny.pdf

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Physics 2.8
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02 PEK_W03, PEK_W04, PEK_W05, PEK_W06, PEK_W07, PEK_W08	K1MTR_W01, K1MTR_W02, K1MTR_W13, K1MTR_W25	C1		N1, N6, N7
PEK_W01, PEK_W09, PEK_W10, PEK_W11 PEK_W12, PEK_W13, PEK_W14	K1MTR_W02, K1MTR_W07, K1MTR_W14, K1MTR_W25	C2		N1, N6, N7
PEK_U01 - PEK_U11	K1MTR_U01, K1MTR_U24, K1MTR_U25	C3 – C5		N1-N7
PEK_K01 - PEK_K08	K1MTR_K02, K1MTR_K11	C5		N1-N7

SUBJECT SUPERVISOR

Jan Masajada email: jan.masajada@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Blok humanistyczny: FILOZOFICZNO - ETYCZNY**
Name in English:
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **HMH100035BK.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		2
		Total hours: 2

TEACHING TOOLS USED

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

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE
SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechatronics**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W25			
PEK_K01	K1MTR_K02, K1MTR_K07			

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Blok humanistyczny: OCHRONA WŁASNOŚCI**
Name in English:
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **HMH100035BK.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15				
Number of hours of total student workload (CNPS)	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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		2
		Total hours: 2

TEACHING TOOLS USED

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W05			
PEK_K01	K1MTR_K09			

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Blok humanistyczny: AUTOPREZENTACJA**
Name in English:
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **HMH100035BK.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		2
		Total hours: 2

TEACHING TOOLS USED

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	wg kart opracowanych przez SNH	
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U25			
PEK_K01	K1MTR_K15			

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYKI OBCE**
Name in English: **Block of Foreign Languages**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **JZL100400BK.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K1MTR_U06	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.
PEK_K1	K1MTR_K01	wg kart przygotowanych przez SJO.		wg kart przygotowanych przez SJO.

SUBJECT SUPERVISOR

dr hab. inż. Jacek Reiner tel.: 29-81 email: jacek.reiner@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Algebra z geometrią analityczną**
Name in English: **Algebra and Analytic Geometry**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MAT001402**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1.5	1.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is recommended to know the basic algebraic operations on rational and real numbers, and knowledge of basic geometric figures and shapes

SUBJECT OBJECTIVES

C1. Understanding the basic properties of complex numbers
C2. Learning basic algebraic properties of polynomials
C3. Mastering the concept of a vector, a vector space and the base of a linear space
C4. Learning how to calculate the distance between the points in the space Rn, how to determine the equations of lines and planes and understanding the concept of conic sections
C5. Mastering the concepts of matrices, matrix operations, and learn the methods of solving systems of linear equations

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - PEK_W01 Knows basic properties of complex numbers
PEK_W02 Knows basic algebraic properties of polynomials
PEK_W03 Knows basic concepts of theory of linear spaces and methods of description of lines, planes and conic sections
PEK_W04 Knows basic methods of solving systems of linear equations

II. Relating to skills:
PEK_U01 - PEK_U01 Can carry out calculations with complex numbers
PEK_U02 Can add, multiply and divide polynomials
PEK_U03 Can find the equations of planes and lines in three dimensional space
PEK_U04 Can add and multiply matrices and calculate determinants
PEK_U05 Can solve systems of linear equations

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Natural, rational and real numbers. Mathematical induction. Newton's binomial formula	2
Lec2	Complex numbers. Basic operations, modulus, complex conjugate	2
Lec3	Polar form of complex number. Multiplication, division and exponentiation in polar form. Roots of complex numbers. The notion of algebraic field	2
Lec4	Polynomials. Addition and multiplication of polynomials. Roots of polynomial. Polynomial remainder theorem. Fundamental theorem of algebra	2
Lec5	The decomposition of a polynomial with real coefficients into product of linear and quadratic factors. Rational functions. Real simple rational factors. Decomposition of the functions into rational simple factors	2
Lec6	Vectors in the space Rn. Addition and multiplication by scalars. Distance between points. Scalar product. Length of vector. Cauchy–Schwarz inequality. The angle between vectors	2
Lec7	Analytic geometry of the plane. Straight line formulas (normal parametric and directional form). Distance of a point from a line. The angle between lines	2
Lec8	Analytic geometry of the space R3. Equations for lines and planes. Distance between point and a plane. Intersection of planes	2
Lec9	Linear combinations of vectors. Linearly independent vectors. The base of a space. Linear mappings. Matrix representation of linear mappings	3
Lec10	Addition and multiplication of matrices and its correlation with operations on linear mappings. Example of matrices	2

Lec11	Permutations and its sign. Definition of determinant and methods of calculation of determinant Algebraic complement of an element of a matrix. Laplace’ formula for determinant. Determinant and volume	2
Lec12	Inverse matrix. Systems od linear equations. Cramer’s formulas. Examples. Homogeneous and non-homogeneous systems	3
Lec13	Properties of linear mappings (kernel, image, rank). Rouché –Capelli theorem. Gaussian elimination	2
Lec14	Eigenvalues and eigenvectors	2
Lec15	Conic sections	2
		Total hours: 32
Form of classes – Classes		Number of hours
Cl1	Real and complex numbers	2
Cl2	Polynomials	2
Cl3	Geometry of the plane	2
Cl4	Geometry of the space R3	2
Cl5	Basis and linear mappings	2
Cl6	Matrices and determinants	2
Cl7	Systems of linear equations	2
Cl8	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. Lecture - traditional method
N2. Classes - traditional method
N3. Student’s self-work with the assistance of mathematical packages

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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_W04	Exam or e-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_U05	Oral answers, quizzes, written tests and/or e-test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. A. Białynicki-Birula, Algebra Liniowa z Geometrią, PWN 1976
2. F. Leja, Geometria analityczna, PWN, Warszawa 1972
3. A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963
4. G. Banaszak, W. Gajda, Elementy algebry liniowej, część I, WNT, Warszawa 2000

SECONDARY LITERATURE

1. G. Farin, D. Hansford, Practical Linear Algebra: A Geometry Toolbox 2004, AK Peters, 2005
2. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2011
3. T. Jurlewicz, Z. Skoczylas, Algebra liniowa. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2005
4. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna.. Definicje, twierdzenia i wzory. Oficyna Wydawnicza GiS, Wrocław 2011
5. T. Jurlewicz, Z. Skoczylas, Algebra liniowa. Definicje, twierdzenia i wzory. Oficyna Wydawnicza GiS, Wrocław 2005
6. E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993
7. W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Algebra and Analytic Geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W04	K1MTR_W01	C1-C5	Lec1-Lec15	N1-N3
PEK_U01-PEK_U05	K1MTR_U01	C1-C5	Cl1-Cl6	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza matematyczna 1.1 A**
Name in English: **Mathematical Analysis 1A**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
Subject code: **MAT001412**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It is recommended that the knowledge of mathematics is equivalent to secondary school certificate at the advanced level.

SUBJECT OBJECTIVES

C1. Understanding the basic methods of analysis of the graph of functions of one variable
C2. Understanding the concept of definite integral and its basic properties and methods of determination
C3. Understanding the practical applications of mathematical methods for the analysis of functions of one variable

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic definitions and theorem from Mathematical Analysis of functions of one variable
PEK_W02 - Knows the notion of definite integral and its basic applications

II. Relating to skills:
PEK_U01 - Can examine graphs of simple functions
PEK_U02 - Can calculate integrals of simple functions

III. Relating to social competences:
PEK_K01 - Understand how calculus affects the development of technical civilization

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Understand how calculus affects the development of technical civilization	2
Lec2	Basic properties of functions (injective and monotonic functions). Composition of functions. The inverse function. Power and exponential functions, and opposite to them. Properties of logarithms	2
Lec3	Trigonometric functions and their inverses. Graphs of trigonometric and of its inverses	2
Lec4	Sequences and limits. Basic formulas and theorems. Number e. Improper limits	2
Lec5	The limit of a function in a point. Directional limits of function. Asymptotics of function	2
Lec6	Continuity of a function in a point and on the interval. Basic properties of continuous functions. Approximate solutions of equations. Points of discontinuity	3
Lec7	The definition of derivative. Basic formulas and theorems. Geometric and physics interpretations. Mean value theorem. De L'Hospital rule	2
Lec8	Extreme values, monotonicity. Higher order derivatives. Convexity of function	2
Lec9	Examination of the graph of a function.	2
Lec10	Taylor formula. Approximation of function. Applications	2
Lec11	Definite integral. Simple examples. Connection between integral and derivative (Fundamental Theorem of Calculus). Simple examples	2
Lec12	Indefinite integral: basic formulas. Areas of simple figures	2
Lec13	The basic methods of calculus of integrals: integration by parts and by substitution	2
Lec14	The basic methods of calculus of integrals: simple rational functions. Area and perimeter of a circle. The volume of rotary figures	2
Lec15	Application of methods of mathematical analysis of one variable functions	2
		Total hours: 31

Form of classes – Classes		Number of hours
Cl1	Tautologies, de Morgan laws, union, intersection and complement of set	2
Cl2	Natural numbers, integers, rational and real numbers. Logarithm	2
Cl3	Graphs of simple functions. Inverse function. Composition of functions	2
Cl4	Trigonometric functions and trigonometric identities	2
Cl5	Limit of sequences	2
Cl6	The limit of a function in poin	2
Cl7	Continuous functions	2
Cl8	Points of discontinuity. Solutions of equations	2
Cl9	Derivatives. Tangent line to a graph of a function	2
Cl10	Examination of graphs of functions - I	2
Cl11	Examination of graphs of functions - II	2
Cl12	Taylor formula. De L'Hospital rule	2
Cl13	Integration - I	2
Cl14	Integration - II	2
Cl15	Integration - applications	2
		Total hours: 30

TEACHING TOOLS USED
N1. Lecture - traditional method N2. Classes - traditional method N3. Student's self-work with the assistance of mathematical packages

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W02	Exam or e-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_K01	Oral answers, quizzes, written tests and/or e-tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012
2. W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. I, PWN, Warszawa 2006

SECONDARY LITERATURE
1. K. Kuratowski, Rachunek Różniczkowy i Całkowy. Funkcje Jednej Zmiennej, Wydawnictwo Naukowe PWN, 2012
2. G. M. Fichtenholz, Rachunek Różniczkowy i Całkowy, T. I-II, PWN, Warszawa 2007
3. M. Gewert, Z. Skoczylas, Analiza Matematyczna 1. Przykłady i Zadania, Oficyna Wydawnicza GiS, Wrocław 2011

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mathematical Analysis 1A
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K1MTR_W01	C1-C3	Lec1-Lec15	N1-N3
PEK_U01-PEK_U02	K1MTR_U01	C1-C3	Cl1-Cl15	N2-N3
PEK_K01	K1MTR_K01	C1-C3	Cl6,7	N2-N3

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza matematyczna 2.1 A**
Name in English: **Mathematical Analysis 2.1 A**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
Subject code: **MAT001422**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	30			
Number of hours of total student workload (CNPS)	120	90			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	4	3			
including number of ECTS points for practical (P) classes		3			
including number of ECTS points for direct teacher-student contact (BK) classes	3.0	2.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1. Can explore convergence of sequences and calculate the limits of functions of one variable
2. Knows the calculus of functions of one variable and its applications
3. Knows and can use the indefinite integral functions of one variable
4. Knows the basic concepts of linear algebra

SUBJECT OBJECTIVES

C1. Knowing the structure and properties of the definite integral. Acquiring skills in the use of the definite integral (including inappropriate) for engineering calculations
C2. Understanding the basic concepts of differential and integral calculus of several variables
C3. Mastery of basic knowledge about numerical series and power series
C4. Application of acquired knowledge to develop and analyze mathematical models to solve theoretical and practical issues in various fields of science and technology

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the structure of the definite integral and its properties, knows the concept of the integral wrong
PEK_W02 - Knows the basics of differential and integral calculus of several variables
PEK_W03 - Has a basic knowledge of the theory of series and power series, knows the convergence criteria

II. Relating to skills:
PEK_U01 - He can calculate and interpret the definite integral, is able to solve engineering problems using integrals
PEK_U02 - He can calculate partial derivatives, directional and gradient function of several variables and interpret the values, is able to solve tasks of optimization for the function of many variables
PEK_U03 - He can calculate and interpret the multiple integral, is able to solve engineering problems using double and triple integrals
PEK_U04 He can develop functions in power series, knows how to use received results for estimated calculations

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mathematical notations (logical connectives, quantifiers), elements of set theory, real numbers, subsets of real numbers (intervals, half-lines). Linear and quadratic functions	2
Lec2	Basic properties of functions (injective and monotonic functions). Composition of functions. The inverse function. Power and exponential functions, and opposite to them. Properties of logarithms	3
Lec3	Trigonometric functions and their inverses. Graphs of trigonometric and of its inverses	2
Lec4	Sequences and limits. Basic formulas and theorems. Number e. Improper limits	2
Lec5	The limit of a function in a point. Directional limits of function. Asymptotics of function	2
Lec6	Continuity of a function in a point and on the interval. Basic properties of continuous functions. Approximate solutions of equations. Points of discontinuity	2
Lec7	The definition of derivative. Basic formulas and theorems. Geometric and physics interpretations. Mean value theorem. De L'Hospital rule	3
Lec8	Extreme values, monotonicity. Higher order derivatives. Convexity of function	2
Lec9	Examination of the graph of a function.	2
Lec10	Taylor formula. Approximation of function. Applications	2

Lec11	Definite integral. Simple examples. Connection between integral and derivative (Fundamental Theorem of Calculus). Simple examples	2
Lec12	Indefinite integral: basic formulas. Areas of simple figures	4
Lec13	The basic methods of calculus of integrals: integration by parts and by substitution	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Tautologies, de Morgan laws, union, intersection and complement of set	5
Cl2	Natural numbers, integers, rational and real numbers. Logarithm	4
Cl3	Graphs of simple functions. Inverse function. Composition of functions	3
Cl4	Trigonometric functions and trigonometric identities	4
Cl5	Limit of sequences	8
Cl6	The limit of a function in point	4
Cl7	Continuous functions	2
		Total hours: 30

TEACHING TOOLS USED

N1. Lecture - traditional method
N2. Classes - traditional method
N3. tutorials
N4. Student's self-work – preparation to classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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 or e-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_U04	Oral answers, quizzes, written tests and/or e-tests

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] W. Żakowski, W. Kołodziej, Matematyka, Cz. II, WNT, Warszawa 2003.
[2] W. Żakowski, W. Leksiński, Matematyka, Cz. IV, WNT, Warszawa 2002.
[3] M. Gewert, Z. Skoczylas, Analiza matematyczna 2. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2012.
[4] M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne. Teoria, przykłady, zadania, Oficyna Wydawnicza GiS, Wrocław 2011.
[5] W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I-II, PWN, Warszawa 2006.

SECONDARY LITERATURE

[1] G. M. Fichtenholz, Rachunek różniczkowy i całkowy, T. I-II, PWN, Warszawa 2007.
[2] M. Gewert, Z. Skoczylas, Analiza matematyczna 2, Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2012.
[3] F. Leja, Rachunek różniczkowy i całkowy ze wstępem do równań różniczkowych, PWN, Warszawa 2008.
[4] R. Leitner, Zarys matematyki wyższej dla studiów technicznych, Cz. 1-2, WNT, Warszawa 2006.
[5] H. i J. Musielakowie, Analiza matematyczna, T. I, Cz. 1-2 oraz T. II, Cz. 1, Wydawnictwo Naukowe UAM, Poznań 1993 oraz 2000.
[6] J. Pietraszko, Matematyka. Teoria, przykłady, zadania, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000.
[7] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. B, PWN, Warszawa 2003.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mathematical Analysis 2.1 A
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C4	Lec1-Lec3	N1, N3, N4
PEK_W02	K1MTR_W01	C2, C4	Lec4-Lec11	N1, N3, N4
PEK_W03	K1MTR_W01	C3, C4	Lec12-Lec13	N1, N3, N4
PEK_U01	K1MTR_U01	C1, C4	Cl1	N2, N3, N4
PEK_U02	K1MTR_U01	C2, C4	Cl2-Cl4	N2, N3, N4
PEK_U03	K1MTR_U01	C2, C4	Cl5	N2, N3, N4

PEK_U04	K1MTR_U01	C3, C4	Cl6	N2, N3, N4

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe zwyczajne**
Name in English: **Ordinary Differential Equations**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MAT001452**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	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	1.0	1.0			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 1. Knows the calculus of functions of one and several variables
2. Knows and knows how to use indefinite and definite integrals of functions of one variable
2. 3. Understands basic concepts of numerical series and a power and knows how to explore the convergence of series
4. Can use in the calculation of complex numbers
3. 5. Knows the basic concepts of linear algebra

SUBJECT OBJECTIVES

C1. Understanding the basic types of ordinary differential equations and methods of solving them
C2. Acquisition of stacking skills of differential equations to describe simple models in physics and engineering
C3. Mastering the Laplace operators methods for solving equations and systems of differential equations
C4. Knowledge of basic methods for testing the stability of systems of differential equations

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the most important types of differential equations and methods of solving
PEK_W02 - Knows the method for solving systems of linear equations with constant coefficients
PEK_W03 - Knows the Laplace operator method of solving differential equations

II. Relating to skills:
PEK_U01 - Can arrange and solve a differential equation describing simple physical models
PEK_U02 - Can solve basic types of differential equations
PEK_U03 - Can solve differential equations with constant coefficients

III. Relating to social competences:
PEK_K01 - Is able to search for and use of literature recommended for the course and independently acquire knowledge

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Ordinary differential equations of the first order. Problems leading to differential equations. Differential equations with separated variables. Linear ordinary differential equations of the first order	2
Lec2	Examples of issues that lead to differential equations of the second order. Preliminary notions for linear ordinary differential equations of the second order	1
Lec3	Linear ordinary differential equations second order homogeneous. Lowering the order linear differential equation of second order	2
Lec4	Linear ordinary differential equations second order inhomogeneous. Method of variation of parameters	2
Lec5	Linear ordinary differential equations of the second order with constant coefficients. Method of undetermined coefficients	2
Lec6	Preliminary notions for systems of ordinary differential equations. Homogeneous systems of linear ordinary differential equations	2
Lec7	Systems of linear ordinary differential equations with constant coefficients (simple eigenvalues)	2
Lec8	Applications of Laplace transform to solve initial value problems for linear ordinary differential equations with constant coefficients	2
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Construction of differential equations describing the simple physical issues. Solving differential equations with separated variables. Finding solutions to problems early	1
Cl2	Construction and solving differential equations of the first order	2
Cl3	Construction and solving differential equations of the second order, and initial value problems for such equations	2

Cl4	Solving linear ordinary differential equations of the second order non-homogeneous method of variation of parameters	2
Cl5	Solving linear ordinary differential equations of the second order with constant coefficients method of undetermined coefficients.	2
Cl6	Solving homogeneous systems of linear ordinary differential equations	2
Cl7	Solving linear systems of ordinary differential equations with constant coefficients of individual eigenvalue	2
Cl8	Solve initial value problems for linear ordinary differential equations with constant coefficients by Laplace Transformation	2
		Total hours: 15

TEACHING TOOLS USED

N1. Lecture - traditional method
N2. Classes - traditional method
N3. tutorials
N4. Student’s self-work – preparation to classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-W03	Exam or lecture assessment
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-U03 PEK_K01	Classes assessment
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] M. Gewert, Z. Skoczylas, Równania różniczkowe zwyczajne. Teoria, przykłady, zadania, Oficyna Wydawnicza GiS, Wrocław 2007.

SECONDARY LITERATURE

[1] J. Muszyński, A. D. Myszkis, Równania różniczkowe zwyczajne, PWN, Warszawa 1984.
[2] M.M. Matwiejew, Zadania z równań różniczkowych zwyczajnych, PWN, Warszawa 1976.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ordinary Differential Equations
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C2	Lec1-Lec9	N1, N2, N3, N4
PEK_W02	K1MTR_W01	C3	Lec10-Lec13	N1, N2, N3, N4
PEK_W03	K1MTR_W01	C4	Lec14-Lec15	N1, N2, N3, N4
PEK_U01	K1MTR_U01	C1, C2	Cl1-Cl8	N1, N2, N3, N4
PEK_U02	K1MTR_U01	C3	Cl1-Cl8	N1, N2, N3, N4
PEK_U03	K1MTR_U01	C4	Cl1-Cl8	N1, N2, N3, N4
PEK_K01	K1MTR_K01	C1 - C4	Cl1-Cl8	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia**
Name in English: **Chemistry**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD031001**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of chemistry at the high school level
2. Knowledge of mathematics at the high school level
3. Knowledge of physics at the high school level

SUBJECT OBJECTIVES

C1. To familiarize students with the basic general chemistry issues in the field of study, especially,the atom and molecule structure , crystallography.
C2. To familiarize students with the kinetics of chemical reactions and factors which have influence on the rate and the direction of chemical reaction
C3. To familiarize students with the chemistry and electrochemistry of metals including the chemical and electrochemical corrosion.
C4. To familiarize students with the essential elements of organic chemistry, the division of organic compounds and polymer chemistry.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Has the knowledge in the field of the basic chemistry, especially, in the subject of crystallography and physicochemical properties of inorganic and organic materials, including the relationship between their properties and structure, from the point of view of the widely understood engineering materials.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts and laws of the chemistry	2
Lec2	The atomic structure, the periodic table	2
Lec3	The molecule structure	2
Lec4	States of matter and their properties	2
Lec5	The elements of crystallography	2
Lec6	Chemical reactions and kinetics	2
Lec7	Chemical equilibrium	2
Lec8	The chemistry of solutions	2
Lec9	Electrochemistry	2
Lec10	Chemistry of metals	2
Lec11	Corrosion of metals	2
Lec12	Chemistry of non-metals	2
Lec13	Introduction to organic chemistry	2
Lec14	Elements of polymer chemistry	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of computer slides
N2. tutorials
N3. problem discussion
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	Discussion Final test
P = P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] I. Barycka, K. Skudlarski, Podstawy chemii, Oficyna Wydawnicza Politechniki Wrocławskiej , 2001.
[2] Praca zbiorowa pod redakcją Jacka Banasia i Wojciecha Stolarskiego, Chemia dla inżynierów, AGH, Kraków 2008.

SECONDARY LITERATURE
[1] L. Pauling, P. Pauling, Chemia, WNT 1997.
[2] F. A. Otton, G. Wilkinson, P.L. Gaus, Chemia nieorganiczna, WNT 1995.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07	C1-C4	Wy1-Wy14	N1-N4

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy i układy elektroniczne**
Name in English: **Electronic Components and Circuits**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD032001**
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 physics - Electricity and Magnetism

SUBJECT OBJECTIVES

C1. To learn basic physical properties and operation of semiconductor devices
C2. To learn parameters and characteristics of electronic components
C3. To learn how to choose proper electronic device for circuit design
C4. To gain ability to define priorities in engineering tasks
C5. To provide background in scientific research competence in the areas of micro- and nanoelectronics and passive and active electronic components

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Understands basic physics of semiconductors, operation of semiconductor devices and their applications

PEK_W02 - The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic electric circuit laws. R, L, C components	2
Lec2	Properties of semiconductors. Energy band model	2
Lec3	Influence of temperature, light and magnetic field on semiconductors	2
Lec4	The p-n junction. Types of diodes and applications	2
Lec5	Rectifying and voltage regulator circuits	2
Lec6	Bipolar transistor: principle of operation, dc bias	2
Lec7	Midterm test	2
Lec8	Bipolar transistor characteristics and parameters. Equivalent circuits	2
Lec9	Transistor amplifier circuits	2
Lec10	Field effect transistors - JFET, MESFET, MOSFET	2
Lec11	Switching devices: thyristors, triacs, IGBT	2
Lec12	Optoelectronic components	2
Lec13	Introduction to analog ICs, OP-AMP applications	2
Lec14	Digital TTL and CMOS circuits	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

N1. Lecture with slide presentation and discussion
N2. tutorials
N3. Individual study with lecture material
N4. Student work - preparation to the class tests

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. A. Świt, J. Pułtorak, Przyrządy półprzewodnikowe, WNT, 1988
2. B. Boratyński, Notatki z wykładu, kopie (pliki .pdf) materiałów wykładowcy, 2011
3. W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, 1984

SECONDARY LITERATURE
1. A. Guziński, Liniowe elektroniczne układy analogowe, WNT, 1983
2. G. Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronic Components and Circuits
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W14, K1MTR_W29	C1-C2	Lec1-Lec14	N1, N2, N3, N4

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy informatyki**
Name in English: **Fundamentals of Computer Science**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD032101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		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 the course material: Information technology

SUBJECT OBJECTIVES

C1. Gaining theoretical knowledge about C and C++ languages referred to in Le_01-Le_14
C2. Gaining practical skills (programming C and C++ applications) through laboratory tasks La_01-La_14

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the basics of C/C++

II. Relating to skills:
PEK_U01 - He can develop a simple application in C/C++ implementing the selected algorithm

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Encoding information. Character encodings: ASCII, ISO 8859-2, UNICODE. Representation of integers in the U1, U2, + N, BCD, BCD+3. The IEEE 754 and the limits of calculation accuracy	2
Lec2	Portability of code and data: code reuse across platforms, data exchange between different systems and processors of different architectures	2
Lec3	Single- and multi-dimensional arrays. Pointers and pointer arithmetic. Conditions and loops	2
Lec4	Dynamic memory allocation. Exceptions	2
Lec5	Binary and text files. Introduction to the data serialization	2
Lec6	Structures, unions, organization of fields of structures in memory	2
Lec7	Functions, function parameters, recursion. Error prevention against stack overflow. Different conventions for function calls and their impact on performance and code portability	2
Lec8	Data processing: sorting algorithms. The use of function pointers	2
Lec9	Classes in C++ as a smart structure	2
Lec10	Operator overloading. Defining custom data types	2
Lec11	Polymorphism and paradigms of object-oriented programming	2
Lec12	Features of C# and Java as object-oriented languages	2
Lec13	Basics of programming TCP/IP	2
Lec14	Communication and data exchange between Java and C++ applications. Using 16- bit big-endian and 32-bit little-endian processor and data portability	2
Lec15	Final test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Configuration of the Integrated Development Environment	2

Lab2	Basic data types. Standard input-output. Operations on numeric variables	2
Lab3	Debugger. Type conversions	2
Lab4	Strings, arrays, files	2
Lab5	Selected algorithms for processing strings in C	2
Lab6	Local, global, static variables. Functions	2
Lab7	Conditional statements and multiple-choice switch case instruction	2
Lab8	Dynamic allocation of memory and pointer arithmetics	2
Lab9	Introduction to classes and objects	2
Lab10	Object-oriented I/O in C++	2
Lab11	Sorting algorithms and complexity of algorithms	2
Lab12	Applications of function pointers	2
Lab13	Completion of the final project (application in C)	2
Lab14	Presentation of successful completion of the final projec	2
Lab15	v	2
		Total hours: 30

TEACHING TOOLS USED

N1. The traditional lecture with presentations and discussion
N2. Program completion quizzes to verify the current curriculum
N3. tutorials
N4. Self study - preparation of selected topics in the lecture
N5. ND_05 Self study - preparation of selected topics in the laboratory ND_06 Laboratories

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Discussions and 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_K01	Partial tests and quizzes, lab reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Prata, S., Język C. Szkoła programowania. Wydanie V, Helion, 2006
2. Kerningham B. W., Ritchie D. M., Język ANSI C, WNT, 2001
3. Kuczmarski, Karol, Kurs C++, http://avocado.risp.pl, 2012

SECONDARY LITERATURE
1. Bartlet, Jonathan, Programming from the Ground Up, http://www.bartlettpublishing.com/, 2012
2. Stroustrup, Bjarne, The C++ programming language, ADDISON-WESLEY PUBL. CO., 1991

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Computer Science
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 (wiedza)	K1MTR_W19	C1	Lec1-Lec14	N1 - N4
PEK_U01 (umiejętności)	K1MTR_U19	C2	La1-La14	N2, N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy i układy elektroniczne**
Name in English: **Electronic Components and Circuits**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD033001**
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 physics - Electricity and Magnetism
2. Lecture: Electronic Elements and Circuits

SUBJECT OBJECTIVES

C1. To learn basic physical properties of semiconductors
C2. To learn parameters and characteristics of diodes, transistors and integrated circuits
C3. To learn how to choose proper electronic device for circuit design
C4. To learn how to analyse simple electronic circuits
C5. Team work skill development
C6. To provide background in scientific research competence in the areas of micro- and nanoelectronics and passive and active electronic components

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Ability to use data sheets to choose proper electronic component for specific application. Skill of using semiconductor elements in electronic circuits.

PEK_U02 - The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions

III. Relating to social competences:

PEK_K01 - Independent and team work ability in laboratory experiments

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the Laboratory	3
Lab2	The p-n junction characteristics	3
Lab3	Rectifying diodes and circuits	3
Lab4	Voltage regulator with a Zener diode	3
Lab5	Bipolar transistor characteristics	3
Lab6	Bipolar transistor amplifier	3
Lab7	MOSFET characteristics and application	3
Lab8	Bipolar transistor characteristics and parameters. Equivalent circuits	3
Lab9	CMOS gates	3
Lab10	Make-up lab meeting	3
		Total hours: 30

TEACHING TOOLS USED

N1. Oral introduction to the experiments, 10-minute quizzes
N2. tutorials
N3. Individual study -preparation for lab experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

F1	PEK_U01, PEK_K01	Short tests and oral quizes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] B. Streetman, Przyrzady półprzewodnikowe, WNT, 1984
[2] B. Boratynski, Notatki z wykładu – kopie (pliki .pdf) materiałów wykładowcy , , 2011
[3] Zespół, Instrukcje do cwiczen laboratoryjnych (pliki .pdf), , 2012
[4] W. Marciniak,, półprzewodnikowe i układy scalone,, WNT, 1984
[5] A. Swit, J. Pułtorak, , Przyrzady półprzewodnikowe, WNT, 1984

SECONDARY LITERATURE

[1] G.Rizzoni, Fundamentals of Electrical Engineering, McGraw-Hill, 2010
[2] A.Guzinski, Liniowe elektroniczne układy analogowe, WNT, 1993

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electronic Components and Circuits
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U02	K1MTR_U32	C1-C3	La1-La10	N1, N2, N3
PEK_K01	K1MTR_K03	C4-C5	La1-La10	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Statystyka inżynierska**
Name in English: **Engineering Statistics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD033002**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the elements of probability corresponding to high school at the primary level

SUBJECT OBJECTIVES

C1. Acquisition of knowledge of basic probability distributions, their properties and applications
C2. Acquisition of knowledge on the role of statistical methods in engineering activities; data collection methods, descriptive analysis and graphical presentation of experimental data
C3. Acquisition of skills solve problems independently from the application of probabilistic models and statistical methods in engineering practice
C4. Consolidation of student awareness regarding the need to use statistical methods in engineering activities

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of basic probabilistic models, methods of data collection and presentation of statistical data, he knows the basic methods of statistical data analysis

II. Relating to skills:
PEK_U01 - Is able to select and use appropriate tools to solve selected problems of statistical data analysis, is able to draw conclusions on the basis of their analysis

III. Relating to social competences:
PEK_K01 - Can work as a team member to solve engineering problems using statistical methods

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Rules. Probability and the role of statistics in engineering. Collection of empirical data	1
Lec2	Geometric probability, independent events, conditional probability, Bayes' theorem. Random variables. Moments of random variables, distribution function	2
Lec3	Distributions of functions of random variables (binomial, geometric, Poisson, exponential, tables of normal distribution, standardization, random variable, Student-t distribution, chi-square)	2
Lec4	Moments of trial, Descriptive statistics (stem and leaf, quantile of the trial, histogram, box plots, graphs timelines)	2
Lec5	Approximation of distributions of discrete normal distribution. Independence of random variables. Covariance and correlation. Central limit theorem. Estimators and their properties	2
Lec6	Estimation methods. Confidence intervals	2
Lec7	Selected statistical tests	2
Lec8	Passing test	2
		Total hours: 15
Form of classes – Classes		**Number of hours**
Cl1	Introductory exercises, range of exercises, principles of assessment	1
Cl2	Solving basic tasks in the field of probability, calculation of moments	2
Cl3	Solving the scope of the selected probability distributions	2
Cl4	The use of descriptive statistics in data analysis - problem solving	2
Cl5	The use of descriptive statistics in data analysis - problem solving	2
Cl6	Central limit theorem – solving selected examples	2
Cl7	Estimation methods – solving selected examples	2
Cl8	Selected statistical tests – solving examples	2

	Total hours: 15

TEACHING TOOLS USED

N1. Traditional lectures using multimedia presentations and discussion
N2. tutorials
N3. Self - preparation for the lecture inflicted issues
N4. Self - preparation for exercise
N5. Self - self-inflicted solving problems during exercise Exercises: a short, 15-minute tests at the beginning of classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Solving exercises, discussions, short test during classes
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. W. Krysicki i inni, Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach, PWN, Warszawa 1995
2. W. Kordecki, Rachunek prawdopodobieństwa i statystyka matematyczna. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2003

SECONDARY LITERATURE

1. D.C. Montgomery, G.C. Runger, Applied Statistics and probability for engineers; Students solutions Manual, Wiley&Sons, 2006, 4th Ed.,
2. Roman Nowak, Statystyka dla fizyków, PWN, 2002
3. R. Lyman Ott, Michael Longnecker, An introduction to statistical methods and data analysis, Brooks/Cole Cemgage Learning, 6th, Ed., 2010
4. Dr. Graham Currell, Dr. Antony Dowman, Essential Mathematics and Statistics for Science, 2nd Edition, Wiley, 2009

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1,C2	Le_01-Le_08	N1-N3
PEK_U01	K1MTR_U01	C3	Cl_01-Cl_08	N4-N6
PEK_K01	K1MTR_K03	C4	Cl_01-Cl_08	N1-N6

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praktyka programowania w języku C**
Name in English: **The Practice of Programming in C**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD033101**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the course material: Information technology
2. Completed the course material: Introduction to computer science

SUBJECT OBJECTIVES

C1. Ability to program microcontroller based devices in C language

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Gaining practical skills through laboratory tasks

III. Relating to social competences:
PEK_K01 - Gaining experience working in a development team

PROGRAMME CONTENT		
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the chosen IDE for microcontrollers	3
Lab2	Software implementation of OSI layers 2-4. Using the Ethernet interface. Synthesis and decoding of IP/UDP packets in network microcontrollers	3
Lab3	Extensions for C in microcontrollers and standard ANSI C	3
Lab4	Boot sequences of selected microcontrollers - from power-on to the main() function	3
Lab5	Servicing interrupts in C. UART programming	3
Lab6	AT command support - software communication with GSM / GPRS	3
Lab7	Floating-point arithmetic and other mathematical operations a microcontroller, or how to live without FPU. When we use fixed-point arithmetic instead of floating point	3
Lab8	RF - OOK: transmitting the data, synthesis of bitstream with NRZ coding	3
Lab9	RF - OOK: receiving and decoding the bit-oriented data (state machine of a decoder)	3
Lab10	Additional (spare) classes	3
		Total hours: 30

TEACHING TOOLS USED

N1. Program completion quizzes to verify the current curriculum
N2. tutorials
N3. Self study - preparation of selected topics in the laboratory
N4. Laboratory exercises using microcontrollers

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Kernighan, Brian W., Lekcja programowania : najlepsze praktyki, Helion, 2011
King, K. N., Język C : nowoczesne programowanie, Helion, 2011

SECONDARY LITERATURE
Krzysztof Urbański, Instrukcje do laboratorium, opracowanie autorskie, 2012

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The Practice of Programming in C
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19	C1	La1 - La9	N2 - N4
PEK_K01	K1MTR_K03, K1MTR_K04	C1	La1 - La9	N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy techniki mikroprocesorowej**
Name in English: **Principles of microprocessor technology**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD034001**
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	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 in the field of electronic components and circuits
2. Basic knowledge in the field of computer programming

SUBJECT OBJECTIVES

C1. Gaining the knowledge of the design and operation of microprocessors
C2. Gaining the knowledge of the microcontroller peripherals
C3. Gaining experience in programming of microprocessors and their peripherals
C4. Preliminary preparation to carry out the researches in fields related to digital electronics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge about the architecture and operation of microprocessors
PEK_W02 - Knowledge of peripheral devices in single-chip microcontrollers
PEK_W03 - The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

II. Relating to skills:
PEK_U01 - Ability to microprocessors low-level programming
PEK_U02 - Ability to use microcontroller peripherals
PEK_U03 - The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

III. Relating to social competences:
PEK_K01 - The student is aware of the importance and understands the non-technical aspects and results of engineering activity, including its impact on the environment, and the associated responsibility for made decisions

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Architecture of the RISC processor basing on the ATMEGA8535 as an example	2
Lec2	ATMEGA8535 microcontroller instruction set	2
Lec3	Peripherals - handling with I/O ports, analog to digital converter	2
Lec4	Interrupts - mechanism and programming	2
Lec5	Peripherals - programmable timers/counters	2
Lec6	Peripherals - analog comparator, watchdog, additional EEPROM memory	2
Lec7	Peripherals - SPI serial interface	2
Lec8	Summary	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction - how to handle with programming tools and educational kits	4
Lab2	Programming of ports, loops, jumps and subroutines	4
Lab3	Interrupts, use of the analog to digital converter, cooperation of the peripherals	4
Lab4	Timer/counters - counting of external pulses and timing	4
Lab5	Counters - generation of rectangular waveform with variable duty factor	4
Lab6	SPI interface, programming the 7-segment displays drivers, programming of text information	4
Lab7	Programming the EEPROM, controlling the LCD display	4
Lab8	Additional term	2
		Total hours: 30

TEACHING TOOLS USED
N1. Traditional lecture with the use of transparencies and slides N2. Own work - self studies and preparation for examination N3. Exercises N4. Own work - preparation for laboratory class

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Hitachi HD44780 LCD Controller, technical documentation
Maxim MAX7219/MAX7221, technical documentation
Atmel ATMega8535, technical documentation

SECONDARY LITERATURE
R. Baranowski, Mikrokontrolery AVR ATmega w praktyce, BTC, 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Principles of microprocessor technology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MTR_W16	C1, C2	Lec1-Lec8	N1, N2, N4
PEK_U01-PEK_U03	K1MTR_U16	C3	Lab1-Lab8	N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wprowadzenie do sieci komputerowych**
Name in English: **Introduction to Computer Networks**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD034103**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the course material: Information technology
2. Completed the course material: Introduction to computer science

SUBJECT OBJECTIVES

C1. Gaining theoretical knowledge referred to in La_01-La_07
C2. Gaining practical skills through laboratory tasks La_01-La_07
C3. Gaining theoretical knowledge referred to in Le_01-Le_07

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the principles of operation of computer networks and their security aspects
PEK_W02 - He knows the rules of designing network solutions and their programming

II. Relating to skills:
PEK_U01 - The ability to design simple and secure computer networks, including the safety aspects
PEK_U02 - The ability to practical application of network technology, and to communicate with the measuring systems and devices

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction: ISO / OSI model, network topologies, protocols	2
Lec2	The ARP protocol. Static and dynamic ARP table entries. Prevention of attacks carried out on the basis of the ARP protocol. Example implementation of the ARP protocol using networked microcontroller	2
Lec3	The IP protocol. Route selection. Address Translation. Overview of the TCP, UDP, ICMP	2
Lec4	High-level network programming: client-server architecture. Portability of data on the network	2
Lec5	Safety: traffic monitoring, attack detection, firewalls, data encryption, certificates, privacy	2
Lec6	Selected network services: DNS, FTP, HTTP. Configuring and securing devices against selected attacks	2
Lec7	Wireless Networks. Bluetooth, Wi-Fi. Configuration, range, safety	2
Lec8	Final test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	What is the Internet? The most important protocols. Getting familiar with tool WireShark	2
Lab2	The principle of operation of L2 and L3 switch. The ARP protocol. MAC spoofing and certain types of attacks	2
Lab3	TCP and UDP applications. Client-server architecture. Network programming using the BSD sockets. Multi-threaded server application	2

Lab4	Implementation of embedded web server and TCP stack in single chip microcontroller. Remote device control and data acquisition using a Web browser	2
Lab5	The HTTP protocol and the DNS system. Configuration of http server, including support for multiple domains	2
Lab6	Principle of operation of NAT. Setting up Windows ICS and NAT devices. Port mapping	2
Lab7	Setting up and running the SSH and RDP services allow remote access to the computer located behind NAT	2
Lab8	Additional (spare) classes	1
		Total hours: 15

TEACHING TOOLS USED

N1. Program completion quizzes to verify the current curriculum
N2. tutorials
N3. Self study - preparation of selected topics in the lecture and laboratory
N4. Specialized software to perform the tasks of laboratory
N5. ND_05 Educational kits with networked microcontrollers ND_06 Giving the knowledge necessary to carry out laboratory activities

EVALUATION OF SUBJECT EDUCATIONAL 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	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_U1, PEK_U2	Program completion quizzes, lab reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Stevens W. R., Programowanie zastosowań sieciowych w systemie Unix, Helion, 2010
2. Tanenbaum, Andrew S. , Sieci komputerowe, Helion, 2004
3. Schneier, Bruce, Kryptografia dla praktyków: protokoły i programy źródłowe w języku C, WNT, 2002

SECONDARY LITERATURE
1. Danowski, Bartosz, Wi-Fi : domowe sieci bezprzewodowe, Helion, 2010
2. Park, John, Practical data communications for instrumentation and control, Elsevier, 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to Computer Networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W20	C1	Lec1-Lec7	N1,N3,N4
PEK_W02	K1MTR_W20	C1	Lec1-Lec7	N1 - N6
PEK_U01	K1MTR_U20	C2	La1-La7	N2 - N6
PEK_U02	K1MTR_U20	C2	La1-La7	N2 - N6

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania układów elektronicznych**
Name in English: **Fundamentals of Electronic Design**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD035001**
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 of electrical engineering and analog technique
2. Basic knowledge of issues related to semiconductor devices

SUBJECT OBJECTIVES

C1. To acquaint students with basic electronic systems, properties and applications of electronic circuits
C2. To acquaint students with basics of analog and digital circuits design
C3. Preliminary preparation to carry out the researches in fields related to micro- and nanoelectronics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Students have systematic and theoretically founded knowledge of basic digital and analogue circuits
PEK_W02 - The student knows the basic methods, techniques, tools and materials used in solving simple engineering problems from the studied field of study

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Properties and characteristics of operational amplifiers	2
Lec2	Linear and nonlinear circuits designed with operational amplifiers	2
Lec3	Properties and characteristics of instrumental and differentia amplifiers	2
Lec4	Circuits for acquisition of photodetector signals	2
Lec5	Current and voltage sources	2
Lec6	Digital to analog and analog to digital converters	2
Lec7	Input and output circuits for analog to digital and digital to analog converters	2
Lec8	Test in writing	1
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with discussion
N2. Multimedia lecture with discussion
N3. tutorials
N4. Individual work – preparation of selected topics of the lecture
N5. Individual work – preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J. Baranowski, G. Czajkowski, Układy analogowe nieliniowe i impulsowe, WNT, 2004
2. P. Górecki, Wzmacniacze operacyjne, Wydawnictwo BCT, 2004
3. S. Kuta, Układy elektroniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 1995

SECONDARY LITERATURE

1. P. Horowitz, W. Hill, Sztuka elektroniki, Wydawnictwo Komunikacji i Łączności, 2009
2. S. Kuta, Elementy i układy elektroniczne cz.2, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Electronic Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02 (wiedza)	K1MTR_W31	C1-C3	Lec1-Lec8	N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zastosowanie optoelektroniki**
Name in English: **Applications of optoelectronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD035002**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Znajomość podstaw fizyki (w tym optyki geometrycznej) oraz podstaw fizyki ciała stałego
2. Completion of Fundamentals of electrical engineering course
3. Completion of Electronics Elements and Devices course

SUBJECT OBJECTIVES

C1. To familiarize students with the basic optical phenomena in semiconductors, including the transmission of light in semiconductors and optical fiber
C2. Students become acquainted with the structure, parameters and conditions of optoelectronic components

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has ordered in terms of theoretical knowledge of photonics, including the knowledge necessary to understand the physical basis of optical components telecommunications track and knows areas of photonic systems application in particular in the automotive, energy and microsystems.

II. Relating to skills:

PEK_U01 - Student can use optical fiber systems and simple elements known in engineering practice

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction do optoelectronics	1
Lec2	The basics of optical phenomena in semiconductors	2
Lec3	Optical fiber technique	3
Lec4	Ligth sources	2
Lec5	Photodetectors	2
Lec6	Basics of the solar cells	1
Lec7	Areas of application of optoelectronic devices	3
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Attenuation of a multisegment optical fiber transmission system measurement	2
Lab2	Study of the attenuation of optical fibers	2
Lab3	Testing of optical polarizer	2
Lab4	Investigation of spectrum characteristics of light sources	2
Lab5	Investigation of matching efficiency of optical connectors in different transmission optical windows	2
Lab6	Machine Vision for manufacturing quality assurance	2
Lab7	Optical microscope and interferometry measurements for 2D/3D	2
Lab8	Measurement of surface scattering and photometric light characteristics \	2
Lab9	Industrial laser technologies	2
Lab10	Metods of laser beam measurement and process monitoring	2
Lab11	Panels and solar cells	2
Lab12	Optical fiber sensors	2
Lab13	Optotelecommunication track	2
Lab14	Optical fiber connection technology (welding of fiber optics, measurement of the geometry of the optical fiber)	2

Lab15	Semiconductor ligthing systems	2
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with presentations and discussion
N2. Self work - independent studies and preparing for the test
N3. tutorials
N4. self study - preparation for laboratory class
N5. A brief test at the beginning of the laboratory activities

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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, discussion
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	brief tests, discussion, reports after exercise
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] B. Mroziewicz, M. Bugajski, Wł. Nakwaski, Lasery półprzewodnikowe, WNT 1985,
[2] J. E. Midwinder, Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ 1995,
[3] J. I. Pankove, Zjawiska optyczne w półprzewodnikach, WNT 1984,
[4] J. Piotrowski, A. Rogalski, Półprzewodnikowe detektory podczerwieni, WNT 1985,
[5] B. Ziętek Optoelektronika, Wyd. UMK, 2004,
[6] Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT 2001

SECONDARY LITERATURE
[1] A. Smoliński, Optoelektronika światłowodowa, WKŁ 1985,
[2] J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT 1986,
[3] J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN 1997,
[4] J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ 1997,
[5] M. Marciniak, Łączność światłowodowa. WKŁ 1998,
[6] G. Einarsson, Podstawy telekomunikacji światłowodowej, WKŁ 1998,

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Applications of optoelectronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W30	C1, C2	Lec1-Lec7	N1-N3
PEK_U01	K1MTR_U33	C2	Lab1-Lab15	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory i aktuatory**
Name in English: **Sensors and actuators**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD035101**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. None.

SUBJECT OBJECTIVES

C1. Various methods of actuation and detection in microscale will be presented.
C2. To familiarize oneself with basic properties of micromechanic sensors
C3. Review of chosen micromachines which integrate sensors and actuators will be shown.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Organization of knowledge in the fields of micromechanic sensors and actuators.

II. Relating to skills:
PEK_U01 - Is able to use selected methods and instruments to measure basic parameters of micromechanic sensors (acceleration, pressure and optical) and actuators (electrostatic and pneumatic) to be applied in mechatronic systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Review of chosen methods of actuation and sensing utilized with MEMS	3
Lec2	Introduction to fundamental mechanics of microstructures, bending, tensing in various micromechanic structures.	2
Lec3	Piezoresitive pressure sensor – principle of operation, construction.	2
Lec4	Piezoresitive pressure sensor – parameters, conditioning of electric signal, examples of realisations	2
Lec5	Acceleration sensors, gyroscopes – principles of operation, construction, parameters and examples of realisations.	2
Lec6	Micromachines as devices with various sensors and actuators.	2
Lec7	Final colloquium	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Piezoresitsive pressure sensor	3
Lab2	Barometric altitude meter.	3
Lab3	XYZ MEMS accelerometer.	3
Lab4	E-compas.	3
Lab5	Pneumatic actuation in microsclae.	3
Lab6	Capacticane MEMS pressure sensors	3
Lab7	Thermoconductive flow meter.	3
Lab8	Fluid flow in microscale.	3
Lab9	Micromechanic valves.	3
Lab10	Reserve term.	3
		Total hours: 30

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Lecture materials.

SECONDARY LITERATURE

1.M. Bao, Analysis and Design Principles of MEMS Devices, Elsevier 2005
2. Data sheets of discised sensors and actuators.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors and actuators
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6	N4
PEK_U01	K1MTR_U15	C1, C2	Lec1-Lec6, Lab1-Lab9	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie układów logicznych**
Name in English: **Logic Circuits Modeling**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD035102**
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. No requirements

SUBJECT OBJECTIVES

C1. Understanding of logic circuits
C2. Gaining the skill of logic circuits modeling

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - PEK_W01 Knowledge of the logic circuits
PEK_W02 The student knows the area of logic circuits application and know how to model them
PEK_W03 The student knows the basic method, techniques, tools and materials used in solving simple engineering problems from the studied field of study
PEK_W04 The student knows the typical engineering technologies in the area of studied field of study

II. Relating to skills:
PEK_U01 - PEK_U01 Fundamental skill of logic circuits modeling
PEK_U02 Fundamental skill of coding in VHDL
PEK_U03 The student is able to select and properly use development tools to model logic circuits
PEK_U04 The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to VLSI digital technology	2
Lec2	VHDL basics	2
Lec3	Modeling of combinational circuits	2
Lec4	Introduction to digital sequential circuits	2
Lec5	Modeling sequential circuits	2
Lec6	State machines	2
Lec7	Serial-to-parallel interface	2
Lec8	Final test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction to VLSI digital technology	2
Lab2	VHDL basics	2
Lab3	Modeling of combinational circuits	2
Lab4	Introduction to digital sequential circuits	2
Lab5	Modeling sequential circuits	2
Lab6	State machines	2
Lab7	Serial-to-parallel interface	2
Lab8	Final test	1
		Total hours: 15

TEACHING TOOLS USED

N1. Lecture with discussion
N2. Self - preparation for final test
N3. computer laboratory

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U04	Evaluation of the laboratory program implementation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M. Zwoliński, Projektowanie układów cyfrowych z wykorzystaniem języka VHDL, WKŁ, 2007

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Logic Circuits Modeling
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W04	K1MTR_W16, K1MTR_W19	C1	Lec1-Lec8	N1, N2
PEK_U01-PEK_U04	K1MTR_U22	C1, C2, C3	La1-La8	N1, N3
PEK_U02	K1MTR_U19	C1, C2, C3	La1-La8	N1, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podzespoły elektroniczne**
Name in English: **Electronic Components**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD035201.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED

N1.
N2.
N3.
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	

P = F1

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W01	C1		N1, N2, N4
PEK_U01	K1MTR_MM_U01	C2		N2 - N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy (MEMS)**
Name in English: **Microsystems (MEMS)**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD036001**
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. No requirements

SUBJECT OBJECTIVES

C1. Familiarizing students with the basics of micromachines technology with elements of nanotechnology, the basics of design and application of the modern microsensors, microsystems MEMS, MEOMS, microactuators and micromachines, also chosen solutions micro- and nanorobots
C2. Acquiring skills in working with selected microsystems

SUBJECT EDUCATIONAL EFFECTS
I. Relating to knowledge: PEK_W01 - Student has structured and theoretically founded knowledge of the operation, construction and basic parameters of the micromechanical actuators, sensors and certain mechanical and electrical microsystems **II. Relating to skills:** PEK_U01 - PEK_U01 The student is able to formulate the principle of operation of selected micro, select and apply appropriate sensors to measure various physical quantities and use them in systems of measurement, monitoring, control PEK_U02 The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions PEK_U03 The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks PEK_U04 The student is able to see system and non-technical aspects of engineering tasks during their formulating and solving **III. Relating to social competences:** PEK_K01 - Able to interact and work in a group, taking in the different roles

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, the history of microsystems, the role and position in the market.Materials and technological basics: a review of the planar procedures	2
Lec2	Materials and technological basics: a review of the planar procedures	2
Lec3	Technological basics cont.: a review of procedures of the deep silicon micromechanics	2
Lec4	3D silicon structures: the use in the construction of micro-sensors and actuators	2
Lec5	Technological basics: LIGA and non-photolithographic methods microforming 3	2
Lec6	Pressure sensors from a chip to encapsulated sensor: design, parameters, types, technical	2
Lec7	Movement in a microscale: static and dynamic microstructures	2
Lec8	The accelerometers, sensors of vibration, force, displacement, construction and usage	2
Lec9	Complex systems MEMS, MEOMS	2
Lec10	Basics of microfluidics, micromechanical components for the control and flow measurement; dispensers, mixers, micropumps, valves, etc	2
Lec11	From microreactors to bio/med lab-chips and point-of-care systems	2
Lec12	The use of microsystems in technics: automotive, aviation, military technology, household appliances, etc.	2
Lec13	Micromachines; from simple static micro constructions to micro robots	2
Lec14	Nanosystems; technological base, examples of solutions, nanoelectronics 3D	2

Lec15	Summary, the development in the next 10 years. Test	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	The piezoresistive pressure sensor: modeling of silicon membranes, the basic element piezoresistive pressure sensor	3
Lab2	The piezoresistive pressure sensor: measuring the deflection of the membrane of silicon using a fiber optic meter distance	3
Lab3	The piezoresistive pressure sensor: measurement and determination of metrological parameters of the sensor and pressure sensor	3
Lab4	Microscale flow management: gas micropump	3
Lab5	Fiber optical MEMS switch	3
		Total hours: 15

TEACHING TOOLS USED

N1. Lecture with presentation and discussion.
N2. Prepare for laboratory, short test the knowledge
N3. tutorials
N4. Own work - prepare for the test and the exam
N5. Analysis of the results and prepare of the report

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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_W01	Exam
P = 0,5*(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_U04, PEK_K01	Short tests at the beginning of the exercises, discussion.

F2	PEK_U01-PEK_U04, PEK_K01	Evaluation of the reports of the exercises
P = 0,5*(F1+F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. J. Dziuban, Technologia i zastosowanie mikromechanicznych struktur krzemowych i krzemowo-szklanych w technice mikrosystemów, Oficyna Wydawnicza Politechniki Wrocławskiej, 2002

SECONDARY LITERATURE
1. Introduction to microsystem technology, Wiley, 2010
2. MacDouk, MEMS Handbook, MC, New York, 2009

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microsystems (MEMS)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 (wiedza)	K1MTR_W15	C1	Lec1-Lec15	N1,3,4
PEK_U01 (umiejętności)	K1MTR_U15	C1, C2	La1 - La5	N2,5
PEK_K01 (kompetencje)	K1MTR_K03	C2	La1 - La5	N2,5

SUBJECT SUPERVISOR

dr hab. inż. Anna Gorecka-Drzazga email: anna.gorecka-drzazga@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania układów elektronicznych**
Name in English: **Fundamentals of Electronic Design**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCD036002**
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. Basic knowledge of electrical engineering and analog technique
2. Basic knowledge of issues related to semiconductor devices

SUBJECT OBJECTIVES

C1. To acquaint students with basic electronic systems, properties and applications of electronic circuits
C2. To educate students how to select components of electronic circuits to realize defined engineering task
C3. Preliminary preparation to carry out the researches in fields related to micro- and nanoelectronics

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Students are able to design electronic circuits responsible for measurement and acquisition of sensor signals and depending on the system complexity to conduct, test and characterize the fabricated analog and digital circuits

PEK_U02 - The student is able to identify and formulate a specification of simple and practical engineering tasks, characteristic for the studied field of study

III. Relating to social competences:

PEK_K01 - Students are able to identify priorities needed to realise defined engineering task, connected with design, analysis and measurement of basic parameters of analog and digital circuits

PEK_K02 - Students are able to identify which tasks are to realize individually or in group

PEK_K03 - The student is able to think and act in an entrepreneurial way

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction, security training, regulations how to realise the project tasks, introduction to measurement experimental techniques	2
Proj2	Discussion and valuation of block diagram of the designed linear and or analog electronic circuit	2
Proj3	Design of schematic diagram of the constructed electronic circuit - Part I system supply and passive components	2
Proj4	Design of schematic diagram of the constructed electronic circuit - Part II active components	2
Proj5	Theoretical analysis of the designed circuit	2
Proj6	Simulation of the designed circuit	2
Proj7	Discussion and correction of mechanical setup of the designed electronic circuit	2
Proj8	Introduction of list of project	2
Proj9	Discussion on selected project tasks	2
Proj10	Design of dedicated printed circuit board-Part I supply and passive components	2
Proj11	Design of dedicated printed circuit board-Part II supply and active components	2
Proj12	Fabrication of printed circuit board	2
Proj13	Assembly of selected blocks of the designed electronic circuit	2
Proj14	Launching of the fabricated system	2
Proj15	Project presentation and defense	2
		Total hours: 30

TEACHING TOOLS USED

N1. Multimedia presentation
N2. tutorials
N3. Individual work – analysis of indicated project tasks
N4. Individual work – study of project related issues

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 - PEK_K03	Written reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. J. Baranowski, G. Czajkowski, Układy analogowe nieliniowe i impulsowe, WNT, 2004
2. P. Górecki, Wzmacniacze operacyjne, Wydawnictwo BCT, 2004
3. S. Kuta, Układy elektroniczne, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 1995

SECONDARY LITERATURE
1. P. Horowitz, W. Hill, Sztuka elektroniki, Wydawnictwo Komunikacji i Łączności, 2009
2. S. Kuta, Elementy i układy elektroniczne cz.2, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków, 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Electronic Design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U02 (umiejętności)	K1MTR_U32, K1MTR_U34	C1, C2	Pr1-Pr14	N1 - N4
PEK_K01 (kompetencje)	K1MTR_K04	C2		N1, N2, N4

PEK_K02	K1MTR_K03	C2		N2, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Teodor Gotszalk email: teodor.gotszalk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie numeryczne konstrukcji mikroelektronicznych**
Name in English: **Numerical prototyping of microelectronic structures**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036101**
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 on mathematics and physics
2. Basic knowledge on numerical methods
3. Basic computer skills

SUBJECT OBJECTIVES

C1. Familiarize students with the basics of numerical prototyping of microelectronic structures
C2. Gaining skills for computer software usage concerning numerical modelling based on finite element method as FlexPDE, Ansys
C3. Getting familiarize with typical problems connected with numerical prototyping including simulation, optimization and deisgn of experiments, etc.
C4. Consolidation of skills for self and team work based on supplied instruction materials

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Is capable of selecting appropriate engineering tools for computer aided engineering and use such software as FlexPDE, Ansys, SolidWorks in order to solve typical problems of numerical prototyping in micro-engineering

PEK_U02 - Is able to analyze and interpret the achieved results using appropriate experiment design methods, optimization, numerical modelling and simulation as well as analysis and data interpretation mehods

PEK_U03 - Can properly identify and prioritize the dilemmas connected with the interdisciplinary problems.

III. Relating to social competences:

PEK_K01 - Can properly prioritize tasks in order to finalize a specified work.

PEK_K02 - Can properly identify and solve the dilemmas associated with a profession practice.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to numerical modelling and software tools as FlexPDE and Ansys	2
Lab2	Introduction to numerical modelling of micromechanical structures	2
Lab3	Analysis and optimization methods of micromechanical structures in FEM software tools as FlexPDE and Ansys	2
Lab4	Analysis of strain and stress distribution	2
Lab5	Analysis of heat dissipation and temperature distribution	2
Lab6	Analysis of electrostatic field distribution	2
Lab7	Extraction of basic electrical parameters as resistance.	2
Lab8	Analysis of laminar and turbulent flows	2
Lab9	Analysis of stress and strain distribution for bimterial structures	2
Lab10	Numerical prototyping with parametric models	2
Lab11	Analysis of a coupled electro-thermo-mechanical field	2
Lab12	Methods of thermo-electric phenomena modelling	2
Lab13	Optimization of a micromechanical pressure sensor	2
Lab14	Individual projects - problem selection and analysis	2
Lab15	Individual project - assessment	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02	tests and laboratory reports
P = (F1+...F12)/12		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Zienkiewicz O.C., Taylor R.L., “The Finite Element Method: Volumes 1-3”, Butterworth-Heinemann, London, 2000
2. Thompson E., “Introduction to the Finite Element Method”, John Wiley and Sons, 2005
3. Kreyszig E., „Advanced Engineering Mathematics”, John Wiley and Sons, 2006

SECONDARY LITERATURE
1. Montgomery D., “Design and Analysis of Experiments”, John Wiley and Sons, 2005
2. William D., Callister Jr., “Materials Science and Engineering an Introduction”, John Wiley and Sons, 2007
3. Montgomery D., Runger G., “Applied Statistics and Probability for Engineers”, John Wiley and Sons, 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Numerical prototyping of microelectronic structures
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U22	C1-C3	La1-La13	N1-N3
PEK_K01	K1MTR_K04, K1MTR_K05	C4	La14-La15	N4

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody przetwarzania sygnałów**
Name in English: **Methods of Signal Processing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036103**
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. Competence in mathematical analysis and linear algebra.

SUBJECT OBJECTIVES

C1. Teaching students about techniques of signal processing and signal analysis
C2. Teaching students about implementation of basic signal processing algorithms with scripting languages (offline processing)
C3. Bringing the need for application of signal processing and analysis in engineering to the students’ attention and teaching the ability to predict effects of this application

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has knowledge of methods of analysis of deterministic and random signals in the domain of time and frequency

II. Relating to skills:
PEK_U01 - The student is able to analyze signals by means of Fourier transform, he can design FIR and IIR filters and implement signal processing algorithm in a scripting language

III. Relating to social competences:
PEK_K01 - The student understands that application of signal processing techniques leads to innovative solutions and is a tool making mechatronic devices more competitive

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The survey of examples of application of signal processing techniques. Basic definitions and terms computed in the time domain	2
Lec2	The family of Fourier transforms - signals specification in frequency domain	2
Lec3	Linear systems, superposition principle, system properties in domains of time and frequency	2
Lec4	Test no. 1	2
Lec5	Laplace and Z transforms as tools for linear systems design and specification	2
Lec6	AD and DA conversions - sampling, quantization, reconstructions and ADC /DAC properties	2
Lec7	Digital FIR and IIR filtration - methods of filters design	2
Lec8	Test no. 2	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introductory classes - software environment presentation	3
Lab2	Discrete Fourier Transform	3
Lab3	DFT properties	3
Lab4	Finite impulse response filters (FIR)	3
Lab5	Infinite impulse response filters (IIR)	3
		Total hours: 15

TEACHING TOOLS USED

N1. Oral presentation with audio-visual tools N2. Computer classes with scripting environment supporting engineering calculations N3. tutorials N4. Self-study - studying issues selected by lecturer N5. Self-study - preparation for labs, N6. Self-study - preparation for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Test no. 1
F2	PEK_W01	Test no. 2
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Assessment of lab preparation and work
F2	PEK_U01, PEK_K01	Assessment of lab preparation and work
F3	PEK_U01, PEK_K01	Assessment of lab preparation and work
F4	PEK_U01, PEK_K01	Assessment of lab preparation and work
P = (F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] J. Szabatin, Podstawy teorii sygnałów, WKŁ Warszawa, 2007
[2] S. W. Smith, Cyfrowe przetwarzanie sygnałów – praktyczny poradnik dla inżynierów i naukowców, BTC Warszawa , 2007
[3] R.G. Lyons, Wprowadzenie do cyfrowego przetwarzania sygnałów, WKŁ Warszawa, 2007

SECONDARY LITERATURE
[1] A. Papoulis, Probability, Random Variables and Stochastic Processes, MacGraw-Hill, 1991
[2] V.K. Madisetti, D.B. Williams, Digital Signal Processing Handbook, Chapman&Hall/CRC, 1999
[3] R.N. Bracewell, The Fourier Transform and Its Applications, MacGraw-Hill, 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods of Signal Processing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W21	C1	Lec01-Lec08	N1,N3, N4,N5
PEK_U01	K1MTR_U01	C2	Lab01-Lab05	N2, N5
PEK_K01	K1MTR_K06	C3	Lab01-Lab05	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w medycynie**
Name in English: **Microsystems in medicine**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036104**
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. No requirements

SUBJECT OBJECTIVES

C1. Familiarize students with the design and operation of selected microsystems and possibilities of their application in biology and medicine, as well as devices and apparatus microsystems for specific tasks
C2. Learn how to work with the selected microsystems for specific tasks in biology/medicine.
C3. Fusing ability to work independently and in a team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has a general knowledge of the structure and operation of the selected microsystem devices, and possibilities of their application in biology and medicine, he knows some devices and microsystem instruments for specific tasks in biology / medicine.

II. Relating to skills:
PEK_U01 - Student can work with selected microsystem devices and instruments designed for specific tasks in biology / medicine.

III. Relating to social competences:
PEK_K01 - Student is able to work independently and in laboratory group by adopting different roles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Microtechnologies in molecular genetics (DNA, chip, PCR)	2
Lec2	Cardiac assist devices, artificial heart	2
Lec3	Artificial sense organs: electronic hearing, bionic eye	4
Lec4	Invasive and non-invasive microsystems for measuring blood pressure	2
Lec5	Miniature robots for colonoscopy and endoscopy	1
Lec6	Tonometer, sensors and microsystems for medical diagnosis	1
Lec7	Lab-on-a-chips and biochips	1
Lec8	Test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Flow and mixing of the liquids in the microchannels	3
Lab2	Dosing of micro- and nanovolumes with conductivity detection	3
Lab3	Droplet microfluidic system	3
Lab4	Microcytometer to study biological cells	3
Lab5	DNA analyser with fluorometric detection	3
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides
N2. Laboratory: short tests beginning laboratory
N3. Tutorials
N4. Self study - preparation for laboratory exercises
N5. Self study – independent studies and preparation for test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	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	Short tests beginning laboratory
F2	PEK_K01	Laboratory reports and participation in discussions
P = F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Bibliography

SECONDARY LITERATURE
Scientific magazines and materials from lectures

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microsystems in medicine
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1	Lec1-Lec7	N1, N3, N5

PEK_U01	K1MTR_U15	C2, C3	La1-La5	N2, N3, N4
PEK_K01	K1MTR_K03	C3	La1-La5	N3, N4, N5

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w motoryzacji**
Name in English: **Automotive microsystems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036105**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic physics (mechanics, electricity and magnetism)
2. Completion of the course Fundamentals of Electrical Engineering
3. Completion of the course Components and Electronic Systems

SUBJECT OBJECTIVES

C1. To familiarize students with the basic microsystems (sensor systems), used in automotive engineering
C2. Introduction to the structure, working conditions and measurement of the main parameters used in the above-mentioned sensor systems
C3. Strengthening teamwork skills

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has the basic knowledge of the operation, construction, properties and characteristics of sensor systems and sensors (including intelligent and microsensors) used in vehicles.

II. Relating to skills:
PEK_U01 - Able to select and use the appropriate sensors to measure various physical quantities, investigate the fundamental characteristics of the sensors and use them to control systems and control vehicles.

III. Relating to social competences:
PEK_K01 - Able to interact and work in a group (a group of laboratory), taking part in a variety of roles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Sensor systems for automotive - historical overview	2
Lec2	Fuel supply systems - tasks, principles of operation, sensors	2
Lec3	Ignition systems - tasks, principles of operation, sensors	2
Lec4	Combustion control systems of air-fuel mixture	2
Lec5	Microsystems for active and passive safety	3
Lec6	Microsystems for navigation and driver information	2
Lec7	Test	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Lambda sensor for stoichiometric mixture	3
Lab2	Sensors: throttle position, absolute pressure (MAP), oil pressure, fuel level	3
Lab3	Sensors for the position and speed of the crankshaft	3
Lab4	Accelerometers	3
Lab5	Additional term	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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, PEK_K01	quiz, a report from the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Marek J. „Sensors for Automotive Technology", Wiley-VCH, Darmstadt 2003
[2] Herner A. „Elektronika w samochodzie", WKŁ Warszawa 2001
[3] Gajek A., Juda Z., Czujniki, WKŁ Warszawa 2008,

SECONDARY LITERATURE

[1] „Czujniki w pojazdach samochodowych", Informator techniczny f-my Bosch, 2002
[2] „Mikroelektronika w pojazdach", Informator techniczny f-my Bosch, 2002
[3] „Układy bezpieczeństwa i komfortu jazdy", Informator techniczny f-my Bosch, 2002

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1, C2	Lec1 - Lec6	N1

PEK_U01	K1MTR_U15	C1, C2	Lab1 - Lab5	N2, N3
PEK_K01	K1MTR_K03	C3	Lab1 - Lab5	N2

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fotonika**
Name in English: **Photonics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036201**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of Physics (including geometric optics) and fundamentals of the physics of solids
2. Successful completion of the course: Fundamentals of electrical engineering, Electronics Elements and Devices, Applications of the optoelectronics

SUBJECT OBJECTIVES

C1. To familiarize students with the basic optical phenomena in semiconductors, including the transmission of light in semiconductors and optical fiber, structure, parameters and conditions of opto-electronic components supply
C2. To familiarize with the semiconductor detectors and sources of light, their design and working conditions
C3. Persisting the ability to work in a group

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has ordered and supported in theory, knowledge of photonics, including the knowledge necessary to understand the physical basis of optical components and systems for application areas sa well as student knows telecommunications optical track in particular in the automotive, energy and microsystems

II. Relating to skills:
PEK_U01 - Student can use known methods and mathematical models as well computer simulations for the analysis and performance evaluation of optoelectronic components and simple optical fiber systems, student can correctly use the selected methods and facilities to enable the measurement of the basic parameters of elements and integrated optoelectronic. Student can develop documentation for implementation of engineering tasks and prepare a text containing an overview of the results of the implementation of this task

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Optical phenomena in semiconductors	2
Lec2	Materials for optoelectronics	2
Lec3	Manufacturing technology of optoelectronic structures	2
Lec4	Ligth sources	2
Lec5	Advanced methods of detection and processing of light energy	2
Lec6	Displays	2
Lec7	Optoelectronics in technique	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introductory training	3
Lab2	Colour theory	3
Lab3	Ligth sources - LED, LD diodes	3
Lab4	Ligth radiation detectors	3
Lab5	Solar cells I	3
Lab6	Solar cells II	3
Lab7	Optrons	3
Lab8	Optical fiber track	3
Lab9	Lighting panels	3
Lab10	Supplementary term	3
		Total hours: 30

TEACHING TOOLS USED
N1. Traditional lecture with presentations and discussion N2. Laboratory: a short, 10-minute test at the beginning of the exercises, N3. Self work - preparing for the lab exercises N4. Self work - independent studies and preparation for the seminar on N5. tutorials, consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	discussions, 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	test at the beginning of the exercises, laboratory reports, evaluation class implementation exercises
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] B. Mroziewicz, M. Bugajski, Wł. Nakwaski, Lasery półprzewodnikowe, WNT 1985,
[2] J. E. Midwinder, Y. L. Guo, Optoelektronika i technika światłowodowa, WKŁ 1995,
[3] J. I. Pankove, Zjawiska optyczne w półprzewodnikach, WNT 1984,
[4] J. Piotrowski, A. Rogalski, Półprzewodnikowe detektory podczerwieni, WNT 1985,
[5] B. Ziętek Optoelektronika, Wyd. UMK, 2004,
[6] Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT 2001,

SECONDARY LITERATURE

[1] A. Smoliński, Optoelektronika światłowodowa, WKŁ 1985,
[2] J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT 1986,
[3] J. Godlewski, Generacja i detekcja promieniowania optycznego, PWN 1997,
[4] J. Siuzdak, Wstęp do współczesnej telekomunikacji światłowodowej, WKŁ 1997,
[5] M. Marciniak, Łączność światłowodowa. WKŁ 1998,
[6] G. Einarsson, Podstawy telekomunikacji światłowodowej, WKŁ 1998,
[7] K. Booth, S. Hill, Optoelektronika, WKŁ, Warszawa 2001,
[8] R. Bacewicz, Optyka ciała stałego, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1995.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W02	C1, C2	Lec1-Lec8	N1-N5
PEK_U01	K1MTR_MM_U02	C1-C3	Lab1-Lab10	N2, N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikro- i nanoelektronika**
Name in English: **Micro- and Nanoelectronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD036202**
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 physics.
2. Basic knowledge of mathematics.
3. Basic knowledge of chemistry.

SUBJECT OBJECTIVES

C1. To familiarize students with the techniques of modern production systems of micro-and nano-
C2. To familiarize students with the properties of components made using the techniques of micro-and nano-
C3. To familiarize students with the current state of technology and development trends of micro-and nano-

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student has structured and theoretically founded knowledge of the materials, technology, construction and selected electrical parameters and stability of modern elements and components in electronic circuits and mechatronic systems.

PEK_W02 - The student knows and understands the basic processes involved in the manufacture of micro-devices and nano applied in mechatronics. Versed in the current state of technology and development trends of micro-and nano-electronics.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, development trends of modern semiconductor technology, a review of the fundamental processes of micro-and nanotechnology. Preparation of substrates (doped silicon, strained silicon, SiGe, SOI technology and SON), silicon epitaxy	2
Lec2	Thermal oxidation of silicon, the production of layers of dielectric and polysilicon LPCVD technique, dielectrics with high and small k, a porous ULK materials	2
Lec3	Advanced techniques for micro-and nanolitography (photolithography, electronolitography, rentgenolitography, ionolitography, interference lithographs, scanning probe lithography)	2
Lec4	Doping layers: diffusion and ion implantation, annealing (RTA)	2
Lec5	Cleaning of substrates, wet and dry etching processes of layers and structures of MEMS and NEMS	2
Lec6	Preparation of metallic contacts and connections (silicides, Al, Cu), thin-film materials used as diffusion barriers and etching stop layer	2
Lec7	Properties of individual nanoparticles: carbon nanotubes, nanodiament, graphene. Application in the new devices	2
Lec8	Fundamentals of thin and thick film technology.	2
Lec9	Principles of design thick film components.	2
Lec10	High temperature thick films - materials, processes, properties, application.	2
Lec11	Polymer thick films - materials, processes, properties, applications.	2
Lec12	MCM (Multichip Module).	2
Lec13	Technology LTCC (Low Temperature Cofired Ceramics) - materials, processes, properties.	2
Lec14	The use of LTCC ceramics in microelectronics.	2
Lec15	Technology development trends of micro-nano.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

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

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Micro- and Nanoelectronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W01	C1-C3	Lec1-Lec15	N1, N2, N3

PEK_W02	K1MTR_MM_W03	C1-C3	Lec1-Lec15	N1, N2, N3

SUBJECT SUPERVISOR
Prof. dr hab. inż. Leszek Golonka email: leszek.golonka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma seminar**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037001**
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. ECTS credit no greater than it is due to the resolution of the Council of the Faculty

SUBJECT OBJECTIVES

C1. The student's self presentation skills qualification from the scope of the knowledge, skills and social competence
C2. Persisting the ability to work in a group

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can present their own skills with a range of knowledge, skills and social competences typical for the direction of Mechatronics

III. Relating to social competences:
PEK_K01 - Student is able to think and act in a way that is creative and enterprising, he can interact and work in a group

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction	1
Sem2	Information about diploma work and diploma exam - requirements	1
Sem3	Overview and scope of the topics diploma works foreseen and the rules for creating the correct technical and scientific texts	4
Sem4	Multimedia presentations, CV (expanded version), discussion	4
Sem5	Discussion of the issues concerning diploma exam, comments	8
Sem6	Multimedia presentations of the diploma works, discussion	6
Sem7	Presentation and preparations for the diploma exam	4
Sem8	Summary of coursework and grading	2
		Total hours: 30

TEACHING TOOLS USED

N1. Presentation of selected issues relating to the thesis and discussion
N2. Preparing a multimedia presentation on the task issues - self work
N3. Independent study and preparation for diploma thesis final exam - self work
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	The ability to discuss the issues raised in the discussion, activity in the course classes

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1) Rules of studies at Wroclaw University of Technology
2) Publications from the scope of the thesis carried out
3) Lecture materials

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_MM_W05, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31	C1, C2	Sem3-Sem7	N1, N2, N4
PEK_K01	K1MTR_K03	C2	Sem2-Sem7	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca dyplomowa**
Name in English: **Diploma thesis**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037002**
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)				360	
Form of crediting				Examination	
Group of courses					
Number of ECTS points				12	
including number of ECTS points for practical (P) classes				12	
including number of ECTS points for direct teacher-student contact (BK) classes				12.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS deficit no greater than it is due to the resolution of the Faculty Council

SUBJECT OBJECTIVES

C1. Conduct by the student thesis on the basis of the acquired while studying structured, underpinned by the theory of general and detailed knowledge with a range of science and technical areas relevant to studiowanego the direction of Mechatronics
C2. Writing by a student "thesis" (as work) and to present an oral presentation concerning the issues of the scope of the study Mechatronics, on the basis of the information from the literature and the results of their own work
C3. Persisting the ability to work independently and in a team

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student can create technical texts ("thesis") and multimedia presentations from the scope of the issues towards Mechatronics

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

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Collecting the literature of the subject and to become acquainted with it	0
Proj2	Own work - critical assessment and interpretation of laboratory results	0
Proj3	Writing a thesis as works	0
		Total hours: 0

TEACHING TOOLS USED

N1. Presentation of selected issues relating to the thesis and discussion
N2. Own work - study of literature from the scope of the topic of the thesis and research work
N3. Own work - writing technical and scientific text controlled by the promoter
N4. Consultation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Work in a semester, the deliver of thesis as works
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Specialist subject literature agreed with the promoter

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MM_U01, K1MTR_MM_U02, K1MTR_MM_U03, K1MTR_MM_U04, K1MTR_MM_U05, K1MTR_MM_U06, K1MTR_U01, K1MTR_U02, K1MTR_U03, K1MTR_U04, K1MTR_U05, K1MTR_U06, K1MTR_U07, K1MTR_U08, K1MTR_U09, K1MTR_U10, K1MTR_U11, K1MTR_U12, K1MTR_U13, K1MTR_U14, K1MTR_U15, K1MTR_U16, K1MTR_U17, K1MTR_U18, K1MTR_U19, K1MTR_U20, K1MTR_U21, K1MTR_U22, K1MTR_U23, K1MTR_U24, K1MTR_U25, K1MTR_U26, K1MTR_U27, K1MTR_U28, K1MTR_U29, K1MTR_U30, K1MTR_U31	C2	Proj2, Proj3	N1, N3, N4
PEK_K01	K1MTR_K03, K1MTR_K10	C3	Proj1, Proj2, Proj3	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Laboratorium mikro- i nanoelektroniki**
Name in English: **Laboratory on micro- and nanoelectronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037201**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Introducing students with the fabrication techniques of modern microelectronics devices
C2. Introducing students with the properties of the elements fabricated using -techniques of the micro- and nanoelectronics
C3. Introducing students with the organization and operation of modern microelectronic laboratories

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Students can design a manufacturing process used to manufacture electronic components including selected commercial and economic criteria, using appropriate methods, techniques, tools and materials. Apply principles of occupational health and safety, and knows the rules of working in a laboratory environment and industrial

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	The organization and operation of modern semiconductor laboratory	3
Lab2	The use of CVD technology (PECVD techniques, ICPCVD, RIE) in microelectronics	3
Lab3	Technological equipment for thick film and LTCC technology	3
Lab4	Fabrication of the microelectronic circuits using thick-film technology	3
Lab5	Fabrication of the microelectronic circuits using LTCC technology	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1) L. Golonka, K. Malecha, "Ceramic microsystems", Printpap, Łódź, 2011

SECONDARY LITERATURE
1) L. Golonka, "Technology and applications of low temeprature cofired ceramic (LTCC) based sensors and microsystems", Bulletin of the Polish Academy of Sciences, Technical Science, vol. 54, no. 2, 2006, 221-231

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laboratory on micro- and nanoelectronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MM_U03	C1-C3	La1-La5	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody numeryczne**
Name in English: **Numerical methods**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037202**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on mathematics
2. Basic knowledge on software engineering
3. Basic knowledge on computer skills

SUBJECT OBJECTIVES

C1. Familiarize students with numerical methods and algorithms used in engineering
C2. Familiarize students with prons and cons of numerical methods and techniques
C3. Hands-on learning the scrippting Python language
C4. Consolidation of skills for self and team work based on supplied teaching materials

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has the basic, structured and theoretically founded knowledge in the field of numerical methods applied in engineering. Range of the contained knowledge covers such problems as: error analysis, numerical differentiation and integration, solving linear and nonlinear equations and set of equations, numerical interpolation and approximation, single and multi-criteria optimization along with design of experiments
PEK_W02 - Contains the basic knowledge on numerical modelling of continuum and discrete simulation of physical phenomena in macro, micro and meso scale.

II. Relating to skills:
PEK_U01 - Is capable of selecting appropriate engineering methods, software tools and numerical algorithms in order to solve typical problems concerning numerical prototyping in engineering.
PEK_U02 - Is able to interpret the achieved results and use appropriate methods of experimental data validation
PEK_U03 - Can properly prioritize tasks in order to finalize a specified work concerning numerical prototyping in engineering

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Introduction to numerical methods, Python scripping language and Modelus software	2
Lab2	Numerical differentiation and integration methods	2
Lab3	Linear and nonlinear equations	2
Lab4	Linear and nonlinear set of equations	2
Lab5	Interpolation, approximation and extrapolation methods	2
Lab6	Numerical methods of solving partial differential equations	2
Lab7	Design of experiments methods and data analysis	2
Lab8	Individual project assessment	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Janowski WE., „Matematyka” tom I i II, PWN, 1968
2. Volk W., „Statystyka stosowana dla inżynierów”, WNT, 1973
3. Feynmann R.P.; „Feynmana wykłady z fizyki” tom I i II, PWN, 1968

SECONDARY LITERATURE

1. Kreyszig E., „Advanced Engineering Mathematics”, John Wiley and Sons, 2006
2. Montgomery D., “Design and Analysis of Experiments”, John Wiley and Sons, 2005
3. Pang T., “ An Introduction to Computational Physics”, Cambridge University Press, 2006

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W04	C1-C3	La1-La7	N1-N3
PEK_U01	K1MTR_MM_U04	C1-C3	La1-La7	N1-N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Artur Wymysłowski email: artur.wymyslowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Montaż zespołów elektronicznych i fotonicznych**
Name in English: **Packaging of Electronic and Photonics Systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037203**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The knowledge gained in this course: Electronic Components

SUBJECT OBJECTIVES

C1. Mastery of theoretical knowledge specified in Wy_01-Wy_09
C2. Gaining practical skills through laboratory tasks L_01-L_06
C3. Able to work in a group of laboratory, taking in the different roles

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Structured and theoretical knowledge in the field of electronic packaging allows independent design of electronic systems based on the available electronic components and packaging techniques
PEK_W02 - The knowledge of electronic packaging allows independent performance electronic systems

II. Relating to skills:
PEK_U01 - Ability for proper selection and applying the techniques of electronic packaging according to the design requirements and reliability made devices

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture; packaging levels	1
Lec2	Elements and architecture of connections	2
Lec3	Substrates. Printed circuit boards	2
Lec4	Wire bonding	1
Lec5	Flip chip bonding	2
Lec6	Soldering technology	2
Lec7	Adhesives for packaging; materials and technology	2
Lec8	Connections and connectors	1
Lec9	Environmental exposure, heat dissipation problems	1
Lec10	Completion of the course	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction to laboratory classes, health and safety regulations	2
Lab2	Surface mount technology	3
Lab3	The use of electrically conductive adhesives for electronic packaging	3
Lab4	The study of mechanical strength of solder and adhesive joints	3
Lab5	The study of ionic contamination introduced in the packaging processes	3
Lab6	Completion of the course	1
		Total hours: 15

TEACHING TOOLS USED

N1. Lecture with multimedia presentations and discussion
N2. Laboratory: a brief 10-minute introduction to the course and knowledge test
N3. tutorials
N4. Self-study and preparation for test
N5. Self-study and preparation for laboratory classes

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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	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	Summary results of the work carried out within the framework of the laboratory
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] J. Felba, Montaż w elektronice, Oficyna Wydawnicza Politechniki Wrocławskiej, 2010

SECONDARY LITERATURE
[1] R. Kisiel, Podstawy technologii dla elektroników, Wydawnictwo BTC Korporacja, 2012
[2] K. Bukat, H. Hackiewicz, Lutowanie bezołowiowe, Wydawnictwo BTC, Warszawa, 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Packaging of Electronic and Photonics Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W18	C1	Lec1-Lec9	N1, N3, N4
PEK_W02	K1MTR_W18	C2	Lec1-Lec9	N2, N3, N5
PEK_U01	K1MTR_U18	C1,C2,C3	La1-La5	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Urządzenia peryferyjne systemów komputerowych**
Name in English: **Peripheral Devices in Computer Systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCD037204**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic PC computer skills
Basic knowledge in the field of information technology and information transmission

SUBJECT OBJECTIVES

C1. Mastering the intermediate level of knowledge of the principles of operation and maintenance of peripheral devices used in computer systems
C2. Knowledge and skill in standard modes of communication with PC peripherals, principles of data transmission, processing and collection
C3. Preparing students to carry out research in the field of digital electronics, mechatronics, electronic and optoelectronic sensors

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Theoretical and practical knowledge of a wide range of peripheral devices used in computer systems

II. Relating to skills:
PEK_U01 - Ability to use and practical application of peripherals, including advanced acquisition and data systems
PEK_U02 - The student is able to plan and carry out experiments, including measurements and computer simulations, interpret the acquired results and draw conclusions
PEK_U03 - The student is able to use the analytical, simulation and experimental methods for formulating and solving engineering tasks

III. Relating to social competences:
PEK_K01 - The student is able to interact and work in a project group, assuming different roles in the project

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification of peripheral computer systems, integration of peripheral devices in computer systems - interfaces and control protocols	3
Lec2	Monitors and graphics adapters	3
Lec3	Data storage. Physical rules for recording information on a different medium	3
Lec4	Graphics devices. Ways to create characters and graphics	3
Lec5	Sound cards - digital recording and sound synthesis	3
Lec6	Keyboard and pointing devices	3
Lec7	Wired communication interfaces	3
Lec8	Wireless communication interfaces	3
Lec9	The measuring equipment running on ISA, PCI, PCI Express busses.	3
Lec10	Test	3
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	The development of theoretical assumptions of the proposed device	4
Lab2	Carrying out computer simulation of the designed device	4
Lab3	The preparation of documentation of designed device	7
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture supported by presentations and interactive elements of the knowledge evaluation
N2. Proof test in the mid of the course
N3. Laboratory: short, 10-minute tests on the beginning of the exercises
N4. Own work - preparation for laboratory exercises
N5. ND_05 Self-study and preparation for test ND_06 Consultations ND_07 Final test

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U3	Assessment of the performed exercises, evaluating the effectiveness of the implementation of exercises
F2	PEK_K01	Assessment of the performed exercises, evaluating the effectiveness of the implementation of exercises
P = F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Halsall F., Data Communications, Computer Networks and Open Systems, Addison-Wesley, 1992
2. Kolan Z., Urządzenia techniki komputerowej, SCREEN, Wrocław, 1994
3. Kolan Z., Urządzenia peryferyjne mikrokomputerów, CWK, Wrocław, 1992
4. Rembold U., Armbruster K., Ulzmann W., Interface technology for computer controlled manufacturing processes,, Marcel Dekker Inc., New York, 1983
5. Smith N., Drukarki laserowe HP Laser Jet, MIKOM, 1995
6. Wojtuszkiewicz K., Urządzenia techniki komputerowej, Cz.2 Urządzenia peryferyjne i interfejsy, MIKOM, 2007

SECONDARY LITERATURE
1. Gniadek K., Optyczne przetwarzanie informacji, PWN, Warszawa, 1992
2. Kopacz T., Karty graficzne VGA i SVGA, MIKOM, 1995
3. Prendergast R., Brekke D., Modemy, krótki kurs, ZNI MIKOM, 1996

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Peripheral Devices in Computer Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MM_W02, K1MTR_MM_W06	C1, C2	Lec1-Lec10	N1,2,5,6
PEK_U01	K1MTR_MM_U02	C1, C2	La1-La3	N3,4,6
PEK_K01	K1MTR_K03	C1, C2	La1-La3	N3,4,6

SUBJECT SUPERVISOR

dr inż. Mateusz Wośko email: mateusz.wosko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska**
Name in English: **Engineering Graphics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM031005**
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

1. Basic drawing skills with the use of drawing tools

SUBJECT OBJECTIVES

C1. The acquisition of knowledge and skills in basic issues of descriptive geometry.
C2. The acquisition of knowledge and skills in rectangular in mapping the elements of space on the plane and the rules for engineering drawing with the use of views, sections, and lays in the engineering drawings.
C3. The acquisition of knowledge and skills in the field of reading and drawing skills used in typical technical documentation using the handwriting method and using computer technique.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows and is able to propose an appropriate way of representing spatial geometry in the plane of the drawing.
PEK_W02 - The student knows and is able to explain the rules of constructions drawings and creating the technical documentation of elements and mechanical components.
PEK_W03 - The student knows and is able to select appropriate drawing techniques in the conducted design and construction process.

II. Relating to skills:
PEK_U01 - The student can apply the descriptive geometry for the geometric shapes plot.
PEK_U02 - The student knows how to draw the drawings used in the technical documentation.
PEK_U03 - The student can use computer technique when creating drawing documentation.

III. Relating to social competences:
PEK_K01 - The student is able to correctly identify and evaluate information in drawing the technical documentation of machine component and complex technical systems

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Space projection on a plane. Methods of projection. The orthographic projection of points, lines, planes and simply figures.	1
Lec2	The basic rules in the engineering graphics. Types of views in a technical documentation.	2
Lec3	The application of sections, revolved and removed sections.	2
Lec4	The rules of dimensioning of machine elements. Tolerance dimensioning.	2
Lec5	The drawing of basic joints of machine elements.	2
Lec6	The creation of technical drawing documentation (detail drawings, assembly drawings, general arrangement drawings, schematic drawing).	2
Lec7	Final test	2
Lec8	The rules of standardization in engineering graphics. Discussion of the final rest results. The course summary.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction. The orthographic projection. Points, lines and planes in space - projection on two ortogonal planes of projection (Monge's method projection).	2
Lab2	The mutual position of points, straight lines and the planes in space in Monge's projections.	2
Lab3	The projection and intersections of flat figures.	2
Lab4	The composition of drawings in engineering graphics. Technical sketches. Projection - views of simple elements of machine.	2
Lab5	Fundamentals of computer-aided design (CAD) programs. Schematic drawing.	2

Lab6	Drawing simple machine elements using CAD software.	2
Lab7	Sections. Drawing elements with a higher degree of complexity.	2
Lab8	Drawing of rotary machine components (shaft or bush type)	2
Lab9	Dimensioning. Tolerances.	2
Lab10	Final test	2
Lab11	Reading the information of the technical documentation on the example of detail drawings. Description of the surface roughness on drawings. Tolerances of shape and position.	2
Lab12	Design work - drawing technical documentation of a simple device with welded and threaded joints. Presentation of the topic - technical sketch.	2
Lab13	Design work - the assembly drawing.	2
Lab14	Design work - detail drawings, schematic drawing.	2
Lab15	Evaluation of design work. Final grade of the course.	2
		Total hours: 30

TEACHING TOOLS USED

N1. The traditional lecture with the use of transparencies and slides
N2. The individual work at the computer under the guidance of the teacher
N3. Solving drawing tasks with the tutor
N4. Student self-study; solving the homework

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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	quizes
F2	PEK_U02	test

F3	PEK_U03	rating of solved tasks during laboratory classes using computer-aided design programs
P = 0.2*F1+0.6*F2+0.2*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Dobrzański T., Rysunek techniczny maszynowy. Wydawnictwo Naukowe PWN, Warszawa 2017.
[2] Rydzanicz I., Zapis konstrukcji. Podstawy. Oficyna Wyd. PWr, Wrocław 2000.
[3] Suseł M., Makowski K.. Grafika inżynierska z zastosowaniem programu AutoCAD, Oficyna Wydawnicza PWr, 2005.
[4] F. E. Giesecke et al., Engineering Graphics. Pearson Education Inc. 2004.

SECONDARY LITERATURE
[1]Rydzanicz I., Rysunek techniczny jako zapis konstrukcji. Zadania. WN-T, Warszawa 2009.
[2] K. Michel, T. Sapiński: Rysunek techniczny elektryczny, WNT, Warszawa, 1987
[3] Zbiór zadań z geometrii wykreślnej pod red. T. Nowakowskiego. Oficyna Wyd. PWr, Wrocław 2001

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W06	C1, C2	Lec1-Lec6, Lec8	N1
PEK_U01	K1MTR_U05	C1	Lab1-Lab3	N1, N3, N4
PEK_U02, PEK_U03	K1MTR_U05, K1MTR_U09	C2, C3	Lab4-Lab9, Lab11-Lab14	N2,N3,N4
PEK_K01	K1MTR_K05	C3	Lab11	N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy zarządzania**
Name in English: **Essentials of Management**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM031006**
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. No initial prerequisites are required.

SUBJECT OBJECTIVES

C1. Acquiring knowledge about the process of management and basic trends and concepts of management.
C2. Acquiring knowledge about the nature and mechanisms of an organization.
C3. Acquiring knowledge about the analysis of management problems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student is able to characterize different trends occurring in the evolution of organization and management theory, and to describe the most important concepts of both traditional and modern management

PEK_W02 - The student is able to characterize basic mechanisms of organization, to distinguish between types of organizational structures, to list components of the organization and its environment.

PEK_W03 - The student is able to describe the process of management and how to implement various functions in the organization and management style.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization and its resources. Introduction of the proces of management.	1
Lec2	Organization's environment. Manager and manager's work.	2
Lec3	The evolution of the theory of management.	2
Lec4	The function of planning in organization. Decision making process. Strategy and strategic management.	2
Lec5	The function of organizing. Organizational structures. Human resources management.	2
Lec6	The function of leading. Human behaviors in organizations. Motivating.	2
Lec7	The function of controlling. Steps and levels of control.	2
Lec8	Test.	2
		Total hours: 15

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Essentials of Management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W04, K1MTR_W28	C1-C3	Lec1-Lec7	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie informacyjne**
Name in English: **Information Technology**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM031007**
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. none

SUBJECT OBJECTIVES

C1. The harmonization of terminology in the field of information technology and to present the origins, history and current state of development of computer science.
C2. Strengthening the knowledge on the functioning of computers and provide general principles for constructing algorithms (computer).
C3. General guidance on the preparation of publications and technical presentations.
C4. Internet and privacy on the Internet, adherence to good manners online, law on the Internet, copyright law.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic principles of design and theoretical description of modern computers, knows the rules of binary arithmetic (integer and non-integer).
PEK_W02 - The student knows the basic principles of designing algorithms.

II. Relating to skills:
PEK_U01 - Able to effectively use the tools to support the creation of technical publications, can separate form from content.
PEK_U02 - Students can use the available "office tools" to solve basic engineering tasks.
PEK_U03 - The student can independently construct a simple algorithm solves the given simple problem.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Technical Publication. The content and form. Styles.	2
Lec2	Technical Publication. Automatically lists.	2
Lec3	Computers and computer arithmetic.	2
Lec4	Algorithms. Formal methods of presentation of the algorithm. Finite automaton.	2
Lec5	How to create algorithms?	2
Lec6	The computational complexity. "Difficult" task.	2
Lec7	Internet and around or "Cicer cum caule".	2
Lec8	quiz	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Styles and their modifications, illustrations, and working with a spreadsheet.	2
Lab2	Automatic tables of contents, illustrations, bibliography ...	2
Lab3	(Final) document formatting.	2
Lab4	Calculation errors. Python	2
Lab5	Errors - practical calculations.	2
Lab6	Computational capabilities of the computer.	2
Lab7	Elements of Programming (conditional statements, loops, ...) Interesting tasks.	2
Lab8	Summary and Assessment.	1
		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
N4. computational laboratory experiment.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	quiz
F2	PEK_W02	quiz
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_W01	laboratory report
F2	PEK_W02	laboratory report, quiz.
F3	PEK_U01	laboratory report
F4	PEK_U02	laboratory report
F5	PEK_U03	laboratory report, quiz.
P = F1+F2+F3+F4+F5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Algorithmics: The Spirit of Computing (3rd Edition) by David Harel and Yishai Feldman (Jun 11, 2004)

SECONDARY LITERATURE
2. Computers Ltd.: What They Really Can't Do (Popular Science) by David Harel (Dec 11, 2003)

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W01	C1, C2	Lec1-Lec8	N1, N2, N3
PEK_W02	K1MTR_W02	C2	Lec1-Lec8	N1, N2, N3, N4
PEK_U01	K1MTR_U19	C3	Lab1 - Lab8	N1, N2, N3
PEK_U02	K1MTR_U19	C2, C3	Lab1 - Lab8	N1, N2, N3
PEK_U03	K1MTR_U19	C2	Lab1 - Lab8	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wstęp do mechatroniki**
Name in English: **Introduction to Mechatronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM031008**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of physics and mathematics
2. Technical interest - interdisciplinary

SUBJECT OBJECTIVES

C1. Show area, competencies and requirementsfor Mechatronics - as a guide for the entire study program
C2. Aware of the problems of interdisciplinary work and applied solutions
C3. Introduce the basic components of mechatronic systems and integration between
C4. Make familiar with a variety of application examples of mechatronic systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Can explain the meaning and application of mechatronics in technology and interdisciplinary issues
PEK_W02 - Can discuss the various components of mechatronic systems and integration issues between them
PEK_W03 - Can discuss examples of mechatronic solutions for various applications

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, what is mechatronics, application areas, competence	2
Lec2	Interdisciplinary projects, teamwork, communication and documentation language	2
Lec3	Control and regulation	2
Lec4	Signals and digital transmission, sensor technology	2
Lec5	Actuators and drives, human-machine interface	2
Lec6	PLCs, CNC, RC, and IPC	2
Lec7	Algorithms and programming, operating systems	2
Lec8	Embedded Systems and RT	2
Lec9	Modeling and simulation in mechatronics	2
Lec10	Applications (W5)	2
Lec11	Applications (W12)	2
Lec12	Applications (W10)	2
Lec13	Applications for medicine, entertainment, etc	2
Lec14	Design of mechatronic systems	2
Lec15	Final assessment	2
		Total hours: 30

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem lecture
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

David Bradley & David W. Russell, Mechatronics in Action: Case Studies in Mechatronics - Applications and Education, Springer 2010
David G. Alciatore, Michael B. Histand, Introduction to Mechatronics and Measurement Systems, Fourth edition, McGrawHill, 2011

SECONDARY LITERATURE

A. Milella, D.Di Paola, G. Cicirelli, Mechatronic Systems Applications, InTech2010
MartínezAlfaro H. (ed.) Advances in Mechatronics, InTech 2011
Devdas Shetty, Richard A.Kolk, Mechatronics System Design, SI Version, Cengage Learning 2010
Ryszard Jabłoński & Mateusz Turkowski & Roman Szewczyk, Recent Advances in Mechatronics, Springer 2007
Klaus Janschek, Mechatronic Systems Design: Methods, Models, Concepts, Springer 2012
Ganesh R. Naik (ed.), Intelligent Mechatronics, InTech 2011

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W26	C1, C2	Lecture 1 - Lecture 2	N1-N3
PEK_W02	K1MTR_W10, K1MTR_W15, K1MTR_W16, K1MTR_W19, K1MTR_W22	C3	Lecture 3 - Lecture 8	N1-N3
PEK_W03	K1MTR_W22, K1MTR_W23	C4	Lecture 9 - Lecture 14	N1-N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo I**
Name in English: **Material Science I**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM032004**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of mathematics, chemistry and solid state physics. He can transpose mathematical records (equations) into graphs and interpret them

SUBJECT OBJECTIVES

C1. To familiarize students with the criteria for classification of engineering materials, groups of these materials and their general characteristics (metal alloys, ceramics, plastics, composites)
C2. Teaching interpretation and applications of phase equilibrium graphs to plan and predict microstructures, properties and the possibility of strengthening materials.
C3. Demonstration of the influence of alloy additives and heat treatment on the behavior of engineering materials

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the group of engineering materials and can justify the criteria for division
PEK_W02 - He is able to determine their basic properties and the resulting areas of application
PEK_W03 - He knows the basic methods of strengthening alloys (introduction of alloy additives, heat treatment, plastic working)

II. Relating to skills:
PEK_U01 - He can choose the construction material for specific strength, corrosion and degradation requirements
PEK_U02 - Is able to develop a technology project to strengthen material for specific requirements
PEK_U03 - Is able to present and justify alternative material solutions in relation to a structural element or a construction team taking into account the terms of cooperation

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Systems and criteria for material classification	2
Lec2	Basic groups of materials, historical outline, development trends	2
Lec3	Characteristics of material groups (metals and metal alloys, polymers and plastics, composites, ceramics)	2
Lec4	Metallic bond, crystal lattice of metals, defects	2
Lec5	Balance and balance criteria. Nucleation and crystallization	2
Lec6	Phase structure and alloy structure	2
Lec7	Phase equation charts	2
Lec8	Iron-carbon balance chart	2
Lec9	The division of iron alloys and the influence of carbon on their properties	2
Lec10	Basics of heat treatment	2
Lec11	Heat treatment technologies	2
Lec12	The effect of alloy additives on the microstructure, properties and applications of alloys	2
Lec13	Non-ferrous metal alloys	2
Lec14	Selected problems of corrosion and corrosion protection	2
		Total hours: 28
Form of classes – Laboratory		Number of hours
Lab1	Methods of materials testing, making samples, handling microscopes	2
Lab2	Macroscopic examinations of external surfaces and breakthroughs	2
Lab3	Macroscopic and microscopic studies of non-metallic materials	2
Lab4	Analysis of phase diagrams of bicomponent systems	2
Lab5	Microstructure of iron-carbon alloys	2

Lab6	Microstructure of alloy steels	2
Lab7	Microscopic examination of copper and aluminum alloys, passing the laboratory	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK _ W01 _ PEK - W03	test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK - U01 - PEK - U03	report from laboratory classes, quiz
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Material Science I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK - W01	K1MTR_W07	C1	Lec1-Lec2	N1, N2
PEK - W02	K1MTR_W02, K1MTR_W07	C1,C2	Lec3-Lec6	N1, N3
PEK - W03	K1MTR_W02, K1MTR_W07	C3	Lec7-Lec14	N1, N2, N4
PEK - U01	K1MTR_U07	C1 - C3	Lab1-Lab6	N3, N5
PEK - U02	K1MTR_U07	C2	Lab4	N3, N5
PEK - U03	K1MTR_U07	C3	Lab5-Lab7	N3, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika I (Statyka)**
Name in English: **Mechanics I (Statics)**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM032005**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis (differentiation, integration)
2. algebra (at secondary level) + linear algebra (matrices, determinants)
3. Euclidean geometry and trigonometry

SUBJECT OBJECTIVES

C1. Solving of practical static and kinematic problems based on the laws of classical mechanics
C2. Implementing of static analysis of strength of machine elements
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define the basic concepts in mechanics (force, moment of force). He knows the classical mechanics equations in statics. He knows some selected methods of solving trusses, beams and frames
PEK_W02 - has a knowledge of the geometry of the masses (static moments, moments of inertia and deviation)
PEK_W03 - He has a knowledge of the basic concepts of particle kinematics and the kinematics of a rigid body (speed, acceleration, number of degrees of freedom, the trajectory and motion equations)

II. Relating to skills:
PEK_U01 - He is able to solve typical engineering structures (trusses, beams, frames) under static load: reactions at the supports, the internal forces (as an analytic functions and their graphs)
PEK_U02 - He is able to determine the position of centre masses, static moments and moments of inertia of basic mechanical systems and the principal axes and moments of inertia in coplanar system
PEK_U03 - He can calculate the velocity and acceleration of any points of typical mechanical systems and their components

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. Outline of vector algebra	2
Lec2	Force, moment of force, the main vector and main moment of forces, equilibrium conditions, the axioms of statics. Changing of the moment’s pole	2
Lec3	Concurrent force system. Trusses. Method of separated nodes	2
Lec4	Determination of the reaction forces in the case of coplanar force systems (applying in the beams, trusses, plane frames, etc.)	2
Lec5	Ritter’s method to determining the forces in selected truss members. The reduction of coplanar force system. Culmann’s method.	2
Lec6	The internal forces in statically determinate beams (analytical method)	2
Lec7	Determination of internal forces in the frames	2
Lec8	Centre of masses in discrete and continuous systems. Static moments	2
Lec9	Moments of inertia, parallel and rotational transformation	2
Lec10	principal axes and moments of inertia in coplanar system	2
Lec11	Particle kinematics (trajectory, velocity, acceleration). Curvilinear motion, tangential and normal acceleration. Kinematics in the natural and polar coordinate system	2
Lec12	The notion of a rigid body. Degrees of freedom. Classification of the motion of a rigid body. Formulas for calculation the velocity and acceleration in the general motion case.	2

Lec13	Kinematics of rigid body rotation. Rotational velocity and acceleration. Plane motion. Methods for determining the velocity of the plane motion (instantaneous center of rotation, centroid)	2
Lec14	Acceleration in plane motion of a rigid body. Instantaneous center of accelerations.	2
Lec15	Test	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Basic operations on vectors: analytical and graphical summation, scalar and vector multiplication, etc.	2
Cl2	Determination of forces in the bars of planar systems (trusses) by separated nodes method using equilibrium equations and polygon of forces	2
Cl3	Determination of reaction forces in bearings of any planar systems by analytical methods	2
Cl4	Determination of reaction forces in bearings of spatial systems (one example)	1
Cl5	Determination of forces in freely selected truss rods (by Ritter's method)	1
Cl6	Test 1: vectors, trusses	1
Cl7	Determination of internal forces in beams	1
Cl8	Determination of internal forces in beams (cont.). Articulated beams.	2
Cl9	Determination of internal forces in frames (simple planar frames at most with one node)	2
Cl10	Test 2: the internal forces in planar systems	1
Cl11	Determination of mass centres and static moments in discrete multi-mass systems.	1
Cl12	Determination of mass centres and static geometrical moments in static continuous planar systems.	2
Cl13	Determination of the moments of inertia in planar discrete-continuous systems and deviation moments relative to any axis by application Steiner's law.	2
Cl14	Determination of the position of the principal central axis of inertia and values of the principal inertial central moments for planar systems (one example).	2
Cl15	Test 3: centres of masses, static and inertial moments.	1
Cl16	Solving the problems of particle kinematics in the Cartesian coordinate system.	2
Cl17	Solving the kinematic problems of rotation and translatory motion of rigid body.	2
Cl18	Determination of velocity in rigid body plane motion	2
Cl19	Test 4: kinematics	1
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. 4 tests instead of two colloquia forcing students to more systematic own work during the semester, including greater use of consultation
N4. tutorials

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	test 1 and 2 and/ or oral replies
F2	PEK_U02	test 3 and/ or oral replies
F3	PEK_U03	test 4 and/ or oral replies
P = 2 jeśli ocena F1=2. Jeśli nie to P=(2F1+F2+F3):4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. B. Gabryszewska, A. Pszonka: "Mechanics", Part 1: Statics, WUT, 1988
2. J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
3. J. Misiak: "General Mechanics. Statics and Kinematics ". Volume I, WNT, Warsaw, 1993
4. M. Kulisiewicz St. Piesiak: "The dynamics of mechanical systems in technical tasks" Part I: "Fundamentals of Kinematics", WUT, 2002
5. C. Witkowski, "Exercises in mechanics." Part I. "Kinematics". WUT. 1999
6. Z. Jaśniewicz , "Exercises in statics “ WUT. 1996

SECONDARY LITERATURE
1 J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
2 B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
3 J. Leyko: "General Mechanics", WNT, Warsaw, 1980
4 S. Piasecki, J. Rżysko: "Mechanics" WNT, Warsaw, 1977,
5 W. Siuta: "Engineering Mechanics", WNT, Warsaw, 1968

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics I (Statics)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W01, K1MTR_W02, K1MTR_W08	C1, C2	Lec 1 to Lec 15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MTR_U08	C1, C2	CL 1 to Cl 19	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM032006**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about quantities and units of measurement associated with the geometry of the product description.
C2. Acquisition of knowledge about the types and characteristics of equipment for the measurement of geometrical quantities.
C3. Learning how to use the equipment for measurement of geometrical quantities.
C4. Gaining skills in the selection of test equipment, analyze test results, evaluation of measurement errors and the expression of measurement uncertainty.
C5. Wyszukiwanie istotnych informacji oraz ich krytyczna analiza.
C6. The acquisition and consolidation of social skills including emotional intelligence, involving the cooperation among students with a view to effective problem solving. Responsibility, honesty and fairness in the academic society life.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It can identify the quantity associated with of the geometrical description of the product, can name units of measure used to describe them, know diferences between universal and dedicated equipment for the measurement of geometrical quantities, know how to describe its metrological characteristics. He knows and is able to explain the terms used in metrology of geometrical quantities.
PEK_W02 - Able to define the elements of the measurement process and their impact on the result of the measurement.
PEK_W03 - Knows the specific, standardized quantities are subject of measurements of a different typical machine manufacturing techniques.

II. Relating to skills:
PEK_U01 - Understands the dimensional requirements imposed to products included in the technical documentation. Can use standards for tolerances and fits linear and geometric tolerances. It can calculate the value of measurement errors, estimated measurement uncertainty for the different measurements.
PEK_U02 - He can make the selection of appropriate test equipment and set it up depending on the task measuring. Can use measuring equipment used in engineering to measure the geometrical quantities.
PEK_U03 - Able to solve the basic problems of the practical use of the tools and of measuring. Able to recognize sources of error, their values, and estimate the uncertainty of measurement.

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Team collaboration on improving the method of selection of strategies aimed at optimal solution entrusted of problems to a group.
PEK_K03 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology. Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2

Lec2	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec3	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	2
Lec4	Tolerance and machine parts measurement.	3
Lec5	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec6	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec7	Basics of coordinate masurement technique	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Measurements of linear dimensions.	2
Lab3	Measurements of angular dimensions. Direct and indirect measurements of cones.	2
Lab4	Identification and measurement of threads.	2
Lab5	Assessment of the geometrical structure of the surface.	2
Lab6	Identification and measurement of cylindrical gears.	2
Lab7	Measurements of selected shape deviations and displacement.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Jakubiec W., Malinowski J.: "Metrologia wielkości geometrycznych". WNT, Warszawa 2007.[2] Instrukcje do ćwiczeń laboratoryjnych.

SECONDARY LITERATURE

[1] Adamczak S., Makieła W.: " Metrologia w budowie maszyn. Zadania z rozwiązaniami. Wydanie II, zmienione". WNT, Warszawa 2007.[2] Adamczak S., Makieła W.: "Pomiary geometryczne powierzchni". WNT, Warszawa 2009.[3] Humenny Z. i inni: " Specyfikacje geometrii wyrobów (GPS)". WNT, Warszawa 2004[4] Jakubiec W., Malinowski J., Płowucha W.: "Pomiary gwintów w budowie maszyn". WNT, Warszawa 2008.[5] Jezierski J., Kowalik H., Siemiątkowski Z., Warowny R.:" Analiza tolerancji w konstrukcji i technologii maszyn". WNT, Warszawa 2009.[6] Ochęduszko K., "Koła zębate. Tom 3. Sprawdzanie". WNT Warszawa 2007 (dodruk 2012)[7] Ratajczyk E.: "Współrzędnościowa technika pomiarowa". Oficyna Wydawnicza PW, Warszawa 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Metrology of geometrical quantites
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1MTR_W03	C1; C2; C3; C4; C5; C6	Wy1-Wy7	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1MTR_U29	C1; C2; C3; C4; C5; C6	La1 - La7	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1MTR_K03, K1MTR_K04, K1MTR_K09	C1; C2; C3; C4; C5; C6	La1 - La7	N1; N2; N3; N4; N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wprowadzenie do informatyki**
Name in English: **Introduction to programming**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM032101.**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30		
Number of hours of total student workload (CNPS)	30		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				

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		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
Lab13		2
Lab14		2
Lab15		2
		Total hours: 30

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_K01	
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to programming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19			

PEK_U01	K1MTR_U19			
PEK_K01	K1MTR_K03			

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria programowania i UML**
Name in English: **Software Engineering and UML**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM033005**
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. Understands the principles of computer algorithms processing
2. Knows the semantics and syntax of C

SUBJECT OBJECTIVES

C1. Explain the functions, methods and tools (UML) software engineering
C2. Learn object-oriented thinking
C3. Prepare for practical classes with object-oriented programming

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Understands the essence of methodical troubleshooting and application development tools
PEK_W02 - Has knowledge of object-oriented programming paradigm and writing UML
PEK_W03 - Can read and understand simple programs in C ++

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to object-oriented programming, examples, tools, CASE	2
Lec2	Models of software development (life cycle)	2
Lec3	Object-oriented requirements analysis (UML - Use case diagrams, activity)	2
Lec4	Object-oriented design (UML - basic models, static and dynamic)	2
Lec5	Object-oriented design (UML - basic models, static and dynamic)	2
Lec6	Implementation of object-oriented (C ++) - levels of classes	2
Lec7	Implementation of object-oriented (C ++) - a system level	2
Lec8	Final assesment	1
		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_W01, PEK_W02, PEK_W03	final assesment
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Bruegge Bernd, Dutoit Allen H. Inżynieria oprogramowania w ujęciu obiektowym, Helion 2011
Larman Craig, UML i wzorce projektowe. Analiza i projektowanie obiektowe oraz iteracyjny model wytwarzania aplikacji, Helion 2011

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Software Engineering and UML
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19, K1MTR_W32	C1	Lecture 1 - Lecture 2	N1
PEK_W02	K1MTR_W19, K1MTR_W32	C2	Lecture 3 - Lecture 5	N1
PEK_W03	K1MTR_W19	C3	Lecture 6 - Lecture 7	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika II (Dynamika)**
Name in English: **Mechanics II (Dynamics)**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM033006**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. mathematical analysis (differentiation, integration)
2. differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

C1. Knowledge of analytical methods for the application of the principles of classical dynamics for typical mechanical systems (discrete systems: a material point, system of material points with holonomic constrains, rigid body).
C2. Resolving some technical problems of structure and mechanical systems under dynamic loads.
C3. The acquisition and consolidation of social skills including emotional intelligence relying
ability to work in a group of students with a view to effective problem solving.
Responsibility, honesty and fairness in conduct; observance of manners in
the academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He is able to define key concepts in the dynamics of mechanical systems (momentum, angular momentum, force of inertia, work, kinetic and potential energy)
PEK_W02 - He knows the basic concepts in the field of free and forced vibration of mechanical system with one degree of freedom (natural frequency, frequency characteristics, resonance)
PEK_W03 - He knows the basic principles of dynamic (move of the center of mass, momentum, angular momentum, d'Alembert's principle). He is familiar with the term of conservative system and with energy conservation law. He knows the dynamics equations of rotational motion and plane motion of a rigid body.

II. Relating to skills:
PEK_U01 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion of a point.
PEK_U02 - He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using Newton's second principle. It can calculate the frequency of free vibration for systems with one degree of freedom of the linear viscous damping and without damping.
PEK_U03 - He can derive the equations of motion and calculate its parameters (rotational velocity and acceleration) for rigid body loaded by torque and moves rotation. He can determine the reaction force constraints under dynamic loads. It can calculate the kinetic and potential energy for complex mechanical systems. He is able to apply the energy conservation law to determine the differential equations of conservative system

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Program, requirements, literature. The basic principles of classical mechanics. Kinematics and dynamics. Models of discrete and continuous dynamical systems in mechanics.	2
Lec2	A brief reminder of the kinematics of the material from the previous semester. Addendum: Kinematics of relative motion (Coriolis acceleration)	2
Lec3	Newton's second law (applicable in the dynamics of the free and constrained point)	2
Lec4	The vibrations of the one-mass single degree of freedom system with the linear viscous damping and without damping. Complex notation. Free vibrations.	2
Lec5	Harmonically forced vibration, frequency characteristics, resonance. Dynamic and kinematic excitations	2
Lec6	The forces of inertia and d'Alembert's principle. Momentum, and momentum principle. Angular momentum and angular momentum principle.	2
Lec7	The notion of work. Elementary work. The kinetic and potential energy. The principle of work and kinetic energy equivalence.	2
Lec8	The principle of conservation of energy. Conservative systems. Examples of applications.	2

Lec9	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems	2
Lec10	The principle of the center of mass motion and the principle of momentum in multi-mass systems	2
Lec11	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation.	2
Lec12	Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness	2
Lec13	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces.	2
Lec14	Angular momentum in the plane motion of a rigid body and dynamics of plane motion.	2
Lec15	The kinetic energy of a rigid body in a general motion. König's theorem. Determination of the differential equations of motion and natural frequency of the dynamical conservative systems based on the energy conservation law.	2
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Practical problems of plane motion of rigid body	2
Cl2	Practical problems of kinematiks of relative motion of point	2
Cl3	Solving examples of tasks with dynamic free material point using Newton's second law (rectilinear and curvilinear motion)	2
Cl4	Test 1: kinematics of plane motion and / or the relative motion	1
Cl5	Examples of tasks from free vibration of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations)	2
Cl6	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy)	2
Cl7	Examples of the tasks of the dynamics and rotational motion of the rigid body. Dynamic force responses	2
Cl8	Final test	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	quiz, oral replies
F2	PEK_U02, PEK_U03	test, oral answer
P = (F1+3F2)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1 B. Gabryszewska, A. Pszonka: "Mechanics", Volume II "Kinematics and dynamics", WUT, 1998
2 J. Zawadzki, W. Siuta: "General Mechanics", PWN, Warsaw 1971
3 J. Misiak: "General Mechanics. Dynamics ". Volume II, WNT, Warsaw, 1993

SECONDARY LITERATURE

1 J. Giergiel: "General Mechanics", WNT, Warsaw, 1980
2 B. Skalmierski: "Mechanics" PWN, Warsaw, 1977
3 J. Leyko: "General Mechanics", WNT, Warsaw, 1980
4 M. Klasztorny: "Mechanics", Lower Silesia Ed. Education, Wrocław 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechanics II (Dynamics)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W09	C1	Lec. 1 to Lec. 15	N1, N4

PEK_U01, PEK_U02, PEK_U03	K1MTR_U01, K1MTR_U02	C2	Cl 1 to Cl 15	N2, N3, N4

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów**
Name in English: **Strength of materials, Mechanics of engineering materials**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM033007**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. mathematics (trigonometry, differential and integral equations), physics (statics, kinematics and dynamics)
2. reading comprehension
3. Savoir vivre

SUBJECT OBJECTIVES

C1. Knowledge of fundamental of solid mechanics
C2. The ability to create mathematical models of real structures and their calculations.
C3. acquire skill in qualitative reasoning, interpretation and quantitative analysis of selected phenomena of range strength of materials in the simple and the complex way

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows and understands the concepts of displacement, strain, stress and the stregth hypothesis
PEK_W02 - The student knows the mathematical foundations and their application in the theory of solids continuum
PEK_W03 - Student knows the mathematical models applied in the strength of materials

II. Relating to skills:
PEK_U01 - Student is able to suggest mathematical models and to solve elementary problems of the strength of materials
PEK_U02 - Student is able to design a simple structural member
PEK_U03 - Student is able to solve the statically indeterminate scheme

III. Relating to social competences:
PEK_K01 - Student has the knowledge and skills necessary for effective implementation of the tasks set, ie. he /she knows how

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic definitions and assumptions. Model of the solid. The principle of superposition and de Saint - Venantl law	2
Lec2	Strain and stress analysis	2
Lec3	Stress-strain relationships (The Hooke's Law)	2
Lec4	Tension - compression	2
Lec5	Torsion	2
Lec6	Bending of simple beams- symmetricall bending	2
Lec7	Deflection of beams	2
Lec8	Classical fracture and failure hypotheses	2
Lec9	Tension (compression) and bending. Compression (Tension) and bending.	2
Lec10	Bending and torsion. Tension, bending and torsion	2
Lec11	Bending of beams - unsymmetrical bending	2
Lec12	Columns - Euler's buckling load	2
Lec13	Energy methods	4
Lec14	Test	2
Lec15	1. Riveted joint, Bolted joint, Lap-welded joint - -calculations 2. Torsion - Thin walled irregular sections 3. Curved members 4. Kinetostatic	0
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Calculations on internal forces	2

Cl2	Strain-stress analysis with the common loadings	2
Cl3	Hooke's Law	2
Cl4	Tension (compression)	4
Cl5	Torsion of circular shafts	2
Cl6	Torsion of thin-walled tubes	2
Cl7	Stresses in bending beams	2
Cl8	Deflection of beams	2
Cl9	Strain and stresses of statically determinate beams under simultaneous bending, torsion and tensile (compresion)	4
Cl10	Buckling	2
Cl11	Energy methods	4
Cl12	Test	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_WO3	test, control work, project or other learning achievements during semester, on the basis of Student presence during lectures
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	individual test, oral answers, test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Bielajew N.M., Wytrzymałość materiałów
Brzoska Z., Wytrzymałość materiałów
Huber M.T., Stereomechanika techniczna (Wytrzymałość materiałów)
Katarzyński S., Kocańda S., Zakrzewski M., Badanie własności mechanicznych metali
Kocańda S., Szala J., Podstawy obliczeń zmęczeniowych
Niezgodziński M.E., Niezgodziński T., Wytrzymałość materiałów
Niezgodziński M.E., Niezgodziński T., Wzory, wykresy i tablice wytrzymałościowe
Walczak J., Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności
Zakrzewski M., Zawadzki J., Wytrzymałość Materiałów

SECONDARY LITERATURE
Jakubowicz A., Orłoś Z., Wytrzymałość materiałów
Malinin N. N., Rżysko J., Mechanika materiałów

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of materials, Mechanics of engineering materials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 PEK_W02 PEK_W03	K1MTR_W07	C1	Wy1÷Wy14	N1, N2, N3, N4
PEK_U01 PEK_U02 PEK_U03	K1MTR_U01, K1MTR_U02, K1MTR_U09	C2	Ćw1÷Ćw12	N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy technik wytwarzania**
Name in English: **Fundamentals of manufacturing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM033008.**
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. 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	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K1MTR_W04	C1		N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie w C**
Name in English: **C Programming**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM033102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the semantics and syntax of C
2. Has a basic knowledge of computer algorithms

SUBJECT OBJECTIVES

C1. Learn the ability to use procedural programming paradigm on C language example
C2. Learn skills of programs development and implementation for data processing

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can apply the procedural programming paradigm, ie. To break down the problem into a set of programming functions through various tasks in C

PEK_U02 - Can apply C language to the processing of complex data sets, one and two-dimensional, using dynamic data structures

PEK_U03 - Can test and debug programs written in C, use the C language library documentation, knows and applies the principles of proper programming style

III. Relating to social competences:

PEK_K01 - Can search for technical information and analyze it critically

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Organizational issues, familiarize with the environment of MS Visual Studio	2
Lab2	Signal Processing - generation of selected waveforms data with random disturbances, writing the data to file	2
Lab3	Signal Processing - reading a file, dynamic memory allocation for one dimensional data, programming of filtering algorithms	2
Lab4	Signal processing - robustness, test and debug the program, code documentation	2
Lab5	Image processing - image loading from a file, dynamic memory allocation for multi-dimensional data	2
Lab6	Image processing - data structures	2
Lab7	Image processing - programming of various two-dimensional data processing algorithms	2
Lab8	Image processing - image generating	2
Lab9	Image processing - fault tolerance, organization and project documentation	2
Lab10	Dynamic data structures - work with a dynamic one or doubly linked lists, or a tree	2
Lab11	Dynamic data structure - build a dynamic data structure based on the data stored in the file	2
Lab12	Dynamic data structures - search for items, swap, delete, sort	2
Lab13	Development of individual programs (algorithmization)	2
Lab14	Development of individual programs (implementation and testing)	2
Lab15	Individual Assessment - developed programs	2
		Total hours: 30

TEACHING TOOLS USED
N1. self study - preparation for laboratory class N2. Self - impmementation and documentation N3. tutorials N4. Online knowledge base

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	Verbal answers, quizzes, statements (the assesment program + documentation
P = F1		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE B.W. Kernighan, D. M. Ritchie : Język ANSI C N. Wirth : Algorytmy + Struktury Danych = Programy SECONDARY LITERATURE S. Prata : Szkoła Programowania. Język C++ B. Stroustrup : Język C++ P. Chomicz, R. Ulijasz : Programowanie w języku C i C++. Poradnik programisty

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **C Programming** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechatronics**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19	C1, C2	Lab. 1 - Lab.15	N1, N2, N3
PEK_U02	K1MTR_U19	C1, C2	Lab. 1 - Lab.15	N1, N2, N3

PEK_U03	K1MTR_U19	C1, C2	Lab. 1 - Lab.15	N2, N3, N4
PEK_K01	K1MTR_K01	C1	Lab. 1 - Lab.15	N1, N2, N4

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza i synteza układów kinematycznych**
Name in English: **Analysis and Synthesis of Kinematic Systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM034005**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, analytical geometry, matrix algebra
2. Knowledge of fundamental laws in statics, kinematics and dynamics
3. Skill in fuction analysis, derivatives, fundamental operations on matrices and vectors

SUBJECT OBJECTIVES

C1. Acquire knowledge in topology, kinematics and dynamics of kinematic systems
C2. Acquire knowledge in basic mechanisms design (type and dimensional synthesis)
C3. Getting skills in determining kinematic system analysis (topology, kinematics, kinetostatics)

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Understands theoretical fundamentals of analysis and synthesis of kinematic systems
PEK_W02 - Has the knowledge of kinematic and kinetostatic analysis methods
PEK_W03 - Has the knowledge of dimensional synthesis of basic mechanisms

II. Relating to skills:
PEK_U01 - Is able to evaluate topological properties of kinematic systems
PEK_U02 - Is able to determine kinematic and kinetostatic quantities
PEK_U03 - Is able to create models of mechanisms

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms (links, joints, mobility, redundant constraints)	3
Lec2	Linkages (characteristics). Fundamental kinematic eguations	3
Lec3	Kinematics cont.	2
Lec4	Analytical methods in kinematics	2
Lec5	Planetary transmissions, harmonic drive	2
Lec6	Introduction to dynamics, inertia forces, joint forces	2
Lec7	Kinetostatic analysis, virtual work method	2
Lec8	Friction in joints	2
Lec9	Robot topology, characteristics, analysis of planar systems	2
Lec10	Analysis of manipulators cont.jacobian, forces	2
Lec11	Matrix notation for 3D systems	2
Lec12	Structural synthesis, conceptual design	2
Lec13	Dimensional sythesis of linkages	2
Lec14	Dimensional sythesis of linkages cont	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction, presentation of Adams system - examples of analysis	2
Proj2	Rules of drawing digrams of mechanisms, topology analysis, mobility (test, project)	2
Proj3	Introduction to modelling mechanisms in Adams	2
Proj4	Rules of creating models of mechanisms in Adams	2
Proj5	Rules of creating models of mechanisms in Adams cont (test)	2
Proj6	Mechanism position determination, instant centers of rotation (test, project)	2
Proj7	Kinematic analysis of linkages - velocity and acceleration determination using vector methods (test, project)	2

Proj8	Kinematic analysis of linkages - analytical methods (project)	2
Proj9	Inertia forces, kinetostatic analysis (test, project)	2
Proj10	Kinematics and kinetostatics in Adams (project)	2
Proj11	Planar manipulators - matrix method in kinematics (project)	2
Proj12	Modelling of manipulators using Adams - forward and inverse tasks, driving forces (project)	2
Proj13	Modelling of manipulators cont.	2
Proj14	Planetary transmission analysis - velocity ratio (project)	2
Proj15	Planetary transmission analysis cont.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	project defence
F2	PEK_U01, PEK_U02, PEK_U03	test
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002; Miller S.: Theory of machines and mechanisms. Synthesis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1979

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Analysis and Synthesis of Kinematic Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MTR_W09	C1, C2, C3	Lec1 - Lec15	N1, N2, N4, N5
PEK_U01, PEK_U02, PEK_U03	K1MTR_U09	C3	Pr1 - Pr15	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Antoni Gronowicz tel.: 71 320-27-10 email: antoni.gronowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy technik wytwarzania**
Name in English: **Fundamentals of manufacturing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM034006**
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)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Students should have knowledge of technical drawing, marking dimensions and tolerances of form and position tolerances, surface roughness.
2. Students should have a basic knowledge of mathematics, physics and materials science.
3. The student should be able to overall planning of the experiment and solve simple technical problems.

SUBJECT OBJECTIVES

C1. Transfer of basic knowledge of manufacturing techniques used in mechanical and electronic industries.
C2. Transfer informations about the main ways and techniques of production, grouped in mechanical technologies such as: casting, welding, processing of plastic and machining.
C3. In the area of electronic discussion of such technologies as micro-and nanotechnology production of layers with different properties used in electronics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - The student is able to characterize the manufacturing techniques of different layers used in microelectronic integrated circuits.
PEK_U02 - He can choose the appropriate technology welding, casting and plastic forming and defining the basic parameters of these processes.
PEK_U03 - Students should be able to plan a laboratory experiment in the field of machining, and be able to carry out measurements and analyze the results.

III. Relating to social competences:
PEK_K01 - Students should be aware of professional behavior on the bench and know the main principles of safe operation of lathes.
PEK_K02 - Objectively examine the arguments, rational translations and justify their point of view using the knowledge of manufacturing techniques
PEK_K03 - Students should understand the need for continuous learning and deepen their knowledge and skills with the changing technical and social considerations.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Preparation of thick layer microelectronic circuits.	3
Lab2	Preparation of multilayer LTCC circuits.	3
Lab3	Preparation and characterization of semiconductor layers.	3
Lab4	Preparation and characterization of dielectric layers.	3
Lab5	Preparation and characterization of metal layers.	3
Lab6	Performing cast in sand molds and disposable assets.	3
Lab7	Precision casting using the lost model.	3
Lab8	Manufacture of plastic products.	3
Lab9	Welding (shielded metal Gas metal arc welding, gas tungsten arc welding , micro-plasma welding, gas welding)	3
Lab10	Welding and soldering (resistance and friction welding processes, soldering and brazing)	3
Lab11	Cold deformation and annealing, cupping test plates.	3
Lab12	Rolling of sheets and profile, cutting and bending	3
Lab13	Turning and drilling	3
Lab14	Methods of abrasive machining	3
Lab15	Milling and electrodischarge machining	3
		Total hours: 45

TEACHING TOOLS USED
N1. laboratory experiment N2. self study - preparation for laboratory class N3. report preparation

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Jaworski R. i inni. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr., Wrocław 1981
2.S. Kajzer, R. Kozik, R. Wusatowski: Wybrane zagadnienia z procesów obróbki plastycznej metali. Wyd. PŚl. Gliwice 1997
3.Techniki wytwarzania – obróbka ubytkowa. Laboratorium” pod redakcją Piotra Cichosza
Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002

SECONDARY LITERATURE

1.www.tworzywa.pwr.wroc.pl
2.www.dbc.wroc.pl/Content/7156/Techniki_wytwarzania_Spawalnictwo_A.Ambroziak_linkowane.pdf

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01; PEK_U02; PEK_U03	K1MTR_U03, K1MTR_U11, K1MTR_U29	C1; C2; C3	La1 -La15	N1; N2; N3

PEK_K01; PEK_K02; PEK_K03	K1MTR_K01, K1MTR_K05, K1MTR_K08	C1; C2; C3	La1 - La15	N2; N3

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy wytwarzania i montażu**
Name in English: **Systems for Manufacturing and Assembly**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM034007**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has sound knowledge of and can communicate through engineering drawing.
2. The student has a basic knowledge of manufacturing techniques.

SUBJECT OBJECTIVES

C1. The student is to get to know the structure and technological and utility characteristics of the main types of machine tools.
C2. The student is to get to know how the automatic lathes and numerically controlled machine tools used in automated machining systems work.
C3. The student is to learn the fundamentals of automated assembly and to familiarize herself/himself with the devices used.
C4. The student is to acquire a basic knowledge about the packaging technologies used in electronics and about the packaging equipment used.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the structure of and distinguishes the main types of machine tools and can describe their functionalities. The student knows the structure of and principles of operation of automatic lathes and numerically controlled machine tools and can distinguish them from the conventional machine tools.
PEK_W02 - The student knows the principles of automatic assembly and the solutions used.
PEK_W03 - The student can distinguish the different technologies of packaging electronic elements and can describe the operation of the packaging equipment used.

II. Relating to skills:
PEK_U01 - The student can select cutting machine tools proper for specific technological tasks and develop a concept of an automated manufacturing system.
PEK_U02 - The student can assess the producibility of a design of products to be assembled and employ proper means of automated assembly.
PEK_U03 - The student can employ a proper method of assembling electronic components and select suitable equipment for it.

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The notion of a manufacturing machine, the technological and utility characteristics of manufacturing machines.	2
Lec2	The work components and assemblies of manufacturing systems.	2
Lec3	Drives in contemporary manufacturing systems.	2
Lec4	The main types of machine tools and their technological capabilities.	2
Lec5	The automation of production processes.	2
Lec6	The structure and operation of automatic lathes and automated manufacturing systems.	2
Lec7	The fundamentals of machine tool control.	2
Lec8	NC machine tools in manufacturing systems.	2
Lec9	Robotization in manufacturing processes.	2
Lec10	The automatic assembly of products.	2
Lec11	The levels and technologies of packaging in electronics.	2
Lec12	Systems of wire bonding and flip-chip bonding principles and systems.	2
Lec13	Equipment for manual soldering and wave soldering in electronic packaging.	2
Lec14	Systems for reflow soldering.	2
Lec15	Diagnostic systems in electronic packaging.	2

		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory and discuss safety rules.	1
Lab2	Positioning accuracy measurement of milling machine table.	2
Lab3	Plastic components manufacturing and assembly.	2
Lab4	Analyses of tool changing times in machine tools centre.	2
Lab5	Use of measurement probe to assess the dimensional accuracy of workpiece.	2
Lab6	Machine tool thermal faults compensation in manufacturing process.	2
Lab7	Soldering technology in electronic packaging.	2
Lab8	Diagnostic of joints in electronic packaging.	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W02	final test
F2	PEK_W03	final test
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Bukat K., Hackiewicz H., Lutowanie bezołowiowe, BTC, Warszawa, 2007
2. Felba J., Montaż w elektronice, Oficyna Wydawnicza PWr, Wrocław, 2010
3. Honczarenko J., Roboty przemysłowe. Elementy i zastosowanie., WNT, 1996
4. Kisiel R., Podstawy technologii dla elektroników – poradnik praktyczny, BTC, Warszawa, 2005
5. Koch T., Systemy zrobotyzowanego montażu., Oficyna Wyd. Politechniki Wrocławskiej, 2006
6. Kosmol J., Automatyzacja obrabiarek i obróbki skrawaniem., WNT, 2000
7. Kowalski T., Lis G., Szenajch W., Technologia i automatyzacja montażu maszyn., Oficyna Wyd. Politechniki Warszawskiej, 2000
8. Łunarski J., Szbajkowicz W., Automatyzacja procesów technologicznych montażu maszyn., WNT, 1993
9. Praca zb. pod red. M. Marciniaka, Elementy automatyzacji we współczesnych procesach wytwarzania. Obróbka, mikroobróbka, montaż., Oficyna Wyd. Politechniki Warszawskiej, 2007
10. Tummala R. R. Fundamentals of Microsystem Packaging, McGraw-Hill, New York, 2001

SECONDARY LITERATURE

1. Ganesan S., Pecht M., Lead-free Electronics, John Wiley & Sons Inc., New York, 2006
2. Harper Ch. A., Electronic Packaging and Interconnection Handbook, McGraw-Hill, Inc., New York, 1991
3. Michalski J., Technologia i montaż płytek drukowanych,. WNT, Warszawa, 1992
4. Suhir E., Lee Y.C., Wong C.P., Micro- and Opto- Electronic Materials and Structures, Springer S+B Media, Inc., New York, 2007
5. Weck M., Werkzeugmaschinen. Mechatronische Systeme, Vorschubantriebe, Prozeßdiagnose. , Springer-Verlag, 2001
6. Wong C.P, Kyoung-Sik Moon, Yi Li, Nano-Bio- Electronic, Photonic and MEMS Packaging, New York: Springer, 2010.
7. Zdanowicz R., Robotyzacja procesów wytwarzania., Wydawnictwo Politechniki Śląskiej, 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Systems for Manufacturing and Assembly
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W02	K1MTR_W11	C1-C3	Lec1 - Lec10	N1, N2
PEK_W03	K1MTR_W18	C4	Lec11 - Lec15	N1, N2
PEK_U01 - PEK_U02	K1MTR_U03, K1MTR_U11	C1 - C3	Lab2 - Lab6	N3, N4, N5
PEK_U03	K1MTR_U18	C4	Lab7 - Lab8	N3, N4, N5
PEK_K01 - PEK_K03	K1MTR_K04, K1MTR_K06, K1MTR_K13	C1-C4	Lab1 - Lab8	N3, N4, N5

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sieci przemysłowe**
Name in English: **Industrial networks**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM034103**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed course: PLC controllers

SUBJECT OBJECTIVES

C1. Explain the construction of industrial networks
C2. Explain the operation of industrial networks
C3. Explain the use of industrial networks

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the construction of industrial networks.
PEK_W02 - Can explain the operation of industrial networks.
PEK_W03 - Is able to select a network to an application

II. Relating to skills:
PEK_U01 - Is able to design industrial network.
PEK_U02 - Can build an industrial network.
PEK_U03 - Can set up a network of industrial

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The issue of electronic control and monitoring in industrial environments	2
Lec2	Network models	2
Lec3	The physical layer	2
Lec4	Data link layer	2
Lec5	Examples of industrial networks - construction, characteristics, application areas	3
Lec6	Methods for data exchange in industrial networks. Network Configuration. Specialized software.	3
Lec7	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	PPi and MPI interfaces	2
Lab3	Modbus network	2
Lab4	AS-i network	2
Lab5	Interbus network	2
Lab6	Profibus network	2
Lab7	Profinet network	2
Lab8	CAN network	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_U02, PEK_U03	Test, REPORT OF LABORATORY PRACTICE
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Solnik W., Znajda Z.: Komputerowe sieci przemysłowe Profibus DP i MPI. OficynaWydawnicza Politechniki Wrocławskiej, Wrocław 2004Kwiecień A.,: Analiza przepływu informacji w komputerowych sieciach przemysłowych.WPK J. Skalmierskiego, Gliwice 2000Mielczarek W.: Szeregowe interfejsy cyfrowe. Helion 1993

SECONDARY LITERATURE
Legierski T. i inni: Programowanie sterowników PLC, Wydawnictwo Pracowni Komputerowej JackaSklamierskiego, Gliwice 1998 Kasprzyk J. Programowanie sterowników przemysłowych, Wydawnictwo Naukowo-Techniczne, Warszawa 2006

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W20	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6,	N1
PEK_W02	K1MTR_W20	C2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6,	N1
PEK_W03	K1MTR_W20	C3	Lec5	N1
PEK_U01	K1MTR_U20	C1	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_U02	K1MTR_U20	C2	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3
PEK_U03	K1MTR_U20	C3	LA2, LA3, LA4, LA5, LA6, LA7, LA8	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie w C++**
Name in English: **C++ Programming**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM034104**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He knows the semantics and syntax of C
2. He can write, test and debug programs written in C
3. Has knowledge of object-oriented programming paradigm and writing UML

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

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

III. Relating to social competences:
PEK_K01 - Can search and critically analyze information

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Class, attribute, method, constructor, destructor, object, overloading methods	2
Lab2	Accessors overloaded constructor, copy constructor, new and delete operators	2
Lab3	Inheritance, functions befriended	2
Lab4	Operators, operator overloading, this indicator	2
Lab5	Streams, File operations	2
Lab6	Association, aggregation, composition	2
Lab7	Polymorphism	2
Lab8	Simulation of the control system	2
Lab9	Implementation game MasterMind / Pond / etc.	2
Lab10	Templates	2
Lab11	Exceptions	2
Lab12	Object Modeling with UML	2
Lab13	Implementation of the program modeled in UML	2
Lab14	Testing and debugging the program, documenting code	2
Lab15	Final assesment	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. Own work - implementation, testing and documenting programs
N3. tutorials
N4. Online knowledge base

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	Oral answers, quizzes, reports (impelemented program + documentation UML)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
C++ Programming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19, K1MTR_U35	C1	Lab. 1 - Lab. 15	N1,N2,N3
PEK_U02	K1MTR_U19, K1MTR_U35	C1	Lab. 1 - Lab. 15	N1, N2, N3
PEK_U03	K1MTR_U19, K1MTR_U35	C1	Lab. 1 - Lab. 15	N1, N2, N3
PEK_K01	K1MTR_K01	C1	Lab. 1 - Lab. 15	N1, N2, N3

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy projektowania zespołów mechanicznych**
Name in English: **Fundamentals of machine elements design**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM035001**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30			30	
Number of hours of total student workload (CNPS)	60			90	
Form of crediting	Crediting with grade			Crediting with grade	
Group of courses					
Number of ECTS points	2			3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes	1.2			2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: Student has knowledge on the fundamentals of mechanics, strength of materials, materials technology and technical drawing
2. Skills: Student can use the knowledge on mechanics, strength of materials, materials technology and technical drawing in practice
3. Competences: Student understands and is aware of what the technological activity is and how it influences the environment.

SUBJECT OBJECTIVES

C1. To familiarize students with the design and operation principle of basic machine components and units in mechatronic systems.
C2. To familiarize students with the rules of the engineering design process for basic machine components and units.
C3. To prepare students for independent work on designing machine units and systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the classes, the student is supposed to be able to describe the design and operation principle of basic machine components and units in mechatronic systems.
PEK_W02 - As a result of the classes, the student is supposed to be able to desribe flow of energy, mass and information in selected units.

II. Relating to skills:
PEK_U01 - As a result of the classes, the student is supposed to be able to make engineering calculations of basic machine components and units in mechatronic systems.
PEK_U02 - As a result of the classes, the student should be able to prepare the technical drawings of basic machine components and units in mechatronic systems.

III. Relating to social competences:
PEK_K01 - As a result of the course, the student gains the ability to recognize social needs and forecasting method of their implementation through various technical means.
PEK_K02 - As a result of the course, the student gains the ability to give arguments justifying the decisions taken in the design process.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Mechanical units in mechatronics.	2
Lec2	Load-carrying structures (fasten, connect).	2
Lec3	Construction materials - shapes, sections.	2
Lec4	Joints - welding, soldering, interference connection	2
Lec5	Fastenings - screws, bolts, pins.	2
Lec6	Drive systems (transmission of motion and energy).	2
Lec7	Actuators, energy transformers, connecting elements.	2
Lec8	Axes and shafts.	2
Lec9	Bearings and sealings.	2
Lec10	Couplings - types, application.	2
Lec11	Belt transmissions (v-belt, timing, chain).	2
Lec12	Gears (helical, bevel worm).	2
Lec13	Gears (harmonic, epicyclic).	2
Lec14	Springs, power screw.	2
Lec15	Summary.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Description of a selected technical problem – mechanical unit in a mechatronic system.	2
Proj2	Discussion of a concept of the mechanical system.	4

Proj3	Calculations of mechanical energy flow rate of in the system.	4
Proj4	Calculations of selected elements and joints.	4
Proj5	Selection of mechanical elements and units.	4
Proj6	Making the assembly drawing working of the system.	6
Proj7	Making the working drawings of selected elements of the system.	4
Proj8	Presentation of a final report.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Quiz
F2	PEK_U01, PEK_U02	Partial evaluation of calculations
F3	PEK_U01, PEK_U02, PEK_K01	Partial evaluation of the project
F4	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Evaluation of the final report
P = F1+F2+F3+F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Osiński Z. i inni.: Podstawy konstrukcji maszyn, PWN, Warszawa 1999.
2. Kurmaz L., Kurmaz O.: Projektowanie węzłów i części maszyn. Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.
3. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne, Rozprawy Naukowe nr 44, Politechnika Białostocka, Białystok 1997.

SECONDARY LITERATURE

1. Dietrich M. i inni.: Podstawy konstrukcji maszyn. WNT, Warszawa 1995.
2. Mazanek E. i inni.: Przykłady obliczeń z podstaw konstrukcji maszyn. WNT, Warszawa 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of machine elements design
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07, K1MTR_W09, K1MTR_W10	C1,C2	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15	N1,N2,N4
PEK_W02	K1MTR_W07, K1MTR_W09, K1MTR_W10	C1,C2	Lec1, Lec2, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14, Lec15	N1,N2,N4
PEK_U01	K1MTR_U05, K1MTR_U09, K1MTR_U23	C2,C3	Pr3, Pr4, Pr5	N1,N2, N3,N4
PEK_U02	K1MTR_U05, K1MTR_U09	C2,C3	Pr6, Pr7, Pr8	N1,N2, N3,N4
PEK_K01	K1MTR_K02, K1MTR_K04	C3	Pr1, Pr8	N1,N2, N3,N4
PEK_K02	K1MTR_K02, K1MTR_K04	C3	Pr1, Pr8	N1,N2, N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy napędowe, elementy hydrauliczne i elementy pneumatyczne**
Name in English: **Drive systems, hydraulic components and pneumatic components**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM035004**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of differential calculus. Basic knowledge of mechanics, materials, and automation.
2. Ability to conduct basic analysis of the workings of simple mechanisms. The ability to understand, use and transformation formulas describing the basic relationships and physical phenomena.
3. Basic ability to formulate conclusions on the basis of the knowledge or the results of a laboratory experiment.

SUBJECT OBJECTIVES

C1. Acquaint students with hydrostatic and pneumatic power systems, principles of operation, basic relations, mathematical models describing the elements of the systems, methods of control and regulation. Presentation of the latest trends in the integration of electronic components and elements of hydraulic and pneumatic systems. Miniaturization of hydraulic components.
C2. Present the student the role of individual components in the hydraulic and pneumatic power systems. Determination of the effect of the parameters of the individual elements on the mode of action the whole system. The acquisition of the knowledge needed to make aware changes in hydrostatic and pneumatic systems, which purpose is positive change the work parameters of the system.
C3. Acquisition by the student the teamwork skills. Formulation of proposals by a group of students based on the results of laboratory tests and summary them in writing form.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to define the principle of operation and basic parameters of hydraulic and pneumatic systems. The student is able to describe the work conditions which are necessary for the proper operation of hydraulic and pneumatic systems. The student is able to explain the impact of various system parameters on its performance.
PEK_W02 - The student describes the characteristics and principles of operation of the elements of hydraulic and pneumatic systems. The student independently analyzes the parameters of individual elements of systems by defining their principles of operation.
PEK_W03 - The student selects the individual components of hydraulic and pneumatic systems, creating the concept of a full system based on the initial assumptions. Student by exchanging elements or changing the control system interfere in existing hydraulic and pneumatic systems, making changes that have a positive impact on the output parameters of the whole system.

II. Relating to skills:
PEK_U01 - The student identifies and describes the principle of operation of the elements of hydraulic and pneumatic systems. Students performed a laboratory experiment on which assesses the impact of selected parameters on the operation of the element.
PEK_U02 - The student performs the laboratory experiments on the basis of which identifies the individual parameters of hydraulic and pneumatic systems. A student on the basis of their identifies and describes the physical phenomena whose existence has a significant impact on the performance of individual components or complete systems.
PEK_U03 - The student performs and controls the course of a laboratory experiment, records the results and makes them evaluated. The student collects and publishes the results in a written report and draws conclusions.

III. Relating to social competences:
PEK_K01 - The student takes part in the work of the group of students, the purpose of which is the performance of a laboratory experiment.
PEK_K02 - The student acquires abilities to present the results of their work in the form of a written report supplementing them orally during the consultation 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	To acquaint students with the scope of the course, the terms of credit and the subject literature. Basic knowledge of the mechanics of liquids and gases. Flow characteristics.	2
Lec2	The principle of operation of the hydrostatic drive. Hydraulic fluids and their properties.	2
Lec3	Contaminations - the sources, causes and effects. Analogies between the mathematical models of hydraulic systems.	2
Lec4	Filters and filtration. Classification of the filters, principle of operation, place of installation in the system.	2
Lec5	The efficiency of hydraulic systems, hydraulic efficiency.	2
Lec6	Volumetric efficiency and the total efficiency of the hydraulic systems.	2
Lec7	Energy generators: pumps and compressors. Construction and characteristics.	2

Lec8	Actuators: cylinders and motors. Construction and characteristics. Mathematical models.	2
Lec9	Control elements: flow direction, pressure and flow rate.	2
Lec10	Methods of controlling the speed of the hydraulic actuators.	2
Lec11	Volumetric control and regulation.	2
Lec12	The technique of the proportional control - the basics: elements and hydrotronic systems.	2
Lec13	Designing of the hydrostatic power systems.	2
Lec14	The heat balance of hydraulic systems. Components and systems of the micro hydraulics.	2
Lec15	Exam.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of ratings.	2
Lab2	Experimental designation of working fluid properties - compressibility.	2
Lab3	Experimental designation of the flow resistance in the hydraulic lines - linear resistance.	2
Lab4	Local resistance in hydraulic systems. Orifice as local resistance, the phenomenon of cavitation.	2
Lab5	Determination of characteristics a positive displacement pump.	2
Lab6	Static characteristics of a conventional directional spool valve.	2
Lab7	Examination of the hydrostatic transmission.	2
Lab8	Completion of the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. laboratory experiment
N2. tutorials
N3. report preparation
N4. self study - self studies and preparation for examination
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	axam

P = F1

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. W. Kollek, Basics of the designing hydraulic drives and controls., wydawnictwo: Oficyna Wydawnicza Polit. Wrocławskiej, Wrocław., rok: 2004, (in Polish)
2. E. Tomasiak, The drives and controls systems of the hydraulic and pneumatic.,wydawnictwo: Wydawnictwo Polit. Ślaskiej. Gliwice., rok: 2001, (in Polish)
3. S. Stryczek, Hydrostatic drive., wydawnictwo: WNT, rok: 1996, (in Polish),
4. A. Osiecki, The hydrostatic drive of machines., wydawnictwo: WNT, rok: 2004, (in Polish)

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Drive systems, hydraulic components and pneumatic components
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W1	K1MTR_W10	C1	Lec1÷Lec3	N2, N4, N5
PEK_W2, PEK_W3	K1MTR_W10, K1MTR_W24	C2	Lec4÷Lec14	N2, N4, N5
PEK_U1÷PEK_U3	K1MTR_U10, K1MTR_U23	C3	Lab1÷Lab7	N1, N2, N3
PEK_K1÷PEK_K3	K1MTR_K04	C3	Lab1÷Lab7	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory w budowie maszyn i pojazdów**
Name in English: **Sensors in the machine and vehicle construction**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM035103**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has knowledge of physics necessary to understand the fundamental physical phenomena used in sensors.
2. He has knowledge of the principles of semiconductor electronic components.
3. He has a basic and ordered knowledge in the field of computer science and software engineering, and computer architecture in particular the hardware layer.

SUBJECT OBJECTIVES

C1. The acquisition of organized knowledge about the operation, structure, properties and parameters of sensors and measuring systems. Knowing and understanding of methods of signal processing and measurement of electrical and mechanical basic parameters.
C2. Acquiring the skills of selection of measuring instruments and construction of measurement systems to enable measurement of electrical and mechanical parameters characterized a mechatronic system.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the construction and understands the principles of operation and properties of sensors.
PEK_W02 - Has a basic knowledge of the selection of methods of measurement of electrical and mechanical basic parameters.
PEK_W03 - He has knowledge in the processing of measurement signals.

II. Relating to skills:
PEK_U01 - Is able to select and apply appropriate sensors to measure various physical quantities.
PEK_U02 - Able to plan an experiment and examine the dynamic and static characteristics of sensors.
PEK_U03 - Knows how to build and use the measuring systems enable the measurement of parameters of electro-mechatronic systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic terms and definitions. Metrological properties and classification of sensors. Simple and smart sensors.	2
Lec2	Static and dynamic characteristics of sensors and measuring systems. Standard signals.	1
Lec3	Resistive, inductive, capacitive, ultrasonic and piezoelectric transmitters. Circuits cooperating with the sensors. Optical sensors.	2
Lec4	Sensors of linear and angular displacement, velocity and acceleration. Sensors for measuring the force, torque, pressure, and flow.	2
Lec5	Temperature sensors, contact and non-contact temperature measurements. Unconventional transmitters . MEMS - structures, technologies and applications.	2
Lec6	Analog-to-digital and digital-to-analog conversion. Filtering, processing and transmission of measurement signals. Sources of error. Evaluation of the quality of the measurement signal.	2
Lec7	Signal amplifiers. Multifunctional measuring cards. Computer programs for acquisition, visualization and processing of measurement data. Automation of measurement.	2
Lec8	Conventional and virtual measuring instruments. Communication interfaces of machines and vehicles. Applications measuring systems in mechatronic systems. Systems for condition monitoring of machines and vehicles.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters.	2
Lab2	Comparative tests of various types of displacement sensors.	2
Lab3	Digital signal processing with encoder with multifunctional measuring card.	2
Lab4	Comparative tests of different types of speed sensors .	2

Lab5	Experimental tests of accelerations. Acquisition and processing of measured values.	2
Lab6	Strain gauge transducers.	2
Lab7	Telemetric measurement systems.	2
Lab8	Flow measurements in the drive systems of working machines.	2
Lab9	Tests of AD and DA converters.	2
Lab10	Acoustic measurements in industrial environments.	2
Lab11	The cooperation of selected sensors with microprocessor-based systems. Part 1	2
Lab12	The cooperation of selected sensors with microprocessor-based systems. Part 2	4
Lab13	Comparative tests of different types of temperature transmitters.	2
Lab14	Non-contact temperature measurement of object.	2
Lab15	Measurement of hydraulic and mechanical parameters of industry vehicle with a comprehensive measurement system.	2
		Total hours: 32

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	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	short test, oral answer, report of the laboratory exercises

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors in the machine and vehicle construction
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W03, K1MTR_W15	C1	Lec1-Lec5	N1
PEK_W02	K1MTR_W15	C1	Lec6-Lec8	N1
PEK_W03	K1MTR_W16	C1	Lec6, Lec7	N1
PEK_U01-PEK_U03	K1MTR_U03, K1MTR_U10, K1MTR_U15	C2	Lab1-Lab15	N2-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sterowniki PLC**
Name in English: **PROGRAMMABLE LOGIC CONTROLLERS**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM035104**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of the principles of operation of semiconductor electronic components.
2. Has a basic knowledge of industrial networks.

SUBJECT OBJECTIVES

C1. Making familiar with the construction of a PLC.
C2. Making familiar with the operation of the PLC.
C3. Making familiar with PLC programming languages.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a basic knowledge of the construction of a PLC.
PEK_W02 - Has a basic knowledge of the operation of the PLC.
PEK_W03 - Has a basic knowledge of PLC programming.

II. Relating to skills:
PEK_U01 - Can apply the appropriate PLC for the job.
PEK_U02 - Can configure the PLC.
PEK_U03 - Can program the PLC.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Principles of assessment of the course. Introduction. History of the PLC. Market PLC. Basic definitions.	2
Lec2	Architecture of PLC	2
Lec3	The principle of operation of the PLC. Program Structure and organization of memory.	2
Lec4	Standard PLC programming languages - FBD	2
Lec5	Standard PLC programming languages - LD - basic instructions	2
Lec6	Standard PLC programming languages - LD - extended instructions	2
Lec7	Examples of applications using a PLC.	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, training of health and safety, support teaching positions	1
Lab2	Logo! - software tools, configuration.	2
Lab3	Logo! - FBD programming language	2
Lab4	S7-1200 - software tools, configuration	2
Lab5	S7-1200 - LAD programming language - basic instructions	2
Lab6	S7-1200 - LAD programming language - timers and counters instructions.	2
Lab7	S7-1200 - LAD programming language - extendeed instructions	2
Lab8	S7-1200 and HMI communication.	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Legierski T., Kasprzyk J., Wyrwał J., Hajda J.: Programowanie Sterowników PLC, Wyd. Prac. Komp. J. Skalmierskiego, Gliwice, 1998.Kwasniewski J.: Sterowniki PLC w praktyce inżynierskiej, Wyd. BTC, 2008.

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

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
PROGRAMMABLE LOGIC CONTROLLERS
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W10, K1MTR_W33	C1	Lec1, Lec2,	N1
PEK_W02	K1MTR_W10, K1MTR_W33	C2	Lec3,	N1
PEK_W03	K1MTR_W10, K1MTR_W33	C3	Lec4, Le5c, Lec6, Lec7,	N1
PEK_U01	K1MTR_U16, K1MTR_U36	C1,C2	LA2,LA4, LA5,LA7	N2,N3,N4
PEK_U02	K1MTR_U16, K1MTR_U36	C1,C2	LA2,LA4, LA5,LA7	N2,N3,N4
PEK_U03	K1MTR_U16, K1MTR_U36	C3	LA3, LA4, LA6, LA8	N2,N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory w systemach wytwórczych**
Name in English: **Sensors in manufacturing systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM035105**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has sound knowledge of and can communicate through engineering drawing.
2. The student has basic knowledge relating to the design-construction process, structure, functioning and operation of the main machine elements and assemblies and the principles of their matching and constructing.

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role of sensors in manufacturing, the classifications of sensors.	1
Lec2	Physical operating principles of sensors and their basic characteristics.	2
Lec3	Sensors in machine tools and industrial robots.	2
Lec4	Sensors for measurements the geometry of the workpieces.	2
Lec5	Sensors for tool systems.	2
Lec6	Sensors for monitoring the machining process.	2
Lec7	Sensors for monitoring the various manufacturing processes.	2
Lec8	Sensors used in transport, storage and assembly systems.	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to sensors and discuss safety rules.	2
Lab2	An analysis of the measuring capabilities of the system Svantek.	2
Lab3	Diagnostics of machine tool using Ballbar system.	2
Lab4	Possibilities of measurement using of strain gauges.	2
Lab5	The determination of the characteristics of the selected limit switches.	2
Lab6	The determination of the characteristics of the PSD sensor.	2

Lab7	Configuring the measuring circuit for determining the angle of rotation of the spindle.	2
Lab8	The determination of the characteristic of a laser triangulation sensor.	2
Lab9	Comparison of selected methods of temperature measurement.	2
Lab10	Analysis of sensors in the turning center.	2
Lab11	The measurement of cutting force components using piezoelectric dynamometer.	2
Lab12	The measurement capabilities of laser interferometer.	2
Lab13	The determination of the characteristic of an inductive displacement sensor.	2
Lab14	An analysis of the measuring capabilities of the ConoProbe 3.0 MK HD optical sensor.	2
Lab15	Catching up with the outstanding laboratory classes and completion of reports.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	individual presentation
F2	PEK_W01 - PEK_W03	final test
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

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

SECONDARY LITERATURE
1. Bishop R.H.: The Mechatronics Handbook. CRC Press. Boca Raton London New York Washington, D.C., 2002
2. Bishop R.H.: Mechatronic Systems, Sensors, and Actuators. Fundamentals and Modeling. CRC Press. Boca Raton, London, New York 2008
3. Fleischer J., Denkena B., Winfough B., Mori M.: Workpiece and Tool Handling in Metal Cutting Machines. Annals of the CIRP. Vol. 55/2/2006, pp.817-839
4. Fraden J.: Handbook of modern sensors. Physics, designs and applications. Springer Science + Business Media. New York 2004
5. Jemielniak K.: Automatyczna diagnostyka stanu narzędzia i procesu skrawania. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2002
6. Nyce D.S.: Linear Position Sensors - Theory and Application. John Wiley & Sons 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors in manufacturing systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_W15	C1 - C3	Lec1 - Lec8	N1, N2
PEK_U01 - PEK_U03	K1MTR_U03, K1MTR_U15	C1 - C3	Lab1 - Lab15	N3, N4, N5
PEK_K01 - PEK_K03	K1MTR_K03, K1MTR_K04, K1MTR_K13	C1 - C3	Lab1 - Lab15	N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie procesów technologicznych**
Name in English: **Technological designe processes**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM035202**
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. Ability to read and develop of technical drawing at the basic level.
2. Basic knowledge about typical possibilities of cutting machine tools processes.
3. Knowledge about machine tools construction and processing capabilities.

SUBJECT OBJECTIVES

C1. Acquiring of knowledge about technological documentation and determinants of technical documentation range.
C2. Acquiring of producibility analysis ability.
C3. Acquiring of knowledge about proper manufacturing technology matching for production size and work piece shape.
C4. Acquiring knowledge about proper order of operations in the process.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Selects the correct type of working piece (casting, forging, welded, plastics or rolled profile) due to: the type of material, the size of production, the complexity of the finished product, and so on.
PEK_W02 - Possesion of knowledge of the develope of technological process of elements like body and axially symmetric. Knows the basic rules for determining and fixing the workpiece on the machine.
PEK_W03 - Possesion of knowledge of the capabilities and limitations of the use of different processing technologies.

II. Relating to skills:
PEK_U01 - Skill in selecting the proper process execution semi-fabricated product (casting, forging, plastic working) depending on: the type of material, size, production, etc.
PEK_U02 - Skill in improve the producibility, in order to enable or simplify the processing.
PEK_U03 - Skill in choose the appropriate cutting tool and machining parameters calculated on the basis of catalog data and dimensions of the workpiece.

III. Relating to social competences:
PEK_K01 - Searching for commercial information about materials that may facilitate the development of technological process.
PEK_K02 - Presentation of proposals of technological process. Ability to communicate.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Information on the manufacturing process. Phases of development and product life.	2
Lec2	The general structure of manufacturing, operations and procedures. Method of processing.	2
Lec3	Development of technological process, producibility and type of production.	2
Lec4	Basing on processing and obtained accuracy.	2
Lec5	Selection of materials and semi-finished products, producibility.	2
Lec6	Technological documentation.	2
Lec7	Examples of technological processes of typical machine parts.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Discussion of the course, edition of topics.	2
Proj2	Updating a technical drawings of objects in current standards, the definition of production type.	2
Proj3	Calculating the semi-finished products on account of technological limitations.	2
Proj4	Realization of the project of semifinished product.	2
Proj5	Realization of semi-products documentation.	2
Proj6	Development a framework of technological process for specific parts.	2

Proj7	Filling the technological cards.	2
Proj8	Developing instruction of machining.	2
Proj9	The selection of tools and cutting parameters.	2
Proj10	Selection and characterization of machine tools.	2
Proj11	The calculation of the treatments time execution.	2
Proj12	The calculation of cycle times, auxiliary times and setuptimes.	2
Proj13	Organization of the technological process.	2
Proj14	Prepare of the time cards calculations.	2
Proj15	Presentation of completed projects.	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	Written test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	Assessment of realised project.
F2	PEK_K01, PEK_K02, PEK_K03, PEK_U01, PEK_U02, PEK_U03	Defense of realised project.
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technological designe processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W11	C2	Lec3, Lec4	N1, N2, N3, N4
PEK_W02	K1MTR_W06, K1MTR_W11	C1, C3	Lec2, Lec3, Lec4	N1, N2, N3
PEK_W03	K1MTR_W06	C1	Lec1, Lec5, Lec6, Lec7	N1, N2, N3, N4
PEK_U01 - PEK_U03	K1MTR_M_U03, K1MTR_M_U06	C2, C3	Proj1 - Proj14	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia w produkcji przemysłowej**
Name in English: **Ecology in industrial manufacturing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM035203**
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. He has ordered knowledge of high school biology, chemistry and physics. He can interpret the basic relationship between human activities and behavior of living organisms and the environment.
2. He understands the need for industrial development and implementation of new solutions in the construction, operation and modernization of the equipment of the principles of sustainable development, the protection of natural resources and the environment.

SUBJECT OBJECTIVES

C1. Understanding the structure and functioning of living nature, ecotoxins action and the greenhouse effect. Understanding the risks of escalation of industrial human activity. Legal regulations in the field of environmental protection. Understanding the environmental management systems standard ISO 14000.
C2. Understanding the risks and ways of obtaining energy from conventional and renewable sources and principles of waste management - waste minimization and recycling, LCA method.
C3. Familiarizing with the design, operation and modernization of the equipment, favoring the protection of natural resources and the environment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows and understands the dangers of global warming, the development of technology, energy production, manufacturing and recycling
PEK_W02 - Student understands the need to introduce a new framework for environmental protection, environmental management systems is known, has expertise in the implementation of ISO 14000
PEK_W03 - Student knows and understands the risks of escalation of industrial man knows the rules and benefits of the implementation of environmental measures in the construction and operation of machinery

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Sources of risks arising from industrial activities and the operation of machinery, ectotoxins, the greenhouse effect, energy generation	2
Lec2	International conventions and Polish legislation on environmental protection	2
Lec3	Environmental management. Environmental management systems and existing standards BS, EMAS, ISO 14000 and others	2
Lec4	Ecological consequences of energy production from conventional and renewable sources	2
Lec5	Waste minimization, recycling - efficient and environmentally friendly way of waste management	2
Lec6	Waste management, waste source, treatment, energy recovery and safe disposal	2
Lec7	Biodegradability, toxicity, carcinogenicity and mutagenicity of supplies, polychlorinated biphenyls	2
Lec8	Environment-friendly materials in the operation of machinery - oils, greases, lubricating greases, Ecological aspects of the construction, operation and modernization of the equipment	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Lewandowski W: Proekologiczne odnawialne źródła energii, WNT W-wa 2010 ; Mackenzie A., i inni: Ekologia, PWN W-wa 2009 ; Nierzwicki W: Zarządzanie środowiskowe, Polskie Wyd. Ekonomiczne, W-wa 2006 ; Rosik-Dulewska Cz: Podstawy gospodarki odpadami, PWN 2007

SECONDARY LITERATURE
Papers: "Czysta Energia", „Utrzymanie ruchu", „Recykling", „Nasze Środowisko" , "Ekotechnika"

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology in industrial manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_M_W05	C1 - C3	Lec1-Lec8	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie układów mechatronicznych**
Name in English: **Basics of mechatronical design of systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM036004**
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

1. knowledge and skills of analysis, synthesis and modeling of kinematic systems
2. knowledge and skills of synthesis and modeling of 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.
C2. The aim is to acquire the skill of analysis, modeling and design of a simple mechatronic systems

SUBJECT EDUCATIONAL EFFECTS

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

II. Relating to skills:
PEK_U01 - Ability to design, integrate, and model the simple mechatronic system, and then verify that it works

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
PEK_K02 - Able to interact and work in a group, taking the different roles

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Synergy in designing mechatronics. Examples of use. The structure of mechatronic systems.	3
Lec2	Design of machinery and equipment in terms of mechatronics.	2
Lec3	Methods of the type synthesis of kinematic systems, methods of exploration of alternatives	2
Lec4	Design and modeling of control systems in a dynamic analysis computer system	2
Lec5	Basics of actuators - characteristics, applications	2
Lec6	Selected mechatronic actuators in machine building - piezoelectric, step motor, servodrives	2
Lec7	Virtual Prototyping - examples of use (Hardware in the Loop, Rapid Prototyping)	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	An introduction to the principles of design of mechatronic system. Presentation of the typical project	2
Proj2	Defining the overall concept, the tasks for the mechatronic system and the analysis and validation of the concept of a mechanical system	3
Proj3	Synthesis of mechanical part of mechatronic system - type synthesis	2
Proj4	Synthesis of mechanical part of mechatronic system - geometrical synthesis	2
Proj5	Building computational models - a preliminary verification of the concept	2
Proj6	The simulation researches to determine the basic properties of kinematic and dynamic	3
Proj7	Development of mechanical structure. Selection drives, gears, bearings, couplings, joints	3
Proj8	Model verification, simulation, analysis	2

Proj9	Develop an overall program strategy of mechatronic system, define tasks for the control system	2
Proj10	Determination of sensory data needs	2
Proj11	The selection of sensor and control systems	3
Proj12	The development of a general algorithm of mechatronic system operation and verify its correctness	2
Proj13	Presentation of mechatronic system design	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	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_K01, PEK_K02	Evaluation of the project
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: M. Springer –Verlag, Nowy York 1993.
4. Craig J.: Wprowadzenie do robotyki. WNT 1993.
5. Gronowicz A.: Podstawy analizy układów kinematycznych. Oficyna Wydawnicza PWr., Wrocław 2003.
6. Frączek J., Wojtyra M.: Metoda układów wieloczłonowych w dynamice mechanizmów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007

SECONDARY LITERATURE

1. Bolton W.: Mechatronics. Longman, Nowy York 1999
2. Roddeck W.: Einfurung in die Mechatronik. B.G. Teubner Sttutgart 1997
3. MD. Adams – Reference Manual, 2008

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Basics of mechatronical design of systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W24	C1	Le1-Le7	N1-N5
PEK_U01	K1MTR_U23	C2	pr1-Pr13	N1-N5
PEK_K01, PEK_K02	K1MTR_K02	C1, C2	Le1-Le7, pr1-Pr13	N1-N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Roboty przemysłowe**
Name in English: **Industrial robots**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM036005.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		3
Lec2		3
Lec3		3
Lec4		3
Lec5		3
Lec6		3
Lec7		3
Lec8		3
Lec9		3
Lec10		3
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		3
Lab5		3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W09, K1MTR_W23	C1, C2, C3		N1,N2,N3
PEK_W02	K1MTR_W10, K1MTR_W15	C1, C2, C3		N1,N2,N3
PEK_W03	K1MTR_W09	C1, C2, C3		N1,N2,N3
PEK_U01	K1MTR_U09, K1MTR_U24	C3,C4,C5		N4,N5
PEK_U02	K1MTR_U09, K1MTR_U24, K1MTR_U29	C4, C5		N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie projektami**
Name in English: **Project Management**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM036006.**
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		2
Lec7		3
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. problem lecture
N3. case study

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

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

PEK_W01, PEK_W02	K1MTR_W28	C1 - C3		N1 - N3

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **CAD/MES**
Name in English: **CAD/FEM**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036106.**
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 – Laboratory	Number of hours

Lab1		4
Lab2		4
Lab3		4
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. problem exercises
N3. problem discussion

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
CAD/FEM
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U22	C2, C3		N2
PEK_U02	K1MTR_U22	C1, C2, C3		N2, N3
PEK_U03	K1MTR_U22	C2		N3, N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Przetwarzanie sygnałów**
Name in English: **Signal Processing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036108**
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	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

1. Student has a knowledge of the basics of calculus, complex functions, ordinary differential equations, Laplace and "Z" transforms, the theory of probability, high-level programming language, knows the simple analog electronic circuits (current and voltage dividers, filters and amplifiers).
2. Students can integrate complex functions, solve differential equations by operators , has abilities in in "C programming".

SUBJECT OBJECTIVES

C1. Getting the ability to analyze signals in time and frequency domain.
C2. Acquisition of basic knowledge of algorithms and signal processing effects of one and two-dimensional signals (sampling, quantization, Fourier series, FFT, digital filtering, aliasing, image processing algorithms).
C3. Acquiring skills to design digital filters, FIR and IIR and their application in practice, learning methods for encoding and compression of data (images and 1D signals).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge of the parameters of continuous and discrete signals (power, energy, mean rms, amplification, attenuation).
PEK_W02 - Knowledge of the basic signal processing algorithms (sampling, quantization, encoding, reproduction analog signal from a digital signal, Fourier series, FFT, convolution, DCT).
PEK_W03 - Knowledge of the principles of digital filtering and FIR and IIR filter design.

II. Relating to skills:
PEK_U01 - Student can calculate the basic signal parameters (power, energy, mean, rms, THD)
PEK_U02 - Student is able to choose the sampling frequency of the signals low-and high pass-band, can prevent the effects of aliasing, analyze the frequency response (to analyze the spectrum of a signal), perform filtering images and make simple morphological operations.
PEK_U03 - Student is able to design and program digital FIR and IIR filter and use it in practice.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Prerequisites. Literature. The content of the lecture. The main terms of the signals processing. Deterministic and random signals. Kinds of signals (analog, digital, binary, with finite and infinite energy and power, finite and the infinite duration, finite and infinite amplitude).	2
Lec2	The definition of the trigonometric and the complex Fourierseries. Notation a periodic signal of infinite duration and finite amplitude as a superposition of sinusoidal components. Calculation of the complex and trigonometric Fourier coefficients. The concept of discrete spectral signal. Amplitude and phase spectra of periodic signals. Total harmonic distortion factor.	2
Lec3	Digital signals. Notation discrete signals. Basic concepts of digital signal processing - the frequency and the sampling rate.Analog to Digital processing. The concept of sampling, quantization and coding, Digital-Analog conversion.	2
Lec4	Ambiguity discrete signals in the time domain and frequency domain. Aliasing phenomenon. Kotielnikov-Shannon-Nyquist theorem.	2
Lec5	Algorithms of discrete (DFT) and fast (FFT) Fourier transform.	2
Lec6	Discrete convolution. Design of Finite (FIR) and infinite (IIR) impulse response digital filters.Stability of digital filters.	2
Lec7	Lossy compression and lossless image compression. The final exam.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Measurement distorted waveforms current and voltage. Analysis and synthesis of signals (Fourier series).	2
Lab2	Temperature measurements. Programming filters with finite impulse response (filters implemented by the convolution, moving average filters, filters windowed sinc function).	2

Lab3	IIR filters design. Filtration of low-bad signals.	2
Lab4	Image processing (filtration and morphology)	2
Lab5	The analysis of vibration signals from various sensors (numerical integration and differentiation of signals)	2
Lab6	Determination of the dynamic characteristics of the use of different types of excitations (pulse, white noise, chirp). FFT spectral analysis.	2
Lab7	Analysis of machine vibration at idle and under load (spectral analysis). Test grade.	3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
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_W02	Final exam, oral and written parts
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	short quiz, laboratory reports, participation i discussion, oral answers
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Smith S.W - Cyfrowe przetwarzanie sygnałów - praktyczny poradnik dla inżynierów i naukowców. BTC Warszawa 2007

SECONDARY LITERATURE

Lyons, R.G. -Wprowadzenie do cyfrowego przetwarzania sygnałów. WNT Warszawa 2006

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_W16	C1 - C3	Lec1 - Lect7	N1, N3
PEK_U01 - PEK_U03	K1MTR_U19, K1MTR_U21	C1 -C3	Lab1 - Lab7	N2,N4,N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechatronika w medycynie**
Name in English: **Mechatronics in medicine**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036109**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mechanics and strength of materials.
2. Knowledge of the basics of mechanical design
3. Knowledge of powertrain.

SUBJECT OBJECTIVES

C1. Presentation of the possibility of applying mechatronic solutions in medical devices and apparatus
C2. Directions of development of surgical techniques and medical robots and manipulators construction presentation.
C3. Possibility of applying the signals generated by the human body to control prostheses and artificial organs

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - have the knowledge to describe the basic issues of human musculoskeletal biomechanics
PEK_W02 - have the knowledge to propose the type and structure drive system supporting functions biomechanical inefficient or lost body parts
PEK_W03 - have the knowledge to propose a kind of biological signal that can be used to control the prosthesis or artificial organ

II. Relating to skills:
PEK_U01 - able to carry out physical properties tests of selected mechatronic systems used for the treatment and support functions of human locomotion
PEK_U02 - can use and modify the algorithms controlling the operation of mechatronic devices supporting human locomotion
PEK_U03 - able to interpret the results of physical testing of mechanical systems supporting human locomotion

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Human as a mecahtronical system	1
Lec2	Examples of mechatronic solutions in a device supporting human locomotion	3
Lec3	Mechatronic solutions supporting equipment used in surgery	3
Lec4	The use of mechatronic systems for medical diagnosis	2
Lec5	Mechatronic external fixators of long bones: fracture treatment, limb lengthening, limb axis correction	2
Lec6	Artificial organs: heart, heart prosthesis, heart - lung machine, kidney - the mechanical structure, drive systems, control	2
Lec7	Active artificial limbs: construction, drive systems, control	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction to computer navigation. The measurement of surface geometry.	2
Lab2	The use of computer navigation with medical imaging in medicine.	2
Lab3	The use of robotics in medicine. Controlling humanoid robots	2
Lab4	The use of robotics in medicine. Controlling humanoid robots	2
Lab5	The use dynamometric platform for analysis of load distribution	2
Lab6	Applications of 3D printing technology in medicine	2
Lab7	The use of the electromagnetic navigation to motion of the mandible examination	3
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Nałęcz M. (ed.), Biocybernetics and Biomedical Engineering, Volume 3: Artificial organs, Exit Academic Publishing House, Warsaw 2004
Podsędkowski L.: Roboty medyczne. Budowa i zastosowanie. Wydawnictwo Naukowo - Techniczne, Warsaw, 2011

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W08, K1MTR_W09	C1, C2, C3	Lec1, Lec2, Lec5	N1, N2
PEK_W02	K1MTR_M_W03, K1MTR_W26	C1, C2	Lec2, Lec3, Lec4, Lec5, Lec7	N1, N2
PEK_W03	K1MTR_W23	C3	Lec1, Lec3, Lec6, Lec7	N1, N2
PEK_U01	K1MTR_M_U04, K1MTR_U02, K1MTR_U03	C1	Lab1,Lab4, Lab5, Lab7	N3
PEK_U02	K1MTR_U21	C1	Lab1, Lab2, Lab4, Lab6, lab7	N3
PEK_U03	K1MTR_U21	C1	Lab3	N3
PEK_K01	K1MTR_K01, K1MTR_K07	C1-C3	Lec1-Lec7, Lab1-Lab7	N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy mechatroniczne w technologiach wytwórczych**
Name in English: **Mechatronic systems in manufacturing technologies**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036110**
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. It has a basic knowledge of manufacturing techniques, mechanical and structural design propulsion systems.
2. He has knowledge of the measurement object and process monitoring. He knows the principles of design and testing of control systems.
3. Able to analyze circuits used in technical documentation and interpret the results obtained objects.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge related to mechatronic systems used in manufacturing technologies.
C2. Acquiring the ability of selection to the manufacturing technology dedicated devices: sensors, actuators and mechatronic drives. He can choose the controls productive equipment used in specific mechatronic solutions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - know the basics of applications of mechatronic systems in a variety of manufacturing technologies, know dedicated to this: sensors, actuators and mechatronic units,
PEK_W02 - familiar with the basic principles of mechatronic design and control systems manufacturing facilities,
PEK_W03 - have knowledge of the selected mechatronic solutions for machining, metal forming and welding.

II. Relating to skills:
PEK_U01 - mechatronic solution is able to select a specific technology, manufacturing,
PEK_U02 - able to analyze the effects of the mechatronic system,
PEK_U03 - can design simple mechatronic system used in production systems.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Discussion of the role of mechatroniczneh systems in manufacturing technology.	2
Lec2	Overview of sensors, actuators and mechatronic members for the various manufacturing technologies.	2
Lec3	Introduction to designing mechatronic technologies used mostly in manufacturing.	2
Lec4	Selected applications in mechatronics equipment for machining.	2
Lec5	Selected applications of mechatronics in metal forming.	2
Lec6	Selected applications of mechatronics in welding equipments.	2
Lec7	Final conclusions and recommendations for the design of mechatronic systems in manufacturing technologies.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Mechatronic systems used in the physical modeling of the metal forming.	2
Lab2	Mechatronic systems used in the clinching sheets.	2
Lab3	Mechatronic systems used in advanced measurement methods tempertury for manufacturing systems.	2
Lab4	Mechatronics in welding accessory (handles, wire feeders, darkening helmets).	2
Lab5	Mechatronics in equipment for soldering in microelectronics.	2
Lab6	Mechatronics in equipment for resistance welding.	2
Lab7	Welding robots.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
The development of the subject of the lecture provides a lecturer.

SECONDARY LITERATURE
Marek Gawrysiak: Mechatronics and Mechatronic Design, Białystok 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mechatronic systems in manufacturing technologies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MTR_W09, K1MTR_W15, K1MTR_W23	C1-C2	Lec1-Lec7	N1
PEK_U01-PEK_U03	K1MTR_U03, K1MTR_U11, K1MTR_U15	C2	Lab1-Lab7	N2-N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie zespołów mechanicznych**
Name in English: **Design of mechanical assemblies**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036202**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: Student has knowledge on the design and operation principle of basic machine components and units in mechatronic systems.
2. Skills: Student can design of basic machine components and units.
3. Competences: Student understands and is aware of what the technological activity is and how it influences the environment.

SUBJECT OBJECTIVES

C1. To familiarize students with the design and operation principle of complex machine components and units in mechatronic systems.
C2. To improve by students the design process for machine components and units.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the classes, the student is supposed to be able to describe the design and operation principle of complex machine units in mechatronic systems.
PEK_W02 - As a result of the classes, the student is supposed to be able to desribe flow of energy, mass and information in selected units

II. Relating to skills:
PEK_U01 - As a result of the classes, the student is supposed to be able to make engineering calculations of complex machine units in mechatronic systems.
PEK_U02 - As a result of the classes, the student should be able to prepare the technical drawings of complex machine units in mechatronic systems.

III. Relating to social competences:
PEK_K01 - As a result of the course, the student gains the ability to recognize social needs and forecasting method of their implementation through various technical means.
PEK_K02 - As a result of the course, the student gains the ability to give arguments justifying the decisions taken in the design process.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Complex mechanical units in mechatronics.	2
Lec2	Complex issues in load-carrying structures.	3
Lec3	Complex drive systems (actuators, energy transformers, connecting elements).	2
Lec4	Complex issues of axis and shafts systems.	3
Lec5	Complex issues in gear transmissions.	3
Lec6	Summary.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Description of a selected technical problem – complex mechanical unit in a mechatronic system.	2
Proj2	Discussion of a concept of the mechanical system and calculations of mechanical energy flow rate of in the system.	4
Proj3	Calculations of selected joints and selection of mechanical elements and units.	4
Proj4	Making the technical documentation (assembly drawing, working drawings)	4
Proj5	Presentation of a final report.	1
		Total hours: 15

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Partial evaluation of calculations
F2	PEK_U01, PEK_U02, PEK_K01	Partial evaluation of the project
F3	PEK_U01, PEK_U02, PEK_K01, PEK_K02	Evaluation of the final report
P = F1+F2+F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Osiński Z. i inni.: Podstawy konstrukcji maszyn, PWN, Warszawa 1999.
2. Kurmaz L., Kurmaz O.: Projektowanie węzłów i części maszyn. Wydawnictwo Politechniki Świętokrzyskiej, Kielce 2003.
3. Gawrysiak M.: Mechatronika i projektowanie mechatroniczne, Rozprawy Naukowe nr 44, Politechnika Białostocka, Białystok 1997.

SECONDARY LITERATURE
1. Dietrich M. i inni.: Podstawy konstrukcji maszyn. WNT, Warszawa 1995.
2. Mazanek E. i inni.: Przykłady obliczeń z podstaw konstrukcji maszyn. WNT, Warszawa 2005.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of mechanical assemblies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07, K1MTR_W09, K1MTR_W10	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6	N1,N2,N4
PEK_W02	K1MTR_W07, K1MTR_W09, K1MTR_W10	C1	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6	N1,N2,N4
PEK_U01	K1MTR_M_U01, K1MTR_U09, K1MTR_U22	C1,C2	Pr1 - Pr5	N1,N2, N3,N4
PEK_U02	K1MTR_U23, K1MTR_U24	C1,C2	Pr1 - Pr5	N1,N2, N3,N4
PEK_K01	K1MTR_K02, K1MTR_K04	C1,C2	Pr1 - Pr5	N1,N2, N3,N4
PEK_K02	K1MTR_K02, K1MTR_K04	C1,C2	Pr1 - Pr5	N1,N2, N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyzacja wytwarzania**
Name in English: **Manufacturing automation**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM036203**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has 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 an established knowledge in the field of sensorics applied in the manufacturing systems.

SUBJECT OBJECTIVES

C1. The student is to get to know the functional structure of the manufacturing system and flexible manufacturing system design concepts.
C2. The student is to get to know the functional subsystems of flexible manufacturing systems and the possibilities of their automation.
C3. The student is to familiarize herself/himself with typical manufacturing automation solutions.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the structure of the flexible manufacturing system (FMS) and can distinguish and 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 in FMS.

II. Relating to skills:
PEK_U01 - The student can select a flexible manufacturing system configuration functionally proper for carrying out the set tasks.
PEK_U02 - The student can select a proper system of the flow of tools and organize their circulation according to the technological tasks being carried out.
PEK_U03 - The student can design a system of the flow workpieces, taking into account the manipulation, transport and storage of the material.

III. Relating to social competences:
PEK_K01 - The student understands the need for lifelong learning within the range of mechatronics and improving her/his professional and social competences.
PEK_K02 - The student is able to think and critically analyze the functioning of the production system in order to increase its effectiveness.
PEK_K03 - The student is aware of responsibility for her/his own work and its impact on the functioning of the company.

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 for 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

Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory and discuss safety rules.	1
Lab2	Coordinate Measurements.	2
Lab3	Tool presetting for CNC machines.	2
Lab4	Modular and mechatronic tools.	2
Lab5	Select the operating parameters of the welding robot.	2
Lab6	Wireless management of information in storage systems.	2
Lab7	Coding systems for parts.	2
Lab8	Diagnostic double-action hydraulic press.	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U1 - PEK_U03	entrance test, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

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

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MTR_M_W01, K1MTR_M_W02	C1 - C2	Lec1 - Lec15	N1, N2
PEK_U01- PEK_U03	K1MTR_M_U02, K1MTR_U03	C3	Lab1 - Lab8	N3, N4
PEK_K01- PEK_K03	K1MTR_K03, K1MTR_K04, K1MTR_K13	C3	Lab1 - Lab8	N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Diploma seminar**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM037001**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. ECTS points in required range.

SUBJECT OBJECTIVES

C1. Acquiring ability to present own qualifications, knowledge, skills and social competences.
C2. Consolidation the ability to think critically and work in team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can present their own skills with a range of knowledge, skills and social competences.

III. Relating to social competences:

PEK_K01 - Student is able to think and act in a way that is creative and enterprising, he can work in a group.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, general information about writing Master's thesis and master's examination.	2
Sem2	Rules of proper technical and scientific paper preparation and Master's thesis.	2
Sem3	Review of the issues concerning diploma exam, comments and discussion.	11
Sem4	Multimedia presentations of the diploma works and discussion – students presentation.	13
Sem5	Summary of coursework and grading.	2
		Total hours: 30

TEACHING TOOLS USED

N1. Informative lecture.
N2. Self study - self studies and preparation for examination.
N3. Multimedia presentation.
N4. Tutorials.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	The appreciation of skill of solving in range of qualifying work the technical problems and their multimedia introduction as well as the leadership of discussion.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. R. Zanderowski: Praca magisterska, licencjat: krótki przewodnik po metodologii pisania i obrony pracy dyplomowej, CeDeWuL, Warszawa 2009.
2. A. Lenar: Profesjonalna prezentacja multimedialna, Helion, Gliwice 2010.
3. Publikacje wynikające z zakresu realizowanej pracy dyplomowej.
4. Materialy z wykładów.

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_K01	K1MTR_K01, K1MTR_K03, K1MTR_K04, K1MTR_K06, K1MTR_U24	C1	Sem3-Sem5	N1 - N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRAKTYKA**
Name in English:
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM037003Q.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U29			

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Monitorowanie maszyn i procesów**
Name in English: **Monitoring of machines and processes**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCM037205**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15		15		
Number of hours of total student workload (CNPS)	60		30		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	2		1		
including number of ECTS points for practical (P) classes			1		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		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 on the condition monitoring of production and their processes.
C2. Gaining knowledge of the processing, analysis and evaluation of the diagnostic signal.
C3. Acquisition of competence of accountability, integrity and fairness in the proceedings. Observance force in academia and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has basic knowledge of machine condition monitoring and process it implemented.
PEK_W02 - Has knowledge of various sources of interference with the equipment and appropriate research methods.
PEK_W03 - Has knowledge of the processing, analysis and evaluation of signals.

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 - Respects the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The scope of the lecture, Assessment and literature. Basic issues.	2
Lec2	Tasks systems monitoring, diagnosis and monitoring. Types of diagnostics and their goals.	2
Lec3	Monitoring the condition of machinery manufacturing.	4
Lec4	Supervising tools.	2
Lec5	Supervising the machining process.	2
Lec6	Supervising the accuracy of workpieces.	2
Lec7	Summary of lectures, additional explanations. Checking knowledge.	1
		Total hours: 15

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

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
Monitoring of machines and processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W03, K1MTR_W11	C1	Lec1 - Lec7	N1, N2
PEK_W02	K1MTR_W03, K1MTR_W11	C1	Lec1 - Lec7	N1, N2
PEK_W03	K1MTR_W03, K1MTR_W11, K1MTR_W15, K1MTR_W17	C2	Lec1 - Lec7	N1, N2
PEK_U01	K1MTR_U02, K1MTR_U03	C1, C2, C3	Lab1 - Lab7	N3, N4
PEK_U02	K1MTR_U17, K1MTR_U21	C1, C2, C3	Lab1 - Lab7	N3, N4
PEK_U03	K1MTR_U19, K1MTR_U21	C1, C2, C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K01	K1MTR_K02, K1MTR_K04, K1MTR_K05, K1MTR_K07	C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K02	K1MTR_K05, K1MTR_K06	C1, C2, C3	Lab1 - Lab7	N1, N2, N3, N4
PEK_K03	K1MTR_K01, K1MTR_K08, K1MTR_K09	C3	Lab1 - Lab7	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **SCADA i HMI**
Name in English: **SCADA AND HMI**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCM037208**
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. Completed course: PROGRAMMABLE LOGIC CONTROLLERS

SUBJECT OBJECTIVES

C1. Explain the construction of HMI and SCADA systems
C2. Explain the operation and design of HMI and SCADA systems
C3. Explain the use of HMI and SCADA systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Can describe the construction of HMI and SCADA systems
PEK_W02 - Can explain the operation and design an HMI and SCADA system
PEK_W03 - He can propose the appropriate HMI or SCADA system for a specific application

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The issue of electronic monitoring and control of industrial processes applications	1
Lec2	Construction and operation of SCADA package for example packages In Touch Wonderware Corporation and Siemens WinCC.	2
Lec3	Features and components of packages.	1
Lec4	Tools and methods for creating synoptic screens.	1
Lec5	Animation of graphical objects and the creation and use of libraries of objects	1
Lec6	Scripting language.	2
Lec7	Timing diagrams in real time and present the history of the process charts.	1
Lec8	Alarms: definition, presentation, service, validation, view, save and print ..	1
Lec9	HMI-construction, operation, maintenance, programming	2
Lec10	Communication protocols, communication driver	1
Lec11	Industrial Databases	1
Lec12	Test	1
		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_W01, PEK_W02, PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Programowanie systemów SCADA. WPK J. Skalmierskiego, Gliwice 2002

SECONDARY LITERATURE
Wonderware InTouch Podręcznik Użytkownika, Invensys Systems, Inc. 2005.
SIMATIC HMI WinCC flexible, Siemens, 2008

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19	C1	Lec1, Lec2,	N1
PEK_W02	K1MTR_W19	C2	Lec3, Lec4, Lec5, Lec6, Lec7, Lec8, Lec9, Lec10, Lec11,	N1
PEK_W03	K1MTR_W19	C3	Lec1, Lec2, Lec9, Lec10,	N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy metrologii**
Name in English: **Metrology principles**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR031101**
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. Has knowledge of basics of metrology, physics, algebra, mathematical analysis and informatics.
2. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

C1. Understanding the essence of measurement to recognize true state and relations between physical quantities.
C2. Gaining knowledge of basic metrological concepts, unit system SI, rules of making measurements of physical quantities and basic properties of measurements sensors and apparatus.
C3. Gaining knowledge about signal processing, measurements systems, rules and properties of measurement process.
C4. Gaining basic knowledge about measurement interferences factors.
C5. Gaining basic knowledge about experiment planning and results elaboration and uncertainty analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has basic knowledge of metrology, understands essence of measurements and knows measurements methods
PEK_W02 - Knows basic properties of measurements apparatus and measurements systems.
PEK_W03 - Has basic knowledge of accuracy and measurement uncertainty.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Measurement essence and metrology significance in technics and economy. Technical and legal metrology. Basic terms. Measurements scales and units. SI system and basic units definitions. Measurement services.	2
Lec2	Standards and hierarchical unit scaling system. Measurements equipment: apparatus, systems, measurement chain. Sensors and their properties and application; conditions.	2
Lec3	Experiment planning and measurement methods: division dependent on conditions, properties, example of use.	2
Lec4	Analog and digital measurement instruments: types, components, I/O elements, A/C converters, microprocessor role; metrological properties; influence of interferences.	2
Lec5	Calibration and legalization of measurement instruments: sources of measurement error; conditions and procedures of calibration and legalization; accreditation requirements; errors and corrections calculation; calibration and legalization certificates.	2
Lec6	Measurement uncertainty and results elaboration: sources of uncertainty; division and rules of estimation, calculation of A-type uncertainty.	2
Lec7	Calculation of B-type standard uncertainty and enhanced uncertainty with proper trust level. Methods for results elaboration and presentation.	2
Lec8	Test	1
		Total hours: 15

TEACHING TOOLS USED

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W03	C1, C2		N1, N2, N3
PEK_W02	K1MTR_W03	C3, C4		N1, N2, N3
PEK_W03	K1MTR_W03	C5		N1, N2, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Michał Lisowski email: michal.lisowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy elektrotechniki**
Name in English: **Fundamentals of Electrotechnics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR032102**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	90	30			
Form of crediting	Examination	Crediting with grade			
Group of courses					
Number of ECTS points	3	1			
including number of ECTS points for practical (P) classes		1			
including number of ECTS points for direct teacher-student contact (BK) classes	1.8	0.7			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knows the basic concepts of vector analysis (adding vectors, scalar product and vector operations, differentiation of vector functions, and linear surface integrals).
2. Has basic knowledge of complex numbers and matrix calculus, solving systems of linear equations and analytic geometry in the plane.

SUBJECT OBJECTIVES

C1. To acquaint the student with the knowledge necessary to understand the basic theory of the electromagnetic field.
C2. Familiarize students with the basic knowledge about the analysis of linear circuits in steady state.
C3. Teach the ability to analyze single and three phase electrical circuits with sinusoidal sources , including magnetic coupling.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic laws and theoretical foundations of the theory of electromagnetic field and electric circuit theory.
PEK_W02 - Has basic knowledge of analysis of linear circuits with sinusoidal sources in steady state.
PEK_W03 - Has knowledge of the power and energy in single- and three-phase circuits and methods of its calculations and measurements.
relating to skills:

II. Relating to skills:
PEK_U01 - Can correctly use laws of electromagnetic field theory, determining the physical quantities in engineering (RLC parameters, the electric and magnetic field distributions).
PEK_U02 - Can correctly use various methods for solving electrical circuits in the analysis of linear circuits with sinusoidal sources.
relating to social competences

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Getting to know the subject matter, requirements and method of assessment. Electric charge. Law of conservation of charge. Coulomb's law. The field strength. The potential and voltage. Vector of electric induction. Gauss' law. Introduction to electrostatic field. Electrical capacitance. Capacitor.	2
Lec2	Field flow of electric current. Vector of current density. Electric current. Ohm's law. Joule's law. The law of continuity of the current. Kirchhoff's law.	2
Lec3	Magnetic field. Vector of magnetic induction. The magnetic flux. The Laplace formula and Biot-Savart law. Ampere's law. Field of magnetic vector. Faraday's Law. Self and Biot-Savart law. Ampere's law. Field of magnetic vector. Faraday's Law. Self and mutual inductance.mutual inductance.	2
Lec4	Electrical circuit. The concept of the signal. Branches and nodes. Active and passive components. The accumulation and dissipation of energy in passive components. Direction of currents and voltages. The relationship between voltages and currents on passive components. Wiring diagrams and structural circuit. Graphs. Matrix notation of circuit structure. Incidence matrix. Relations between arrays of incidence. Relationship between potentials in nodal and branch method.	3
Lec5	Classification of signals: aperiodic and periodic. The RMS value and average value of periodic signals. Electrical properties: linearity, stationarity and causality. The general form of the branch circuit. The equations of voltages and currents. Ohm's law and Kirchhoff’s law in matrix notation. The balance of the instantaneous power for the electrical circuit.	2

Lec6	The response of RLC elements on alternating sinusoidal signal. Function of complex sinusoidal signal. Complex value. Algebraic form of complex signals. The Ohm's law and Kirchhoff's laws in complex form. Graphs, Phasor. The phase shift. Triangle of voltages, impedance and admittance. The concept of active, reactive and apparent power. Active and passive components of voltages and currents. The equivalent power source.	3
Lec7	Two- and multi-terminal equivalent circuits. The transformation of the triangle - the star. Method of superposition. Method of loop currents. The method of node potentials. Applying the method of loop currents and node potentials.	4
Lec8	Thevenin and Norton's theorem: the no-load voltage and short circuit current of two-terminal circuit. Impedance equivalence of two-terminal circuit. Equivalence of voltage and current sources. Equivalent sources.	2
Lec9	The resonance of voltages and currents. Conditions of resonance. Characteristics in frequency of resonant circuits. The importance of resonance in electrical engineering. Reactive power compensation. Electric filters.	2
Lec10	Magnetically coupled circuits. Mutual inductance. Positive and negative feedback. Decoupling branch of common node. Coreless Transformer.	4
Lec11	Three phase circuits. Multi-phase voltage source. Three phase circuits in star and triangle. Three- and four-wire circuits. Phase voltages and interphase voltages. Phase currents. The operator of rotation. Graphs and Phasors of 3phase circuits. Distribution of current in symmetrical and asymmetrical circuits. Power in three-phase circuits. Measurement of active and reactive power in balanced and unbalanced three- and four-wire systems.	4
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Coulomb's law. The electric field vector. Calculation of distribution electrostatic field at the given distribution of charge. Calculation of the capacitance.	2
Cl2	Calculation of field flow distribution. Determination the magnetic field intensity distribution for the circuit with current. Resistance and self-inductance.	2
Cl3	Determination of circuit parameters supplied by sinusoidal voltage, based on the measurement data.	1
Cl4	Determination of complex parameters of waveforms. Inverse transformation. The design of phasor diagrams for the RLC elements connected in series and in parallel.	1
Cl5	Calculation of the distribution of currents in the circuit using the branch and nodal methods. Use of the method of Thevenin and Norton in the analysis of electrical circuits.	2
Cl6	Analysis of RLC circuits under conditions of resonance of voltages and currents. Calculation of currents in circuits coupled magnetically	2
Cl7	Calculation of currents and voltages in the three-phase circuits, symmetrical and asymmetrical. Watt-meters in 3 phase circuits.	3
Cl8	Test	2
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. tutorials
N3. self study - self studies and preparation for examination
N4. calculation exercises

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	Exam
F2	PEK_W02	Exam
F3	PEK-W03	Exam
P = 0.4F1+0.3F2+0.3F3		

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	
F2	PEK_U02	
P = 0,5 F1 +0,5 F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1] D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, Electricity and Magnetism, Volume 3, PWN, 2011.
[2] Osowski S., K. Siwek, Daredevil M. Theory of circuits. Warsaw University of Technology, 2006.

SECONDARY LITERATURE

[1] Piątek Z., P. Jablonski, Basic theory of electromagnetic field, WNT, 2010.
[2] Bolkowski S., Brociek W., Rawa H., Theory of electrical circuits, Exercises, WNT 2007

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Electrotechnics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W13	C1, C2	Lec1-Lec5	N1- N4
PEK_W02	K1MTR_W13	C2	Lec6-LEc11	N1 - N4
PEK_W03	K1MTR_W13	C3	LEc10-Lec11	N1- N4
PEK_U01	K1MTR_U13	C1, C2	Cl1, Cl2	N4
PEK_U02	K1MTR_U13	C1, C2	Cl1-Cl3	N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wprowadzenie do programowania**
Name in English: **Introduction to programming**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR032251**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basic problems of computer science (Information technology).
2. Abilities of handling computer with the operating system WINDOWS.
3. The student is able to think and act creatively

SUBJECT OBJECTIVES

C1. Knowing and acquiring proficiency in use of principles of structural approach to creating algorithms.
C2. Knowing of principles of programming in the C language
C3. Mastering a skill of writing programs in the C language.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has knowledge in the scope of structural programming.
PEK_W02 - The student knows fundamentals of the C programming language.

II. Relating to skills:
PEK_U01 - The student is able to make use of principles of structural programming.
PEK_U02 - The student is able to write a simple program in the C programming language.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	An introduction. Algorithms. Principles of creating flow charts	2
Lec2	Ideas of programming: the structural programming, object-oriented programming	2
Lec3	General characteristics of the C programming language. Writing simple programs. Programming calculation of expressions.	2
Lec4	Entering data into a program from the keyboard. Display of calculation results on the screen	2
Lec5	Programming change of the order of the performed calculation. Entering iterations into a program.	2
Lec6	A concept of standard library. Its utilization in a program.	2
Lec7	Test I.	2
Lec8	Extracting the repetitive parts in a program.	2
Lec9	Considering a set of data of the same type.	2
Lec10	Handling address of indicated place in computer memory.	2
Lec11	Declaration of own types. Considering a set of data of different types.	2
Lec12	Handling of text.	2
Lec13	Writing data into a mass storage of a computer.	2
Lec14	Practical principles of writing programs.	2
Lec15	Test II	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Flow charts for simple algorithms.	2
Lab2	Flow charts for more complex algorithms.	2
Lab3	Writing, compiling and running simple programs.	2
Lab4	Reading data from the keyboard. Display of numbers and strings on the screen.	2
Lab5	Writing programs with use of bifurcation of control and jumps.	2
Lab6	Programs utilizing loops.	2

Lab7	Utilization of directives and macrodefinitions.	2
Lab8	Programming with use of functions	2
Lab9	Recurrent functions.	2
Lab10	Programming table operations.	2
Lab11	Introduction of pointers into a program.	2
Lab12	Writing programs with use of data structures and unions.	2
Lab13	Programming more advanced operations on strings.	2
Lab14	Creating programs which read input data from files and write results into files	2
Lab15	Writing programs with various elements of the C programming language.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. report preparation
N4. 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	activity at the classes
F2	PEK_W01 PEK_W02	tests
P = P=0.1*F1+0.9*F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 PEK_U02	activity at the laboratory classes
F2	PEK_U01 PEK_U02	reports from the laboratory classes

P = P=0.3*F1+0.7*F2

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Wirth N., Algorithms + Data Structures = Programs. Prentice-Hall, PTR Upper Saddle River, NJ, USA 1978.
[2] Kernighan B. W. , Ritchie D. M. , The C programming language. Prentice-Hall, Inc. Upper Saddle River, NJ, USA, 2011.
[3] Sexton C. , C Programming Made Simple. Elsevier Science, Oxford, 2011.

SECONDARY LITERATURE
[1] King K.N., C Programming: A Modern Approach, W. W. Norton & Company, 2008.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to programming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W19	C1, C2	Lec1	N1, N4
PEK_W02	K1MTR_W19	C2	Lec2, Lec3, Lec4, Lec5, Lec6, Lec8, Lec9, Lec10, Lec11, Lec12, Lec13, Lec14	N1, N4
PEK_U01	K1MTR_U19	C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, La9, Lab10, Lab11, Lab12, La13, Lab14, Lab15	N2, N3
PEK_U02	K1MTR_U19	C3	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9, Lab10, Lab11, Lab12, Lab13, Lab14, Lab15	N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo II**
Name in English: **Materials Science II**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR033102**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of advanced mathematics on a level permitting to understand mathematical problems in engineering sciences. Knowledge of the principles and laws of physics in the field of classical electrodynamics (electrostatics, electricity, electromagnetic waves, optics) and selected topics in solid state physics.
2. He can correctly and efficiently apply knowledge of mathematics for qualitative and quantitative analysis of mathematical problems related to the field of corresponding engineering studies. He can correctly and efficiently apply the previously acquired principles and laws of physics to the qualitative and quantitative analysis of physical problems as engineering.
3. He knows the possibilities of the further knowledge development and improvement of competences at work.

SUBJECT OBJECTIVES

C1. Acquisition of theory- grounded knowledge about the properties of materials used in mechatronics, electrical engineering, electronics and optoelectronics
C2. Understanding the importance of smart materials and nanomaterials in science and technology
C3. Acquisition of skills related to research organization and materials diagnostics with carefully selected methods

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He/she has knowledge about the properties of conductive, semi-conductive, dielectric and magnetic materials. He/she understands the importance of smart materials and nanomaterials in science and technology.
PEK_W02 - He/she is able to describe the influence of external stresses on the physical characteristics of materials
PEK_W03 - He/she is able to appropriately select materials for specific applications.

II. Relating to skills:
PEK_U01 - He/she can independently determine the parameters of selected materials. He/she can make a critical analysis of the results obtained.
PEK_U02 - He/she can interpret the physical phenomena occurring during the materials examination and testing
PEK_U03 - He/she can use acquired and well chosen methods for the diagnostics of materials

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Scope of the lecture, literature, credit conditions. The electrical conductivity of metals. Wire, contact and thermoelectric materials	2
Lec2	Semiconductor materials. Varistors	2
Lec3	Dielectrics. Electrical conductivity, polarization, dielectric losses. Electric strength	2
Lec4	Inorganic insulating materials: ceramics, glass. Optical fibers.	2
Lec5	Insulating thermoplastic and thermoset materials. Composite materials	2
Lec6	The essence of magnetism. Basic properties. Soft and hard magnetic materials. Ferrites	2
Lec7	Electrets. Smart materials	2
Lec8	Nanomaterials	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Resistance measurements of solid and liquid dielectrics	3
Lab2	Determination of dielectric permittivity. Measurement of dielectric losses	3
Lab3	Dielectrics electric strength examination.	3
Lab4	Examination of magnetic properties of electrical steel sheets.	3
Lab5	Hall effect examination	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Short quiz before laboratory exercises
F2	PEK_U01, PEK_U02, PEK_U03	Report from the laboratory exercises
P = 0,5 F1 + 0,5 F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Newell J., Essentials of modern materials science and engineering, John Wiley and Sons, Inc. 2009[2] Celiński Z., Materiałoznawstwo elektrotechniczne, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, 2011[3] Blicharski M., Wstęp do inżynierii materiałowej, Wydawnictwo AGH, Kraków, 2009[4] Rutkowski J. I inni, Podstawy inżynierii materiałowej – laboratorium, Oficyna Wydawnicza Politechniki Wrocławskiej, 2005 [5] Lisowski M. - Pomiary rezystywności i przenikalności elektrycznej dielektryków stałych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2004[6] Hilczer B., Małecki J.- Elektrety i piezopolimery, PWN, Warszawa, 1992

SECONDARY LITERATURE

[1] Oleś A., Metody doświadczalne fizyki ciała stałego, WNT, Warszawa, 1998[2] Kolbiński K., Słowikowski J., Materiałoznawstwo elektrotechniczne, WNT, Warszawa,1988[3] Recent papers covering usage of materials in engineering

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_W02	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_W03	K1MTR_W07	C1.C2.		N1., N2., N5.
PEK_U01	K1MTR_U03	C3.		N3., N4., N5.
PEK_U02	K1MTR_U03	C3.		N3., N4., N5.
PEK_U03	K1MTR_U03	C3.		N3., N4., N5.

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Instalacje elektryczne i układy zasilania**
Name in English: **Electrical installations and supply systems**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR033231**
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. In the scope of knowledge:
1.Student has the knowledge in the scope basics of the physics, particularly he understands the action of to get warm with electrical current and the mechanisms of heat transmission.
2.Student has the knowledge in the scope basics of the electrotechnics, he knows the basics elements electrical circuits, he knows the basics dimensions which characterize the electrical circuit, he knows to calculation of the simple electrical circuits.
2. In the scope of know-how:
1. Student knows the basics utilization of the computer.
3. In the scope of the competence:
1.Student conscious of the responsibility to assume his work.
2.Student conscious of the imminent of life and health in connexion with work by the electrical devices.
3.Student understands the need and knows possibility self-education, to improve the professional competences.

SUBJECT OBJECTIVES

C1. Acquirement the knowledge of the secure work by the electrical devises.
C2. The competently classification of the electrical low-voltage devices as well as the basics parameters of them.
C3. Acquirement the knowledge of solutions of the tasks and problems useful in choice of the supply and devices in the circuit of the electrical installation.
C4. Acquirement and record social competences which refer the readiness to the work in the team as well as independent, responsibility and honesty in the behaviour, consciousness of the results undertaken engineer's activity.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has the deeply and the verified knowledge in the scope of the construction and the appropriation of the individual part of the electrical installation.
PEK_W02 - Student has the deeply and the verified knowledge in the scope of the over-current and of the over-voltage protection in circuit of electrical installation. Student knows the basic parameters of the low-voltage switches.
PEK_W03 - Student knows the basic elements of the feeders cable of the direct current (DC) as well alternating current (AC) used in the scientific as well as the research laboratories. Student knows the parameters of them as well as he uses them.

II. Relating to skills:
PEK_U01 - Student is able to calculation of short-currents in the circuit of electrical installation in order to attain the choice of electrical apparatus as well as the test electrical shock protection.
PEK_U02 - Student is able to calculation of thermal effect as result flow the short-currents as well as the overload-currents in the wires and in the another elements of the electrical installation.
PEK_U03 - Student is able to choice the type of supply, parameters of circuit supply given another circuit in electrical installation as well as circuit in the laboratory.

III. Relating to social competences:
PEK_K01 - Student well establishment know-how co-operate in team by realization of the given task.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Preliminary information about the subject of the devices and installations electrical. System of the supply in electrical energy of customers.	2
Lec2	Elements of the electrical installation. Calculate of short currents 3-phase and 1-phase in installations circuits in order to attain the choice of electrical apparatus.	2
Lec3	Switches and fuses of the low voltage – construction and basic characteristics. Power electrical wiring and the rules them selection. Insulation and over-voltage protection.	2
Lec4	Thermal effects of the flow the short-currents as well the overload-currents in electrical installations. The thermal characteristics. Protection of the thermal effects.	2

Lec5	Low-voltage switchgear. Basics of the planning as well the projecting of the electrical installation. Electrical shock protection.	2
Lec6	Power quality, reliability of the supply, reserve and un-interruption source of supply.	2
Lec7	Feeder cable of the direct current (DC) as well of the alternating current (AC). Feeder cable utilization in the laboratory. Basics parameters and rules of choice.	2
Lec8	Colloquium for the course.	1
		Total hours: 15

Form of classes – Classes		Number of hours
Cl1	Introductory classes. Discussion of the subject scope and credit of the course. Initial information of the subject of the supply system in power electricity and in electrical installations.	2
Cl2	Calculation of the short-currents in electrical installations in order to attain the choice of electrical apparatus.	2
Cl3	Calculation of the thermal effect in the wires as well in another elements of electrical installation. Thermal characteristics at short-currents as well at overload-currents.	2
Cl4	Calculation of the thermal effect at short-currents and protection against them in the electrical installations.	2
Cl5	Calculation of thermal effect at overload-currents. Protection criterion of the wires against these effects.	2
Cl6	Exemplary, basics the projecting calculation of electrical installations.	2
Cl7	Choice of the feeder to given lab-circuit as well as to electrical installation.	2
Cl8	Colloquium for the course.	1
		Total hours: 15

TEACHING TOOLS USED

N1. calculation exercises
N2. problem exercises
N3. problem discussion
N4. multimedia 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	Colloquium
F2	PEK-W02	Lec3, lec5, Colloquium

F3	PEK-W03	Lec6, Lec7, Colloquium
P = 0,5F1+0,5F2+0,8F3		

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-K01	Participation in problematical discussions.
F2	PEK-U01	Cl1, Cl2, paper test
F3	PEK-U02	Cl3, Cl4, Cl5, paper test
F4	PEK-U03	Cl6, Cl7, Colloquium
P = 0,4F1+0,6F2+0,8F3+0,8F4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Markiewicz H., Urządzenia elektroenergetyczne, WNT, Warszawa, 2005.
Markiewicz H., Instalacje elektryczne, WNT, Warszawa, 2007.

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical installations and supply systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK-W01	K1MTR_W10	C1, C2	Lec1, Lec2	N2, N4, N5
PEK-W02	K1MTR_W10	C2, C3	Lec3, Lec4, Lec5	N1, N2, N4, N5
PEK-W03	K1MTR_W10	C2, C3	Lec5, Lec6, Lec7	N1, N2, N3, N4, N5

PEK-U01	K1MTR_U01, K1MTR_U02	C1, C3	Cl1, Cl2	N1, N2, N3, N4, N5
PEK-U02	K1MTR_U03, K1MTR_U04	C1, C3	Cl3, Cl4, Cl5	N1, N2, N3, N4, N5
PEK-U03	K1MTR_U05	C1, C2, C3	Cl6, Cl7	N1, N2, N3, N4, N5
PEK-K01	K1MTR_K01	C4	Cl1 - Cl7	N2, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie w Matlabie**
Name in English: **Programming in Matlab**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR033251**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of programming in C language.
2. Basic knowledge of mechatronics.
3. Student can think creatively.

SUBJECT OBJECTIVES

C1. To assimilate knowledge to create Matlab programs to solve mechatronic tasks.
C2. To become skillful at the creation of the function reading and writing the external files.
C3. To be able to present the computation results as graphics using library programs.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can use matrix and array operations for solving mechatronic tasks.
PEK_U02 - Student can write the Matlab program containing the functions of reading input data and writing computation results and present them graphicaly.
PEK_U03 - Student can write the program which solve the simple mechatronic task using Matlab library.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Using Matlab for mechatronic calculations - basic matrix operations.	2
Lab2	Matlab instructions - if, switch, for, while, break, return.	2
Lab3	Import and export of data from disc to memory.	2
Lab4	Rules to create Matlab scripts for solving the linear equation set.	2
Lab5	Rules to create Matlab functions for solving the linear electric circuit.	2
Lab6	Rules used for graphical object programming.	2
Lab7	Creating graphics in Matlab using the example transients in basic electric circuits.	2
Lab8	Graphical user interface design for supporting the solution of square equation.	2
Lab9	Cooperation with external files - input and output functions for the solution of square equation.	2
Lab10	Creating the functions for solving the nonlinear mechatronic equations.	2
Lab11	The application of Matlab library functions to minimize the costs of energy generation.	2
Lab12	The application of Matlab library functions to solve differential equations describing the transient states in electric circuit.	2
Lab13	Harmonics analysis of time transients of voltages and currents.	2
Lab14	Statistical and graphical analysis of measurement data imported from external files.	2
Lab15	Final test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory class
N2. Final test.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	report of laboratory exercises
F2	PEK_U01-PEK_U03	test
P = 0.6F1+0.4F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Mrozek B., Mrozek Z., Matlab and Simulink. User handbook. Hellion 2010. /in polish/

Brzóźka J., Dorobczyński L., Programming in Matlab. MIKOM 1998. /in polish/

SECONDARY LITERATURE

Sobierajski M., Łabuzek M.,Programming in Matlab for electricians. Wyd. PWr 2005. /in polish/

Stachurski M., Numerical methods in Matlab. MIKOM 2003./in polish/

Regel W., Symbolic nad numeric calculations in Matlab. MIKOM 2004./in polish/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming in Matlab
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K1MTR_U19	C1,C2,C3	Lab1-Lab14	N1,N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Marian Sobierajski tel.: 71 320 35 41 email: marian.sobierajski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy sieci komputerowych**
Name in English: **Components of computer networks**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR034104**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of computer support.
It has a basic knowledge of functional systems.
It has a basic knowledge of computer programming.
It has a basic knowledge of information retrieval.
2. Is able to recognise key hardware and software parameters of personal computers
Is able to write computer programmes based on given algorithm
3. Is able to think and action in a creative and enterprising manner.

SUBJECT OBJECTIVES

C1. Has basic knowledge about computer communication and data exchange for engineering purposes
C2. Identifies basic design guidelines for building local computer networks
C3. Preparing to solve problems in the project team

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has a basic knowledge of computer communication and exchange of information in the activities of engineering
PEK_W02 - It has an elementary knowledge of modeling and programming network events
PEK_W03 - Knows the basic principles for the design of local area networks

II. Relating to skills:
PEK_U01 - Able to obtain the information from the literature and other sources in the field of communication connections compilation
PEK_U02 - He can use the built-in operating systems and communication procedures through elementary programming in C / C ++
PEK_U03 - Knows how to use available through a computer network resources processes and data servers

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The objectives and tasks of the networks in the activities of engineering. Multitasking and concurrency processes in modern computer systems.Sharing of information resources.	3
Lec2	Network topologies and to compare the physical layer Ethernet and Token Ring. Network frames. Logical structure of the network (LAN) and urban (MAN) and public (WAN) and separated (Corporate).Network protocols: IP, TCP, UDP. ISO model. Advantages and disadvantages of encapsulation and data decapsulator.	3
Lec3	Selected elements of the local network communication technology, Wi-Fi, Bluetooth, USB, RS232, RS485, GPIB.Dedicated applications for engineers: Matlab, LabVIEW. Programming interfaces and communications applications design principles.	3
Lec4	Communication in a client-server system. File servers and processes. Examples Programming Pascal, C / C ++ data in an Ethernet local area networks.Programming Fundamentals network communication TCP / IP and UDP / IP in C / C or Pascal and VBA.	3
Lec5	Terminal work and its importance in the management of distributed systems. Built-in communication procedures in selected network operating systems Linux and Windows (Winsock).	2
Lec6	Final test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	SSH terminal work sessions on networked systems. Commands Linux the information systems (Unix). Network file system and directories. SFTP secure data transmission.	2
Lab2	Shell Programming - shell variables. Process Control.	2

Lab3	Development of elementary procedures for network C on the basis of predetermined communication algorithm.	2
Lab4	Elementary programming procedures in C network based on the algorithm specified communication - monitoring and identification of network events.	2
Lab5	Elementary programming procedures in C network based on the algorithm specified communication - within the process control laboratory and project groups.	3
Lab6	Laboratory project client-server model. Programming in C client server of the steering tasks of teaching - Working in teams laboratory and design.	3
Lab7	Laboratory assessment.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Self-study distance -test partial Educational platform: http://eportal.eny.pwr.wroc.pl
F2	PEK_W01, PEK_W02, PEK_W03	Final test (final) in the presence of conducting classes in the computer lab. Educational platform: http://eportal.eny.pwr.wroc.pl
P = 0,15*F1+0,85*F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02, PEK_U03	The development of electronic sub-reports Educational platform: http://eportal.eny.pwr.wroc.pl

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Przewodnik po sieciach lokalnych, Greg Nunemacher, MIKOM (wydanie dowolne)
[2] Programowanie zastosowań sieciowych w systemie Unix, W.Richaed Stevens,WNT '95
[3] Platforma edukacyjna: http://eportal.eny.pwr.wroc.pl
[4] Netografia

SECONDARY LITERATURE
[1] Nowoczesne sieci miejskie,J.Jaworski, R.Morawski,J.Olędzki,WNT(wydanie dowolne)
[2] TCP/IP. Administarcja sieci, Craig Hunt, OW READ ME (wydanie dowolne)
[3] JAVA Kompendium programisty, Helion, (wydanie dowolne)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Components of computer networks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 (wiedza) PEK_W02 PEK_W03	K1MTR_W19, K1MTR_W20	C1,C2	Lec1,Lec2, Lec3,Lec4, Lec5	N1,N2,N4
PEK_U01 (umiejętności) PEK_U02	K1MTR_U19, K1MTR_U20	C1,C2,C3	Lab1,Lab2, Lab3,Lab4, Lab5,Lab6	N2,N3,N4

SUBJECT SUPERVISOR

doc. dr inż. Jarosław Szymańda tel.: 2625 email: jaroslaw.szymanda@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia elektryczna**
Name in English: **Electrical metrology**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR034105**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basics of metrology, physics, algebra, mathematical analysis and informatics.
2. Is able to identify and describe physical phenomena connected with electrical matter.
3. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

C1. Learn electrical measurement methods and techniques.
C2. Learn operation principles, properties and application possibilities of analog and digital measurement instruments and systems for electrical and non-electrical measurements.
C3. Learn rules of utilization measurements instruments and systems for electrical quantities measurements.
C4. Gaining practical skills of measurements uncertainty analysis and results elaboration.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of measurements methods and techniques of electrical quantities and is able to choose proper one for the task.
PEK_W02 - Knows principles of operation, properties and potential of analog and digital measurement instruments and systems for electrical and non-electrical measurements.
PEK_W03 - Knows rules of operation of measurements instruments and systems for electrical measurements.

II. Relating to skills:
PEK_U01 - Is able to use proper methods and instruments for measurements of basic electrical quantities.
PEK_U02 - Is able to estimate measurements uncertainty and elaborate measurement results.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Structure, principles of operation and properties of measurement instruments for electrical quantities. Rules of selecting measurements instruments in measurements processes. Analog instruments and converters and their properties.	2
Lec2	Digital instruments and A/D converters. Role of microprocessors in digital instruments. Metrological properties of digital multimeters. Measurements of DC voltage and current.	2
Lec3	Measurement of AC voltage and current. Parameters of variable in time electrical signal. Methods for measurements of sinusoidal voltage and current. Analog and digital voltmeters and ammeters and their properties.	2
Lec4	Resistance, impedance, inductance and capacitance measurements. Bridge and digital measurements methods and instruments for resistance measurements. Measurements of impedance components. Functional and metrological properties of impedance and impedance components measurements instruments.	2
Lec5	Single-phase and tree-faze power measurements. Analog and digital wattmeter. Digital electrical grid parameters meters.	2
Lec6	Analog and digital oscilloscope. Principle of operation and structure of analog and digital oscilloscope. Multichannel oscilloscope. Functional and metrological properties of oscilloscope. Oscilloscopic measurements.	2
Lec7	Measurements systems and their configuration. Elements of measurement system: measurements cards and data acquisition cards, signal conditioners, multiplexers. Data transfer, interfaces – types and properties. Virtual instruments – structure and application.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction	2

Lab2	DC voltage and current measurements with analog and digital instruments.	2
Lab3	AC voltage and power measurements	2
Lab4	Resistance measurements with analog and digital instruments.	2
Lab5	Impedance and capacitance measurements.	2
Lab6	Oscilloscopic measurements	2
Lab7	Time for missed classes	2
Lab8	Individual tests	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01	Oral and written test. Laboratory report. Final mark: middle with marks laboratory practices.
P = średnia z uzyskanych ocen cząstkowych		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U03	C1 - C3		N2 - N5
PEK_U02	K1MTR_U03	C4		N3 - N5
PEK_W01	K1MTR_W03	C1		N1, N5
PEK_W02	K1MTR_W03	C2		N1, N5
PEK_W03	K1MTR_W03	C3		N1, N5

SUBJECT SUPERVISOR

Prof. dr hab. inż. Michał Lisowski email: michal.lisowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of control engineering**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR034211.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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. self study - self studies and preparation for examination
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W03	
F2	PEK_W01-PEK_W03	
P = 0,1F1+0,9F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W17	C1		N1
PEK_W02	K1MTR_W17	C2, C3		N1, N2, N3
PEK_W03	K1MTR_W17	C2, C3		N1, N2, N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie obiektowe w Matlabie**
Name in English: **MATLAB Object Oriented Programming**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR034251**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of computer science, linear programming
2. Is familiar with Matlab software, can write, test and run own programs in Matlab
3. Student can think and act creatively. Student is able to work alone.

SUBJECT OBJECTIVES

C1. Getting to know the principles of object-oriented programming
C2. Acquiring the skills to use Matlab to write programs implementing mechanisms of object-oriented programming, and to solve engineering problems using these mechanisms

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is able to do practical algorithmization of any engineering task
PEK_U02 - Can apply object-oriented programming paradigm to solve practical engineering problems
PEK_U03 - Knows and applies the principles of good programming style. Is able to test, debug, document the code of the program

III. Relating to social competences:
PEK_K01 - Can competently, independently, making a multi-criteria analysis, work out the engineering task
PEK_K02 - Understand the need for regular and individual work to learn the course material

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Objects, classes, methods, attributes, structures, constructors, destructors	2
Lab2	Method overloading	2
Lab3	Inheritance, derived classes	2
Lab4	Operators, operator overloading	2
Lab5	I/O operations	2
Lab6	Double linked list	2
Lab7	Polymorphism and virtual functions	2
Lab8	Matlab Class Wizard	4
Lab9	Templates	2
Lab10	The implementation of cellular automatons algorithms such as Life, Mistermind, etc.	6
Lab11	Testing, debugging and documenting of the program	2
Lab12	Final evaluation. Reserve term	2
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for laboratory
N2. individual work - writing the program and documenting
N3. preparation of the report
N4. tutoring

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	activity in classes, participation in problem discussions, reports (program code, documentation)
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Meyer B., Programowanie zorientowane obiektowo, Helion 2005, 2008
Register A.H.,A Guide to MATLAB Object-Oriented Programming, Chapman & Hall/CRC, 2007
Mrozek B., Mrozek Z., Matlab i Simulink. Poradnik użytkownika. Hellion 2010.
Brzóźka J., Dorobczyński L., Programowanie w Matlabie. MIKOM 1998.

SECONDARY LITERATURE
N.M. Josuttis, C++. Programowanie zorientowane obiektowo. Vademecum profesjonalisty, Helion 2003
Chomicz P., Ulijasz R., Programowanie w języku C i C++. Poradnik programisty.Wydawnictwo. PLJ, Warszawa, 1992
Liberty J., C++ dla każdego, Helion 2002
Prata S., Szkoła Programowania. Język C++, Helion 2006
Pratap R., Matlab 7 dla naukowców i inżynierów. MIKOM, Warszawa 2004

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MATLAB Object Oriented Programming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U1 - PEK_U3	K1MTR_U19, K1MTR_U35	C1-C2	La1 - La12	N1, N2, N3, N4
PEK_K1 - PEK_K2	K1MTR_K01	C1-C2	La1 - La12	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie obiektowe**
Name in English: **Object Oriented Programming**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR034251**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)			30		
Number of hours of total student workload (CNPS)			90		
Form of crediting			Crediting with grade		
Group of courses					
Number of ECTS points			3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes			2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Completed the course material: Introduction to computer science

SUBJECT OBJECTIVES

C1. The ability to design and implementation of applications in object-oriented programming language

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Gaining practical skills through laboratory tasks

III. Relating to social competences:

PROGRAMME CONTENT		
Form of classes – Laboratory		Number of hours
Lab1	Introduction to .NET and C # language. Discussion of the objectives of the project target (robot or machine controller)	4
Lab2	Introduction to UML. Design target driver functions in groups	4
Lab3	Development of diagrams: use case and activity classes for the driver. User Interface Design	4
Lab4	Principles of good GUI design. Designing of the user interface for controller	4
Lab5	Gaining knowledge about the class that realizes UDP network communication. Design your own application testing its operation	4
Lab6	The implementation of application implementing the assumption of La_02	4
Lab7	Functional tests and add exception handling (optional)	4
Lab8	Additional (spare) classes	2
		Total hours: 30

TEACHING TOOLS USED

N1. Quizzes to master the material needed to verify the current curriculum
N2. tutorials
N3. Self study - preparation of selected topics in the laboratory
N4. Laboratories
N5. Giving the knowledge necessary to carry out laboratory activities

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	Program completion quizzes, lab reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Rasheed, Faraz, Programmer-s Heaven C# School Book, http://www.programmersheaven.com/ebooks/csharp_ebook.pdf, 2012
2. Petzold, Charles, Programming Microsoft Windows with C#, Microsoft Press, 2001
3. Kubik, Tomasz, UML and service description languages : information systems modelling, PRINTPAP, 2011

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Object Oriented Programming
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19, K1MTR_U35	C1	La1-La7	N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Sensory - właściwości i zastosowania**
Name in English: **Sensors – properties and applications**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR035103**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge of physics, mathematical analysis, basics of metrology and electrical metrology, mechanics, electrotechnics.
2. Is able to identify and describe physical phenomena connected with mechanics and electrotechnics.
3. Understands the need and knows possibilities for continuous improvement.

SUBJECT OBJECTIVES

C1. Learn physical basics of classic and intelligent sensors. Learn most important parameters of sensors, and their use in mechatronics, automatics and measurement systems.
C2. Ability to select and use sensors for measurements of different physical quantities, and use of sensors in measurement, monitoring and control systems.
C3. Ability to examine basic sensor characteristics.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has basic knowledge of properties, functioning and structure of sensors and sensors systems, intelligent sensors and microsensors.
PEK_W02 - Has basic knowledge of sensors application for different physical quantities measurements.
PEK_W03 - Has basic knowledge of sensors application in measurement, monitoring and control systems.

II. Relating to skills:
PEK_U01 - Is able to select and use proper sensor for different physical quantities measurements
PEK_U02 - Is able to use sensors in measurement, monitoring and control systems.
PEK_U03 - Is able to examine basic sensor characteristics.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classical and intelligent sensors in mechatronics, automatics and measurement systems. Measurement and double-state (switching) sensors. Static and dynamic properties.	2
Lec2	Passive and active temperature sensors (resistive, capacitive, thermoelectric, quartz resonance).	2
Lec3	Fiber optic and pyrometric temperature sensors.	2
Lec4	Mechanical quantities sensors. Tensiometers – properties and applications. Displacement, linear and rotational speed sensors.	2
Lec5	Vibration sensors. Optical motion sensors and their application in anti-theft systmes.	2
Lec6	Pressure and flow sensors. Gas sensors, humidity sensors.	2
Lec7	Electric and magnetic field sensors. Illumination sensors.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction	2
Lab2	Investigation of static and dynamic properties of contact temperature sensors and their practical application	4
Lab3	Surface temperature measurements with contactless optical methods: pyrometric, thermovision camera. Measurements of air humidity.	4
Lab4	Investigation of properties of tensiometers and their practical applications (i.e. pressure measurements).	4
Lab5	Investigation of properties of inductive displacement sensors and layer thickness sensor. Inductive sensors for metal detection. Measurements of rotational speed.	4

Lab6	Optical distance measurements. Capacitive sensors and their application (i.e. liquid level sensors). Properties of intelligent motion sensors.	4
Lab7	Light sensitive sensors, illumination measurements.	4
Lab8	Missed classes time.	4
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for laboratory class
N4. self study - self studies and preparation for examination
N5. 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	Oral and written test. Laboratory report.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Sensors – properties and applications
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W15	C1		N1
PEK_U01 - PEK_U03	K1MTR_U15	C2, C3		N2 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Energoelektronika**
Name in English: **Power Electronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR035201.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		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. 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_W02, PEK_W03.	
P = 1*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	
F2	PEK_U01, PEK_U02, PEK_U03	
F3	PEK_U02, PEK_U03	
P = 0,25*F1+0,25*F2+0,5*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W01	C1., C2.		N3., N4.
PEK_W02	K1MTR_MAP_W01	C1., C2.		N3., N4.
PEK_W03	K1MTR_MAP_W01	C1., C2.		N3., N4.
PEK_U01	K1MTR_MAP_U01	C3., C1.		N1., N2., N4.
PEK_U02	K1MTR_MAP_U01	C3., C1.		N1., N2., N4.

PEK_U03	K1MTR_MAP_U01	C3., C1.		N1., N2., N4.

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of control engineering**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR035211.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory	Number of hours

Lab1		1
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	
F2	PEK_U01, PEK_K01	
P = 0,5F1+0,5F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U17	C1		N3, N4
PEK_K01	K1MTR_K03	C1		N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy techniki sterowania**
Name in English: **Elements of control engineering**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR035212**
Group of courses: **no**

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

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.
2. Student should have the basic knowledge of control systems.
3. Student should know how to analyze simple control systems and arrange and rearrange block diagrams of control systems.

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	Models of continuous system. Models of discrete system.	1
Lec2	Open-loop control system design methods. Feedback control system design methods.	2
Lec3	Controllability. Observability. Lyapunov stability.	2
Lec4	Global stability. Linear-quadratic optimal control problem.	2
Lec5	Deterministic optimal control.	2
Lec6	Dynamic programming. Optimal control of continuous systems.	2
Lec7	Bellman’s equation. Time-optimal control.	2
Lec8	Estimation of an unknown parameter measured under disturbances. Minimal risk method.	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	Complement classes.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. laboratory experiment

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

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

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
Elements of control engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W17	C1	WY1-WY3	N1
PEK_W02	K1MTR_W17	C2	WY4-WY6	N1
PEK_W03	K1MTR_W17	C3, C4	WY7-WY8	N1
PEK_U01	K1MTR_U17	C1	La2 - La3, La7	N2
PEK_U02	K1MTR_U17	C2	La4, La7	N2
PEK_U03	K1MTR_U17	C3, C4	La5-La7	N2
PEK K01	K1MTR_K01			

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Bezpieczeństwo w elektrotechnice**
Name in English: **Safety in electrical engineering**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR035241**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the basic principles of electrical engineering and construction of the installation and power grids. Basic knowledge of the construction and operation of the electrical equipment and apparatus.
2. Basic ability to connect the measurement circuits and to use the electrical quantities meters.
3. Ability to cooperate in a team.

SUBJECT OBJECTIVES

C1. Knowledge of operation rules of electric shock protection systems used in low-voltage installations.
C2. Knowledge of effectiveness criteria of electric shock protection systems in low-voltage installations.
C3. Knowledge of principles of low-voltage electrical installations testing.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge of the effects of electrical current on the human body.
PEK_W02 - Student has knowledge of the protective systems and protective measures used in low-voltage installations and knows the criteria of their effectiveness.
PEK_W03 - Student has knowledge of the principles of working on low-voltage electrical equipment, especially of the principles of testing of low-voltage electrical installations.

II. Relating to skills:
PEK_U01 - Student is able to perform the verification measurements in low-voltage electrical installations.
PEK_U02 - Student is able to evaluate the results of measurements and make a report for verification.

III. Relating to social competences:
PEK_K01 - Student can effectively cooperate in a team performing electrical verification tests.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions and designations in protection against electric shock. The impact of electric current on human beings.	2
Lec2	Principles for design and construction of low-voltage electrical installations.	2
Lec3	Low-voltage networks systems.	2
Lec4	Classes of protection of electrical equipment. Degrees of protection provided by enclosures. The criteria of protection against electric shock.	2
Lec5	Basic protection measures used in low-voltage installations.	2
Lec6	Fault protection measures used in low-voltage installations.	2
Lec7	The principles of safe work organization on electrical equipment. Principles of testing of electrical installations.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Presentation of safety rules and guidelines in the laboratory. Establish the requirements for crediting. General introduction to the stand of laboratory.	2
Lab2	Resuscitating of persons shocked by electric current.	2
Lab3	Measurement of insulation resistance and electric strength test of electrical installation and electrical equipment.	2
Lab4	Examination of protection by automatic disconnection of supply with overcurrent devices.	2
Lab5	Examination of protection by automatic disconnection of supply with residual current devices.	2
Lab6	Measurement of earth electrode resistance and the resistivity of soil.	2
Lab7	Measurement of insulation resistance of floors and walls. Measurement of touch voltage.	2

Lab8	Additional term. Laboratory crediting.	1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
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_W02, PEK_W03	presence at lectures
F2	PEK_W01, PEK_W02, PEK_W03	final test
P = 0,2*F1+0,8*F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	activity in the laboratory
F2	PEK_U02	report
P = 0,25*F1+0,75*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Markiewicz H.: Bezpieczeństwo w elektroenergetyce: zagadnienia wybrane. WNT, Warszawa 2009

SECONDARY LITERATURE

1. PN-IEC 60364 Instalacje elektryczne w obiektach budowlanych (norma wieloarkuszowa)
2. PN-HD 60364 Instalacje elektryczne niskiego napięcia (norma wieloarkuszowa)
3. Ustawa Prawo budowlane wraz z rozporządzeniami wykonawczymi

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Safety in electrical engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W27	C1, C2	Lec1	N1, N2
PEK_W02	K1MTR_W27	C1, C2	Lec2-Lec6	N1, N2
PEK_W03	K1MTR_W27	C3	Lec7	N1, N2
PEK_U01	K1MTR_U31	C2, C3	Lab2-Lab7	N3, N4
PEK_U02	K1MTR_U31	C3	Lab2-Lab7	N3, N4
PEK_K01	K1MTR_K13	C3	Lab2-Lab7	N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy elektryczne**
Name in English: **Electrical Drives**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MCR035301**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the field of physics, especially electrodynamics and electromagnetizm.
2. Has basic knowledge in the field of electrotechnics, including basics of DC and AC circuits theory.
3. Can properly and effectively apply the knowledge on the differential and integral calculus of single variable function for qualitative and quantitative analysis of mathematical problems connected with studying field of engineering.

SUBJECT OBJECTIVES

C1. Familiarizing students with the basic steady-state and dynamical performances of electrical drives.
C2. Familiarizing students with the basic converter-fed DC and AC motor drives, with speed control methods of mechatronic drives (including servodrives).
C3. Perfecting skills for measuring, data acquisition and elaboration of test results, their interpretation and analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge on basic elements of converter-fed drive, its operation regimes, can define and describe them. Can explain the principles of the operation and steady-state characteristics of the basic electrical and loading machines.
PEK_W02 - Can characterize and describe the basic methods used for speed control of the DC and AC motor drives.
PEK_W03 - Can characterize and describe the basic control structures of the DC and AC motor drives in open and closed-loop structures, including methods and structures for vector controlled servodrives.

II. Relating to skills:
PEK_U01 - Can calculate basic values characterizing operation of the DC and AC motors
PEK_U02 - Can choose the basic measurements equipment for electrical motors applied in choosen drive systems.
PEK_U03 - Can realize the experimental tests of chosen controlled electrical drives in laboratory set-up including their static and dynamical characteristics and analyse obtained results.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Electrical drive system - basic definition, components. Steady state characteristics of different types of motors and loading machines, regions of operation.	2
Lec2	Motion equation of electrical drive system, static and dynamic states, stable steady-state operation conditions. Influence of different types of mechanical connections to equation of motion.	2
Lec3	DC motor drive systems: construction and operation principle of DC motor with separate excitation, its mathematical model, dynamical performances. Converters supplying the DC motor.	2
Lec4	DC motor drive systems: speed control, breaking methods.	2
Lec5	Cascade structure of the speed and torque control of the DC motor. Controller adjustment methods, transient performances.	2
Lec6	Induction motor (IM) drive systems: principle of IM operation, its steady-state characteristics. Basic static converters supplying AC motors.	2
Lec7	Induction motor drive systems: speed control, breaking methods.	2
Lec8	Basics of frequency speed control method - scalar control: control rule, structure, performances.	2
Lec9	Basics of vector control principle of the IM speed and torque - main idea, control structure, dynamical performances, applications.	2
Lec10	Direct torque control method for the induction motor - main idea, control structure, dynamical performances, applications.	2
Lec11	Brushless DC and AC permanent magnet motors; contruction, principle ofoperation, basic methods for torque and speed control.	2

Lec12	Vector control method of the PMSM torque and speed - structures, dynamical performances.	2
Lec13	Basic requirements and parameters of servodrives. Electrical motors used in servodrives; permanent magnet DC and AC motors, step motors; main parameters and requirements.	2
Lec14	Design of servodrives with DC and AC motors - structures, analogies and differences depending on driving motor. Design rules for position controller, parameter adjustment, dynamics optimization.	2
Lec15	Development trends in electrical drive systems.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction - general description of laboratory set-ups, measurement equipment and measuring methods. Forming of characteristics of the DC motor with separate excitation iin different operation modes.	3
Lab2	Testing of the DC motor drive system supplied from the bidirectional controlled rectifier.	3
Lab3	Starting systems for squirrel-cage and slip-ring induction motors.	3
Lab4	Testing of the induction motor drive supplied form the voltage inverter -scalar control.	3
Lab5	Simulation tests of the cascade control structure of the DC drive system, with the stiff and elastic connection.	3
Lab6	Experimental tests of the cascade control structure of the DC drive system, with the stiff and elastic connection, in digital realization (with digital processor).	3
Lab7	Simulation tests of the field-oriented control of the voltage-inverter-fed induction motor drive system - vector control method.	3
Lab8	Experimental tests of the field-oriented control of the voltage-inverter-fed induction motor drive system - vector control method.	3
Lab9	Simulation tests of the voltage-inverter-fed PMSM motor drive system - vector control method.	3
Lab10	Experimental tests of the voltage-inverter-fed PMSM motor drive system - vector control method. Crediting with grade.	3
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_WO2, PEK_W03	short tests, 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	Evaluation of short tests before laboratory exercisses.
F2	PEK_UO2, PEK_U03	Activity in the exercises and discussion.
F3	PEK_U01, PEK_UO2, PEK_U03	Evaluation of the written works and laboratory reports.
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

W. Leonhard, Control of Electrical Drives, Springer Verlag, 1990

Krishnan R., Electric Motor Drives – modeling, analysis and control, Prentice Hall, 2001

SECONDARY LITERATURE

Automatic Control of Converter-fed Drives, Elsevier, 1994

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Electrical Drives** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechatronics**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number

PEK_W01	K1MTR_W10	C1		N1, N2, N3
PEK_W02	K1MTR_W10	C1, C2		N1, N2, N3
PEK_W03	K1MTR_W10	C1, C2		N1, N2, N3
PEK_U01	K1MTR_U02	C2, C3		N4, N5
PEK_U02	K1MTR_U10	C2, C3		N4, N5
PEK_U03	K1MTR_U10	C2, C3		N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie systemów rozproszonych na bazie sterowników PLC**
Name in English: **Programming of distributed control systems based on PLC**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR035303**
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. He has knowledge of the theory of logic circuits.
2. He can develop a control algorithm of the selected industrial process.

SUBJECT OBJECTIVES

C1. Familiarize students with the structure of the distributed control systems of automation.
C2. The acquisition of basic knowledge of popular communication networks used in industrial automation.
C3. The acquisition skills programming of the automation devices in distributed control systems.

SUBJECT EDUCATIONAL EFFECTS
I. Relating to knowledge: PEK_W01 - It is able to characterize the structure of distributed automation systems. PEK_W02 - It is able list and describe the basic communication networks used in distributed control systems. **II. Relating to skills:** PEK_U01 - He can connect and configure a distributed control system using popular industrial communication networks. PEK_U02 - It is able to program controllers and industrial automation equipment to realize the selected industrial process. **III. Relating to social competences:**

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Introduction. Automation in the modern manufacturing plant. Structures of the industrial control systems.	2
Lec2	Structure and programming of OMRON CJ1M PLC. The CX-One software.	2
Lec3	Communication systems for industrial automation. ISO OSI Reference Model. Principles of data exchange in popular industrial networks.	2
Lec4	Communication in distributed automation systems using OMRON PLCs.	2
Lec5	Application of RS-232 and RS-485 interface for data exchange between automation devices. Communication using PC-Link network.	2
Lec6	Visualization of industrial processes - programming HMI terminals.	2
Lec7	Visualization of industrial processes - the Cx-Supervisor SCADA software.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the Rules and Regulations of internal safety lab. Establish rules for passing. General familiarization with laboratory equipment. Discussion of the laboratory exercises.	2
Lab2	Introduction to the CX-One software. Configuration and programming OMRON CJ1M controller.	2
Lab3	Getting to know the function libraries of the CX-Programmer software.	2
Lab4	Programming of serial ports. The exchange of data between controllers with PC-Link network.	2
Lab5	The use of communication modules PRM21 for data exchange using PROFIBUS network. Operation of the distributed I/O station GRT1-PRT.	1
Lab6	The use of communication modules DRM21 for data exchange using DeviceNet network. Operation of the distributed I/O station GRT1-DRT.	1
Lab7	Programming of control systems of selected models of advanced industrial processes.	4

Lab8	Giving reports, summary and pass the lab.	1
		Total hours: 15

TEACHING TOOLS USED
N1. multimedia presentation N2. laboratory experiment N3. report preparation N4. self study - preparation for laboratory class N5. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK-W01 PEK-W02	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	Rating of reports of completed projects.
F2	PEK-U01 PEK-U02	Assessment of prepare for laboratory exercises.
F3	PEK-U01 PEK-U02	Activity in laboratory classes.
P = 0,4*F1 + 0,3*F2 + 0,3*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Kasprzyk J., Programowanie sterowników przemysłowych, WNT
[2] Pawlak M., Sterowniki Programowalne, e-skrypt, ed. Politechnika Wrocławska, Wrocław 2010, available in Dolnośląska Biblioteka Cyfrowa,

SECONDARY LITERATURE
[1] Flaga S., Programowanie sterowników PLC w języku drabinkowym, BTC, Legionowo 2010
[2] Weigmann J., Kilian G., Decentralization with PROFIBUS-DP, Publicis MCD Verlag, Erlangen 2000
[3] Solnik W., Zajda Z., Komputerowe sieci przemysłowe Profibus DP i MPI, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2004.
[4] Laboratory instruction set, supplementary materials for the lecture, a set of technical documentation of PLCs.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming of distributed control systems based on PLC
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W10, K1MTR_W17, K1MTR_W33	C1	Lec1 Lec2 Lec3 Lec4	N1 N5
PEK_W02	K1MTR_W10, K1MTR_W17, K1MTR_W33	C2	Lec3-Lec7	N1 N5
PEK_U01	K1MTR_U15, K1MTR_U20, K1MTR_U36	C2, C3	Lab2-Lab7	N1, N2, N3, N4
PEK_U02	K1MTR_U15, K1MTR_U20, K1MTR_U36	C2, C3	Lab2-Lab7	N1, N2, N3, N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiały aktywne**
Name in English: **Active materials**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036102**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. KNOWLEDGE
1. Has a basic knowledge in physics, chemistry and materials science.
2. Has a basic knowledge in the field of metrology, including evaluation of the uncertainty of measurements.
2. SKILLS
1. Can apply knowledge of physics, chemistry and materials science to qualitative and quantitative analysis of the physical aspects of engineering problems.
2. Can estimate the uncertainty of measurements of electrical and non-electrical quantities made in laboratory conditions.
3. OTHER COMPETENCES
1. Understands the need to study the chosen field of study.
2. Understands the need for continuous life-long learning to master professional, social and competences.

SUBJECT OBJECTIVES

C1. To familiarize the student with the types, properties and applications of active and intelligent materials.
C2. To familiarize the student with the latest world trends and achievements in research on active and intelligent materials.
C3. To gain practical skills and knowledge of experimental characterization of selected properties of active and intelligent materials .

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Being able to explain the concept of active and intelligent materials, name and characterize their types in detail.
PEK_W02 - Iis able to provide and explain the physical phenomena responsible for the operation and functions of active and intelligent materials.
PEK_W03 - Is able to provide examples of application of active and intelligent materials in mechatronic systems and transducers.

II. Relating to skills:
PEK_U01 - Can experimentally determine the selected properties of active and intelligent materials.
PEK_U02 - Is able to interpret the results of experimental work carried out in the field of active and intelligent materials.
PEK_U03 - Can, on the basis of the obtained results and their conclusions, assess whether active material or a transducer using such material complies with the requirements of mechatronic system.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction: requirements and how to pass. Active , smart, multifunctioinal materials- basic concepts. An overview of the kinds of active materials. Color-changing materials. Electrochromic materials. E-paper.	2
Lec2	Light-emitting materials. Chemo-and electroluminescence.	2
Lec3	Shape-changing materials. Magneto- and electrostrictive materials, piezomaterials. Artificial muscles. Electroactive polymers.	2
Lec4	Electrothermal and thermoresponsive materials . Thermochromic materials. The viscosity-changing materials. Ferrofluids and materials displaying electroreology-related phenomena.	2
Lec5	Self-assembling and self-repairing materials. Biomaterials as matrices. Microcapsules.	2
Lec6	Materials sensitive to changes in pH. Polymer gels. Superhydrophobic, oleophobic and self-cleaning materials.	2
Lec7	MEMS and NEMS structures. Biomimetic materials.	2
Lec8	Final test.	1

		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction: requirements and how to pass. Overview of individual lab exercises. Health and safety training.	1
Lab2	Experimental characterization of electroactive polymer.	3
Lab3	Experimental characterization of piezoelectric material.	3
Lab4	Experimental characterization of electroluminescent material.	3
Lab5	Experimental characterization of electrothermal and thermoresponsive material.	3
Lab6	Extra laboratory exercise. Credition.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. case study
N3. laboratory experiment
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	colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03	short written tests, oral questioning
F2	PEK_U01-PEK_U03	reports of all scheduled and carried out lab exercises
P = 0,5*F1+0,5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Brian Culshaw, Smart structures and materials, Boston ; London : Artech House, cop. 1996
[2] Smart materials / ed. by Mel Schwartz, Boca Raton: CRC Press, Taylor & Francis Group, 2009
[3] Nanoengineering of structural, functional, and smart materials / ed. by Mark J. Schulz, Ajit D. Kelkar, and Mannur J. Sundaresan, Boca Raton, CRC Press, 2006.

SECONDARY LITERATURE
[1] Smart polymers: applications in biotechnology and biomedicine / ed. by Igor Galaev, Bo Mattiasson. 2nd ed., Boca Raton: CRC Press; 2008
[2] Theory and phenomena of metamaterials / ed. by Filippo Capolino, Boca Raton: CRC Press / Taylor & Francis Group, 2009
[3] Jerzy Wiciak, Wybrane zagadnienia redukcji drgań i dźwięków strukturalnych (Selected aspects of structural vibrations and sounds reduction), Kraków AGH Uczelniane WydawnictwaNaukowo-Dydaktyczne, 2008

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W02	C1, C2	Lec1-Lec7	N1, N2, N5
PEK_W02	K1MTR_MAP_W02, K1MTR_W02	C1, C2	Lec1-Lec7	N1, N2, N5
PEK_W03	K1MTR_MAP_U02	C1, C2	Lab1-Lab6	N1, N2, N5
PEK_U01	K1MTR_MAP_U02, K1MTR_U03, K1MTR_U24	C3	Lab1-Lab6	N3, N4, N5
PEK_U02	K1MTR_MAP_U02, K1MTR_U02, K1MTR_U22	C3	Lab1-Lab6	N3, N4, N5
PEK_U03	K1MTR_MAP_U02	C3	Lab1-Lab6	N3, N4, N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Interdyscyplinarny projekt zespołowy**
Name in English: **Interdisciplinary team project**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036103, MCR036231, MCR036302**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				30	
Number of hours of total student workload (CNPS)				90	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				3	
including number of ECTS points for practical (P) classes				3	
including number of ECTS points for direct teacher-student contact (BK) classes				2.1	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the field of informatics and electronics.

SUBJECT OBJECTIVES

C1. Acquisition of practical knowledge and skills for implementation and using of optimization algorithm for processes and devices design.
C2. Acquisition of practical knowledge and skills for design and realization of simple mechanisms based on programmable devices.
C3. Acquisition and fixing the social competences related to creative thinking.
C4. Acquisition and fixing the social competences related to cooperation in group.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Can use proper optimization and statistics methods for optimization of industrial systems.
PEK_U02 - Is able to choose and program (using high level programming languages) configurable devices used for calculation of algorithms used in industrial applications.

III. Relating to social competences:
PEK_K01 - Is able to cooperation and work in team and correctly present results of researches.
PEK_K02 - Is able to creative and enterprising thinking.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction-presentation of the form of classes and realized projects. Division into groups.	4
Proj2	Selection of methods used for realization of tasks, with particular emphasis on the possibility of applying methods of rapid prototyping and cost reduction.	2
Proj3	Presentation of the prepared concepts relating to realization of individual tasks.	4
Proj4	Consultations of projects. Discussion about individual work and cooperative problem solving.	6
Proj5	Presentation of the subsequent stages of work (speech using multimedia tools).	4
Proj6	Consultations of projects. Discussion about results presentation.	6
Proj7	Presentation of final results of projects (speech using multimedia tools and show of the real model). Discussion between all participants of the course.	4
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. multimedia presentation
N3. project presentation
N4. problem discussion
N5. 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	Assessment of presentations
F2	PEK_K01 PEK_K02	Activity
F3	PEK_U01 PEK_U02 PEK_K01 PEK_K02	Assessment of final results
P = 0,3*F1+0,3*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Kardaś M., Mikrokontrolery AVR Język C podstawy programowania, Atnel, 2011.
[2] Doliński J., Mikrokontrolery AVR w praktyce, BTC, 2004.
[3] Grębosz J., Symfonia C ++ Standard, Editions 2000 Kraków, 2008.
[4] Kowalski A.H., Procesory DSP dla praktyków, Wydawnictwo: BTC, Legionowo, 2011.
[5] Michalewicz Z., Algorytmy + Struktury danych = programy ewolucyjne, Wydawnictwa Naukowo Techniczne, 2003.
[6] Anderson R., Cervo D., Arduino dla zaawansowanych, Helion, 2014.

SECONDARY LITERATURE

[1] Ganczarski J., Owczarek M., C++. Wykorzystaj potęgę aplikacji graficznych, Helion, 2008.
[2] Wieczorek H., Eagle, pierwsze kroki, BTC, 2007.
[3] Eckel B., Thinking in C++, Helion, 2002.
[4] Kowalski A.H., Procesory DSP w przykładach, Wydawnictwo: BTC, Legionowo, 2012.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U04, K1MTR_U30	C1	Proj1-Proj7	N1-N5
PEK_U02	K1MTR_U04, K1MTR_U30	C2	Proj1-Proj7	N1-N5
PEK_K01	K1MTR_K03, K1MTR_K06	C3,C4	Proj1-Proj7	N1-N5
PEK_K02	K1MTR_K03, K1MTR_K06	C3,C4	Proj1-Proj7	N1-N5

SUBJECT SUPERVISOR
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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w sterowaniu**
Name in English: **Microsystems in control**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036105**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge in the field of informatics.
2. Has knowledge of algorithms design used in engineering applications.
3. Knows the principles for the design of algorithms used in systems based on microprocessors.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of microprocessor system architecture, addressing modes, numeral systems, types of memory, typical internal elements of microprocessors (AC converters, counters, interrupt systems) needed for control of mechatronics system.
C2. Getting skills related to design of algorithms and hardware implementation of its.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows the architecture and internal components of microcontrollers and can programming devices applied in mechatronics systems.
PEK_W02 - Knows basic methods of control used for drives supplied using power electronics.
PEK_W03 - Has basic knowledge about data transferring methods used in systems based on microcontrollers.

II. Relating to skills:
PEK_U01 - Student can measure and generate signals in systems based on microcontrollers.
PEK_U02 - Has skill about programming of control structures used for basic electrical drives with DC, stepper and AC motors.
PEK_U03 - Can apply basic communication interface for issues of control.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Architecture of microprocessor systems. Microprocessor, microcomputer, microcontroller, digital signal processor. Microcontroller in control systems with mechatronics objects.	2
Lec2	The principle of operation of internal components of microcontrollers (A/D converters, timers, interrupts systems) and basics of programming. Construction and programming of displays.	6
Lec3	Selected serial and parallel communication interface used in control systems.	2
Lec4	Pulse-Width Modulation – methods of generation in systems based on microprocessors and applications in power electronics and automation of electrical drives.	3
Lec5	Examples of real implementation of microcontrollers in temperature control, speed control, electromagnetical torque, etc.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Basic information about laboratory equipment hardware and software environment.	2
Lab2	Measurement of analogue signals using A/D converter of microcontroller.	2
Lab3	Programming of the timer module of microcontroller, PWM signal generation.	2
Lab4	Control of a DC motor using the A/D converter and PWM signal.	2
Lab5	Control of stepper motor.	2
Lab6	Control of servomechanism.	2
Lab7	Programming the selected interfaces.	2
Lab8	Summary of the laboratory.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Assessment of preparation quality for laboratory.
F2	PEK_U02, PEK_U03	Activity during the classes.
F3	PEK_U01, PEK_U02, PEK_U03	Assessment of reports.
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Doliński J., Mikrokontrolery AVR w praktyce, BTC,2004.
2. Baranowski R., Mikrokontrolery AVR ATmega wpraktyce, BTC, 2006.
3.Orłowska-Kowalska T., Bezczujnikowe układy napędowe z silnikami indukcyjnymi, Oficyna wydawnicza Politechniki Wrocławskiej, 2003.
4. Zawirski K., Sterowanie silnikiem synchronicznym o magnesach trwałych, Wydawnictwo Politechniki Poznańskiej, 2005.

SECONDARY LITERATURE
1. Hajduk Z., Mikrokontrolery w systemach zdalnego sterowania, BTC, 2005.
2. Kardaś M., Mikrokontrolery AVR Język C podstawy programowania, Atnel, 2011.
3. Przepiórkowski J., Silniki elektryczne w praktyce elektronika, BTC, 2012.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W21	C1	Lec.1-Lec.3	N1, N2
PEK_W02	K1MTR_W21	C1	Lec.3-Lec.6	N1, N2
PEK_W03	K1MTR_W21	C1	Lec.7,Lec.8	N1, N2
PEK_U01	K1MTR_U15, K1MTR_U16	C2	Lab.1-Lab.6	N3 - N5
PEK_U02	K1MTR_U15, K1MTR_U16	C2	Lab.1-Lab.6	N3 - N5
PEK_U03	K1MTR_U15, K1MTR_U16	C2	Lab.1-Lab.6	N3 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Cyfrowe przetwarzanie sygnałów**
Name in English: **Digital signal processing**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036106**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical knowledge of Laplace and Fourier transforms
2. Basic ability to programming in C and Matlab

SUBJECT OBJECTIVES

C1. Understanding and applying issues of digital signal processing
C2. Description and analysis digital systems in time and frequency domain
C3. Project and implementation of simple digital systems
C4. Effective working in groups, focused on creativity and collaboration

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has ordered knowledge of digital signal processing including: sampling theory, mathematical description and analysis of discrete systems in the time domain and frequency

II. Relating to skills:
PEK_U01 - Able to be used mathematical tools in programming environments for the description and analysis of digital signal processing problems
PEK_U02 - Able to design and implement the correct algorithms for digital signal processor

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, program, bibliography, conditions for course crediting, basic definitions and examples, discrete signals (mathematical model of discrete signal, the signal spectrum, aliasing)	2
Lec2	Discrete-time systems, LTI systems properties, models of systems, difference equations, convolution, impulse response, block diagrams, state space, systems classification, analog-to-digital conversion, periodic sampling, examples, sampling theorem, sampling of band pass signals.	2
Lec3	The z-transform, introduction, definition of the z-transform, relationship between the z-transform and the Laplace transform, basic properties. The inverse z-transform, methods and examples, partial fraction expansion, contour integration, region of convergence, solved problems.	2
Lec4	Using z-transform, transform analysis of systems, solving difference equations, system function, stability and causality. The discrete Fourier transform (DFT), introduction, definition and properties of the DFT, examples, relationship between the z-transform and the DFT. The inverse discrete Fourier transform (IDFT), overlapping effect, windows methods, and frequency resolution.	2
Lec5	Digital filters, introduction, notations, structures for FIR and IIR systems, the zero-pole method for filter design, filter specifications and classification, examples of filters.	2
Lec6	FIR filters, linear phase FIR design using windows, properties, design procedures, examples. IIR filters, introduction, structures for IIR filters, IIR filters design, impulse-invariant transformation, bilinear transformation.	2
Lec7	The Fast Fourier Transform, relationship between the FFT and the DFT, FFT algorithm, introductions, examples, radix-2 decimation-in-time FFT.	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory organization, conditions for course crediting, group division.	1
Lab2	Signal processor programming - introduction (Signal Processor)	2

Lab3	Analog-to-digital conversion (Matlab)	2
Lab4	Generation of signals, real-time processing (Signal processor)	2
Lab5	Spectral analysis, FFT (Signal Processor)	2
Lab6	Digital filters (Matlab)	2
Lab7	Digital filters (Signal Processor)	2
Lab8	Corrections and evaluation of the course	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	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	oral answers
F2	PEK_U02	laboratory reports
P = 0.2*F1+0.8*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
T. P. Zieliński „Cyfrowe przetwarzanie sygnałów”, 2005
A. V. Oppenheim, R. W. Schafer „Cyfrowe przetwarzanie sygnałów“ 1989
R. G. Lyons „Wprowadzenie do cyfrowego przetwarzania sygnałów” 1999

SECONDARY LITERATURE
G. Marven, G. Ewers „Zarys cyfrowego przetwarzania sygnałów” 1999
W. Brodziewicz, K. Jaszczak „Cyfrowe przetwarzanie sygnałów” 1987
R. Gabel, R. Roberts „Sygnały i systemy liniowe” 1978
K. Steiglitz „Wstęp do systemów dyskretnych” 1977

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Digital signal processing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W21	C1, C2	Le1-8	N1
PEK_U01	K1MTR_U21	C3	La1-8	N2,N3,N4
PEK_U02	K1MTR_U22	C3	La1-8	N2,N3,N4

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Prototypowanie systemów sterowania**
Name in English: **Control Systems Prototyping**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036203**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He has an extended knowledge of the structured and theoretically founded knowledge in the field of computer science and software engineering, and computer architecture in particular the hardware layer.
2. He can define the general requirements for the microprocessor systems for a given application, design the structure of the system, choose the software to write a program according to the control algorithm in the low level
3. He is able to interact and work in a group, taking on different roles

SUBJECT OBJECTIVES

C1. Familiarize yourself with the system design based on models (MBD - model-based design)
C2. Become familiar with software Simulink and Real Time Workshop and dSPACE controllers DSP (software and hardware)
C3. Practical realisation and testing in real time different mechatronic systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - He is able to to create in the Simulink software mechatronic systems
PEK_U02 - He is able to to create simple mechatronic systems using RP and HIL methods
PEK_U03 - He can program DSP

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Designing with models (and. Model-Based Design) - the basics of building a simple object models using Matlab-Simulink	3
Lab2	Testing policies in real time. Familiarization with hardware DSP dSPACE	3
Lab3	Software to implement the test in real time - to familiarize themselves with the basics of programming the controller of DSP with the RTW method	3
Lab4	Development of models selected mechatronic systems using the electrical drive systems	3
Lab5	Laboratory studies of selected mechatronic systems using HILLS	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Assessment of preparation for laboratory exercises
F2	PEK_U02, PEK_U03	Activity
F3	PEK_U01 - PEK_U03	Assessment of reports on laboratory exercises
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Bismor D., Programowanie systemów sterowania – narzędzia i metody, WNT, 2010
2.Tunia H., Kaźmierkowski M. P., Podstawy automatyki napędu elektrycznego, PWN, Warszawa 1978
3. Mrozek Z., Komputerowo wspomagane projektowanie systemów mechatronicznych, Wydawnictwo Politechniki Krakowskiej, 2002
4. Mrozek B., Mrozek Z., Matlab Simulink - poradnik uzytkownika, Helion, 2010

SECONDARY LITERATURE

1. Users manuals dSpace (www.dspace.com)
2. Matlab: Guide to Rapid Prototyping with Simulink, RTW and dSpace, MathWorks, 1995

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Control Systems Prototyping
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U19	C1 - C3	L1 - L5	N1 - N3
PEK_U02	K1MTR_U19	C1 - C3	L1 - L5	N1 - N3
PEK_U03	K1MTR_U19	C1 - C3	L1 - L5	N1 - N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie MES w mechatronice**
Name in English: **FEM modelling in mechatronics**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036303**
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 basic knowledge about differential calculus.
2. Student has basic knowledge about electrodynamics (electrostatics, electric current, magnetostatics, magnetic induction, electromagnetic waves)
3. Student is able to utilize theory of electromagnetic field to assess physical quantities.

SUBJECT OBJECTIVES

C1. Description of electromagnetic phenomena in electrical machines and devices.
C2. Introduction to universal method of computation of field (by finite element method) as a tool to evaluate induction, force and power loss parameters.
C3. Introduction to field analysis and designing of electrical machines and devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Student is able to utilize commercial software to field and circuit-field computation.
PEK_U02 - Student is able to design 2-D field and circuit-field model of electrical machines and devices.
PEK_U03 - Student is able to assess results of computations of electromagnetic field.

III. Relating to social competences:
PEK_K01 - Student is able to cooperate in a teamwork for various roles.

PROGRAMME CONTENT

Form of classes – Laboratory		Number of hours
Lab1	Basic terms of electrodynamics and definitions of physical quantities.	2
Lab2	Principles of software to compute fields by finite element method. Training of simple software to compute electromagnetic fields (QuickField and FEMM).	2
Lab3	Construction of field model of electromagnetic device (QuickField and FEMM).	2
Lab4	Geometry construction of simple electrical device and material parameters of its elements.	2
Lab5	Mesh generation. Investigation of mesh quality on the computation results.	2
Lab6	Computation of magnetic field distribution on simple models of electrical devices.	2
Lab7	Analysis of numerical computation results. Methods of results presentation.	2
Lab8	Analysis of field computation results. Integral quantities computation (induction, force, torque).	2
Lab9	Planar-parallel model of device supplied by DC current.	2
Lab10	Planar-parallel model of device with permanent magnet.	2
Lab11	Field axial-symetrical model of electric device supplied by permanent magnets or DC current.	2
Lab12	Computation of magnetic field distribution and electromagnet parameters.	2
Lab13	Computation of magnetic field distribution and DC current actuator parameters.	2
Lab14	Computaion of magnetic field distribution and permanent magnet synchronous machine torque. Teamwork.	2
Lab15	Grades.	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Turowski J., Obliczenia elektromagnetyczne elementów maszyn i urządzeń elektrycznych, WNT, Warszawa 1982

SECONDARY LITERATURE

Bianchi N., Electrical machine analysis using finite elements, CRC Taylor&Francis, Boca Raton, 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
FEM modelling in mechatronics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_U01	C3		N1
PEK_U02	K1MTR_U13	C3		N1
PEK_U03	K1MTR_U02	C3		N1
PEK_K01	K1MTR_K03	C3		N1

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mikrosystemy w pomiarach**
Name in English: **Microsystems in measurements**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR036304.**
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		1
Lec8		2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		3
Lab2		3
Lab3		3
Lab4		2
Lab5		2
Lab6		2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for laboratory class
N4. 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_WO1, PEK_WO2, PEK_WO3	
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	
F2	PEK_U02, PEK_U03	
F3	PEK_U01, PEK_U02, PEK_U03	
P = 0,2*F1+0,4*F2+0,4*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microsystems in measurements
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_W16	C1		N1, N2
PEK_W02	K1MTR_W16	C1		N1, N2
PEK_W03	K1MTR_W16	C1		N1, N2
PEK_U01	K1MTR_U15, K1MTR_U16	C2, C3		N3 - N5
PEK_U02	K1MTR_U15, K1MTR_U16	C2, C3		N3 - N5
PEK_U03	K1MTR_U15, K1MTR_U16	C2, C3		N3 - 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): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037028.**
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 – Seminar		Number of hours
Sem1		2
Sem2		2
Sem3		2
Sem4		6
Sem5		10
Sem6		6
Sem7		2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. self study - self studies and preparation for examination
N3. report preparation
N4. problem discussion
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08	C1		N1 - N5
PEK_K01	K1MTR_K04, K1MTR_K06	C2		N1 - 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): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037038.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		2
Sem2		2
Sem3		2
Sem4		6
Sem5		10
Sem6		6
Sem7		2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2.
N3.
N4.
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08	C1		N1 - N5
PEK_K01	K1MTR_K04, K1MTR_K06	C2		N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie cienkowarstwowe**
Name in English: **Thin-layer technologies**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037102**
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

1. Has a basic knowledge of the foundations of physics .
2. Has a basic knowledge of the materials science engineering

SUBJECT OBJECTIVES

C1. Understanding the physical basis of the generation and measurement of the vacuum.
C2. Understanding the technology of thin films .
C3. Knowledge of contemporary developments in the field of electrical materials technology .

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows basics of vacuum technology

PEK_W02 - Has a basic knowledge of the technology of thin films .

PEK_W03 - Has a basic knowledge of contemporary developments in the field of electrical materials technology .

II. Relating to skills:

PEK_U01 - Is able to select the right technology for obtaining layers of given chemical and physical parameters .

PEK_U02 - Is able to select the appropriate layer for specific applications in industry.

PEK_U03 - Is able to use vacuum techniques in thin film technologies .

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Acquainted with the subject , the requirements and the test requirements. Basic laws , definitions and concepts of thin-film techniques .	2
Lec2	Electrodeposition of layers	4
Lec3	Fundamentals of vacuum technology and vacuum measurement methods	4
Lec4	Chemical vapour deposition	6
Lec5	Physical vapour deposition	8
Lec6	Plasma methods of obtaining carbon layers .	2
Lec7	Methods of test for the basic parameters of the layers.	2
Lec8	Technologies for substrates preparation.	1
Lec9	Final test	1
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Vacuum evaporation	3
Lab2	The use of electron beam	3
Lab3	Preparation of carbon coatings by magnetron sputtering	3
Lab4	Preparation of high melting layers by magnetron sputtering .	3
Lab5	Plasma polymerisation	3
Lab6	Polymerization in the plasma at a frequency of 26 MHz .	3
Lab7	Reactive processes - obtaining oxide layers	3
Lab8	The study of electrical properties of thin films	3
Lab9	Spectrophotometric study of the chemical composition of the plasma.	3
Lab10	Additional classes	3
		Total hours: 30

TEACHING TOOLS USED

N1. problem lecture
N2. multimedia presentation
N3. laboratory experiment

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
F3	PEK_W03	test
P = O,4F1+0,3F2+0,3F3		

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_UO1	test, lab report
F2	PEK_UO2	test, lab report
F3	PEK_UO3	test, lab report
P = O,4F1+0,3F2+0,3F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Kordus A., Plazma w technice, Wydawnictwo Uczelniane Politechniki Poznańskiej, Poznań, 1973[2] Burakowski T., Wierzchoń T., Inżynieria powierzchni, WNT, Warszawa 1995[3] Miernik K., Działanie i budowa magnetronowych urządzeń rozpylających, Radom 1999[4]Tracton A. A., Coating materials and surface coatings, CRC Press 2006

SECONDARY LITERATURE
[1]Posadowski W.M.: Niekonwencjonalne Układy magnetronowe do próżniowego nanoszenia cienkich warstw, Oficyna wydawnicza Politechniki Wrocławskiej, Wrocław 2001[2]Grill A., Cold plasma in materials fabrication, IEEE PRESS1994

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Thin-layer technologies
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W07, K1MTR_W02	C1	Wy1, Wy3	N1, N2
PEK_W02	K1MTR_MAP_W07, K1MTR_W18	C2, C3	Wy2, Wy2, Wy4, Wy5, Wy6, Wy7, Wy8	N1, N2
PEK_W03	K1MTR_MAP_W07, K1MTR_W18	C2,	Wy2, Wy2, Wy4, Wy5, Wy6, Wy7, Wy8	N1, N2
PEK_UO1	K1MTR_U02	C1,	La1	N3
PEK_UO2	K1MTR_U03	C2, C3	La1, La2, La3, La4, La5, La6, La8, La9,	N3
PEK_UO3	K1MTR_U03	C2, C3	La1, La2, La3, La4, La5, La6, La8, La9,	N3

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metody numeryczne**
Name in English: **Numerical methods**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037202**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has basic knowledge about mathematical analysis and linear algebra
Has basic knowledge about developing algorithms and computer programming
2. Is able to write computer C programmes based on given algorithm
3. Recognises the need of continuous education, developing professional, personal and social competences and it able to define opportunities to do so

SUBJECT OBJECTIVES

C1. Introduction to selected numerical computational techniques for engineering purposes
C2. Preparation for problem solving in a design team
C3. Introduction to methods of algorithmization of computational procedures, monitoring and controlling of technological processes.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Is able to source information about selecting numerical methods and procedures necessary to solve elementary engineering problems, from literature, databases and other sources

PEK_U02 - Is able to draft documentation describing execution of an engineering task and prepare a text discussing its results

III. Relating to social competences:

PEK_K01 - Is able to think and action in a creative and enterprising manner.

PEK_K02 - Is able to evaluate design team performance and perform a critical analysis.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Conversion and standardisation of floating-point numbers.	2
Proj2	Summation of infinite alternating trigonometric numerical series using the method of partial sum averaging as modified by Gill-Moler (G-M)	2
Proj3	Solving the Dirichlet electrostatic problem for two-dimensional geometrical areas (examples: Laplace's and Poisson's equation)	2
Proj4	Students in groups of two select a single project problem concerning application of computational techniques in engineering problems. Each project consists of the following stages: theoretical breakdown, algorithmization and programming, launching and testing the end-user application, preparing documentation. Project problems are different every year and are not repeated.	9
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02	
F2	PEK_U01,PEK_U02 PEK_K01,PEK_K02	
P = 0.15F1+0.85F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Metody numeryczne, G.Dahlquist, A.Bjork, PWN (wydanie dowolne)
[2] Przegląd metod i algorytmów numerycznych - cz.1 i 2, J.i M. Jankowscy, WNT
[3] Wstęp do programowania systematycznego, N.Wirth, WNT (wydanie dowolne)
[4] Platforma edukacyjna: http://eportal.eny.pwr.wroc.pl
[5] Netografia

SECONDARY LITERATURE

[1] Algorytmy + struktury danych..., N. Wirth, WNT (wydanie dowolne)
[2] Macierze w automatyce i elektrotechnice, T.Kaczorek, WNT (wydanie dowolne)
[3] Handbook of mathematical functions, M. Abramowitz, I.Stegun, Washington 1964,
(Wydanie rosyjskie dostępne w czytelni Biblioteki Głównej PWr)

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 PEK_U02	K1MTR_U01	C1,C2,C3	Pr1,Pr2,Pr3, Pr4	N1,N2, N3,N4,N5
PEK_K01 PEK_K02	K1MTR_K04, K1MTR_K06	C1,C2,C3	Pr4	N1,N2, N3,N4,N5

SUBJECT SUPERVISOR

doc. dr inż. Jarosław Szymańda tel.: 2625 email: jaroslaw.szymanda@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Automatyka w budynku**
Name in English: **Building automation**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037231**
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

1. In the scope of knowledge:
1.1. Student has a basic knowledge concerning the electrical installations of municipal buildings.
2. In the scope of know-how:
2.1. Student knows how to use basic computer hardware and software.
2.2. Student can obtain information from literature, databases and other sources.
3. In the scope of the competence:
3.1. Student understands the need of continuous education and knows possibilities of improving professional, personal and social competencies.

SUBJECT OBJECTIVES

C1. Acquiring general knowledge regarding the planning of electrical installations in municipal buildings and getting to know of basic principles of the functioning and organization of building automation and security systems as a part of intelligent building.
C2. Acquiring knowledge in the field of topology, physical and logical structure of chosen solutions of intelligent installation systems and security systems.
C3. Getting to know of basic software tools used for configuration of selected building automation systems.
C4. Acquiring detailed knowledge and skills in planning and designing simple arrangements of intelligent installations and security systems in chosen building automation systems with using products of various manufacturers.
C5. Getting to know broad principles of design of electrical installations in municipal buildings.
C6. Acquiring and strengthening social competencies concerning the selfdependence, responsibility and reliability in the proceedings, awareness of effects of engineering actions taken.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows the fundamental assumptions of the building automation and the system technology of intelligent installations and security systems in the building.
PEK_W02 - Student has a general knowledge in the field of the construction and operation of selected intelligent installation systems and security systems in the building.
PEK_W03 - Student has a detailed knowledge in the field of the construction and operation of selected intelligent installation systems and security systems in the building.

II. Relating to skills:
PEK_U01 - Student can design and select the elements of a traditional electrical installation in municipal buildings.
PEK_U02 - Student can design and select the elements of an intelligent installation in chosen buildings automation systems.
PEK_U03 - Student can design and select the elements of a security system installation in chosen buildings automation systems.

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the course and presentation of credit conditions. Preliminary information about the building automation, system technology of intelligent installation and security systems in the buildings. Basic definitions and classifications.	2
Lec2	General presentation of the intelligent installations systems. Basic divisions and classifications.	2

Lec3	General characteristics of the KNX system. Topology of the KNX system and division of the system components. The logical structure of the KNX system. Examples of applications and practical implementation of selected control functions.	2
Lec4	General characteristics of the LCN system. The internal structure of the module, system components, system topology. Division and types of system devices. The logical structure of the LCN system. Examples of applications and practical implementation of selected control functions.	2
Lec5	Security of the intelligent buildings. Automatic control systems in buildings - the types and classifications, basic tasks and functions. General characteristics of the fire detection and fire alarm system. Types of devices and examples of implementation.	2
Lec6	General characteristics of the intruder and hold-up alarm system. Types of devices and topology of the system. Examples of implementation. General characteristics of the access control system. Types of devices and system topology. Examples of implementation.	2
Lec7	General characteristics of the closed-circuit television system. Types of devices and topology of the system. Examples of implementation. General characteristics of the alarm and evacuation sound system, types of devices. Integration and cooperation of the automation systems in the building.	2
Lec8	Final colloquium.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction to the course. Presentation of the course credit conditions. Distribution of project tasks and discussion of their scope. Planning the electrical installation and determining of the power demand requirements in the selected buildings. Sizing and equipping the electrical installations in municipal buildings.	3
Proj2	Sizing and equipping the electrical installations in municipal buildings. Selection of cables, wires and protection devices in the distribution network and in chosen electrical installation circuits. Guidelines concerning equipping the intelligent electrical installations.	3
Proj3	Guidelines concerning equipping the intelligent electrical installations. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj4	Guidelines concerning equipping the intelligent electrical installations. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj5	Guidelines concerning equipping the intelligent electrical installations. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj6	Guidelines concerning equipping the intelligent electrical installations. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems. The content and principles for the preparation of technical project documentation in the field of conventional and intelligent electrical installations.	3
Proj7	Guidelines concerning equipping the electrical installations of security systems. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3

Proj8	Guidelines concerning equipping the electrical installations of security systems. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj9	Guidelines concerning equipping the electrical installations of security systems. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems.	3
Proj10	Guidelines concerning equipping the electrical installations of security systems. Planning, devices selection and designing of the various control functions on the example of chosen building automation systems. The content and principles for the preparation of technical project documentation in the field of electrical installations of security systems.	3
		Total hours: 30

TEACHING TOOLS USED

N1. information lecture with use of audio-visual techniques
N2. multimedia presentation
N3. problem discussion
N4. software tools to design and programming the intelligent installations
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	Colloquium
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	Discussion
F2	PEK_U01, PEK_U02, PEK_U03	Evaluation of the project preparation
F3	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Project defence
P = 0,2F1 + 0,3F2 + 0,5F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Markiewicz H., Instalacje elektryczne, WNT, current edition;
[2] Niezabitowska E. (red.), Budynek inteligentny. Tom II. Podstawowe systemy bezpieczeństwa w budynkach inteligentnych, Wydawnictwo Politechniki Śląskiej, current edition;

SECONDARY LITERATURE
[1] Klajn A., Bielówka M., Instalacja elektryczna w systemie KNX/EIB, Informacje o Normach i Przepisach Elektrycznych – Miesięcznik
Stowarzyszenia Elektryków Polskich, Podręcznik dla Elektryków – Zeszyt 10, Warszawa 2006;
[2] Selected websites of the manufacturers of building automation systems, according to the Supervisor's recommendation;

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MTR_MAP_W03, K1MTR_MAP_W06	C1	Lec1, Lec2, Lec5, Lec7, Lec8	N1, N3, N5
PEK_W02	K1MTR_MAP_W03, K1MTR_MAP_W06	C2	Lec2 - Lec8	N1, N3, N5
PEK_W03	K1MTR_MAP_W06	C2, C3	Lec3 - Lec8	N1, N3, N4, N5
PEK_U01	K1MTR_MAP_U06	C5	Proj1, Proj2, Proj6	N2, N3, N5
PEK_U02	K1MTR_MAP_U06	C3, C4	Proj2 - Proj6	N2, N3, N4, N5
PEK_U03	K1MTR_MAP_U06	C4	Proj7 - Proj10	N2, N3, N5
PEK_K01	K1MTR_K06	C6	Proj1 - Proj10	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): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MCR037301, 7201, 7103**
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. ECTS points in required range

SUBJECT OBJECTIVES

C1. Gaining ability to present own qualifications, knowledge, skills and social competences.
C2. Straightening the ability to think critically and work in team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Is able to think critically and work in team.

III. Relating to social competences:
PEK_K01 - Introduction, general information about Master’s thesis and master's examination.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Introduction, general information about Master’s thesis and master's examination.	2
Sem2	Rules of proper technical and scientific paper preparation.	2
Sem3	Rules of proper multimedia presentation preparation, especially for master's examination.	2
Sem4	Review of current knowledge, aim and scope of individual diploma thesis – students presentations.	6
Sem5	Reports from progress in realization of students work – students presentation.	10
Sem6	Multimedia presentation of students prepared for diploma examintation – students presentation.	6
Sem7	Summary.	2
		Total hours: 30

TEACHING TOOLS USED

N1. Informative lecture
N2.
N3.
N4.
N5. Tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

F1	PEK_U01, PEK_K01	The appreciation of skill of solving in range of qualifying work the technical problems and their multimedia introduction as well as the leadership of discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MTR_MAP_U01, K1MTR_MAP_U02, K1MTR_MAP_U03, K1MTR_MAP_U04, K1MTR_MAP_U05, K1MTR_MAP_U06, K1MTR_MAP_U07, K1MTR_MAP_U08	C1		N1 - N5
PEK_K01	K1MTR_K04, K1MTR_K06	C2		N1 - N5

SUBJECT SUPERVISOR

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Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK ZAJĘCIA SPORTOWE**
Name in English: **Block of Sports Activities**
Main field of study (if applicable): **Mechatronics**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **WFW000000BK**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Block of Sports Activities
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechatronics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_K01	K1MTR_K03, K1MTR_K11, K1MTR_K14	wg kart opracowanych przez SWF.		wg kart opracowanych przez SWF.

SUBJECT SUPERVISOR

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