Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fizyka 1.2**
Name in English: **Physics 1.2**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
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	2.8	1.4			

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	2
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	2
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
Biomedical Engineering

Subject educational effect	Correlation between subject 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_W14	K1IB_W02	C1-C3	Lec	N1,5,7
PEK_U01-PEK_U22	K1IB_U02	C1-C3	Cl	N2-7
PEK_K01-PEK_K08	K1IB_K01	C1-C3	Lec, Cl	N1-7

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): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
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	1.2		1.4		

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

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. Witryna dydaktyczna Instytutu Fizyki PWr; http://www.if.pwr.wroc.pl/index.php?menu=studia zawiera duży zbiór materiałów dydaktycznych
8. 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
9. D. C. Giancoli, Physics Principles with Applications, 6th Ed., Addison-Wesley, 2005; Physics: Principles with Applications with MasteringPhysics, 6th Ed., Addison-Wesley 2009.
10.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
11. 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 2.8
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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_W14	K1IB_W02	C1-C5	Lec	N1-N7
PEK_U01-PEK_U11	K1IB_U02	C1-C5	Cl	N1-N7
PEK_K01-PEK_K08	K1IB_K02	C1-C5	Lec, Cl	N1-N7

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ergonomia w medycynie**
Name in English: **Ergonomy in medicine**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM**
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. One has to have basic knowledge of human anatomy and physiology.
2. One has to have basic knowledge of human movement biomechanics.
3. One has to have basic knowledge of safety regulations, first aid rules and labor law regulations.

SUBJECT OBJECTIVES

C1. Ability to use ergonomics in everyday life, work and education.
C2. Interpretation and understanding of cause-and-effect relationships in ergonomics resulting from the analysis work environment factors and anthropometric and/or biomechanical conditions of the human body.
C3. Understanding the principles of ergonomic design and the ability of their use.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - One knows the aims and scope of the concept of ergonomics, is able to list and characterize the types of work and methods of their measurement. One knows the best work environment parameters.

PEK_W02 - One knows the principles of conducting ergonomic diagnostics. One understands and explain the relationship between anthropometric measurements and design of work place or product.

PEK_W03 - One has knowledge of hazards in the work process, necessary health and safety regulations and the causes of accidents at work and occupational diseases.

II. Relating to skills:

III. Relating to social competences:

PEK_K01 - One understands the need for continuous learning from the field of ergonomics in order to ensure oneself and others optimum conditions and work safety.

PEK_K02 - One is aware of the importance of overloading the body. One draws attention to the application of ergonomic knowledge and skills in everyday life and at work.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to the subject: definitions and norms in ergonomics, its origin and development, man-labor system and its subsystems, variables affecting working conditions, corrective and conceptual ergonomics.	2
Lec2	Interdisciplinarity of ergonomics. Objectives of ergonomics and its significance. Importance of ergonomics in medicine.	2
Lec3	Working environment and its impact on man. Adapt man to work as a two-way process.	2
Lec4	Danger of hazardous and noxious substances in the workplace in medical and peri-medical occupations. Risk factors at work, occupational diseases, stress, professional burnout.	2
Lec5	Anthropometric and biomechanical factors in ergonomics.	2
Lec6	Physiology, hygiene and occupational medicine and their contribution to shaping the place and working conditions. Ergonomic diagnostics in medicine.	2
Lec7	Principles and conditions of ergonomic design in medicine.	2
Lec8	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation
N3. problem lecture

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

E. Górska, Ergonomia: projektowanie, diagnoza, eksperymenty, OWPW, W-wa, 2002.
W.Ł. Nowacka, Ergonomia i Ochrona pracy. Wyd. SGGW, Warszawa, 2013.
A. Batogowska, A. Malinowski, Ergonomia dla każdego, Sorus, Poznań 1997.
J. Jabłoński, Ergonomia produktu. Ergonomiczne zasady projektowania produktów, WPP, Poznań, 2006.
M. Wykowska, Ergonomia, Wydawnictwo AGH, Kraków, 1994.

SECONDARY LITERATURE

Scientific publications from trade journals, websites of the Polish Ergonomic Society and the Intenetional Ergonomics Association.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ergonomy in medicine
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W28	C1, C2	Lec1, Lec2, Lec3	N1, N2, N3
PEK_W02	K1IB_W24	C2, C3	Lec5, Lec6, Lec7	N1, N2, N3
PEK_W03	K1IB_W30	C1	Lec4	N1, N2, N3
PEK_K01	K1IB_K01	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7	N1, N2, N3

PEK_K02	K1IB_K02	C1, C2, C3	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Magdalena Kobielarz tel.: 71 320-22-50 email: Magdalena.Kobielarz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia**
Name in English: **Ecology**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031004**
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 the basic knowledge of chemistry, biology and ecology.
2. Makes use of reference literaturę, exploits available sources, both via the Internet and in print form.

SUBJECT OBJECTIVES

C1. To get the student acquainted with the basic problems of ecology and environmental protection.
C2. To get to know threats resulting from human activity.
C3. Familiarisation with modern solutions serving environmental protection.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has the basic knowledge of the hazards arising from the industrial activities.
PEK_W02 - Has the knowledge of the international conventions and Polish environmental regulations.
PEK_W03 - Can characterize modern solution for environmental protection.

II. Relating to skills:
PEK_U01 - Can collect information from scientific literaturę. Can interpret and draw conclusions.

III. Relating to social competences:
PEK_K01 - Has the awareness regarding the importance of non-technical impacts of anthropogenic activity.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Wprowadzenie. Podstawowe pojęcia i definicje z zakresu ekologii i ochrony środowiska	2
Lec2	Non-renewable energy resources.	2
Lec3	Fuel combustion processes.	2
Lec4	The negative environmental effects related with atmosphere pollution.	2
Lec5	Renewable energy resources.	3
Lec6	Energy storage.	2
Lec7	Final test.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Authoritative internet sources

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Ecology
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_K08, K1IB_W29, K1IB_W30	C1 - C3	lec1 ÷ lek6	N1, N2

SUBJECT SUPERVISOR

dr hab. Agnieszka Baszczuk tel.: 320-32-21 email: agnieszka.baszczuk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wstęp do inżynierii biomedycznej**
Name in English: **Introduction to biomedical engineering**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031006**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the physics (range of secondary school)
2. Student has knowledge of the biology (range of secondary school)

SUBJECT OBJECTIVES

C1. Obtaining basic knowledge of the issues considered in biomedical engineering
C2. Increase an awareness of the importance of technical and biological knowledge integration as the factor determining the development of modern medicine

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has an ordered knowledge of technical aids and substitutes for the functions of organs and parts of the human body, in particular: bone and joint system, the muscular system and the cardiovascular system.

PEK_W02 - Student has basic knowledge of biomechanical aspects of co-operation of implants, artificial organs and prostheses with tissues and human organs.

PEK_W03 - Student has the basics knowledge necessary to understand non-technical conditioning of engineering activities

II. Relating to skills:

III. Relating to social competences:

PEK_K01 - Student has awareness of the role of engineers in the development of civilization.

PEK_K02 - Student has awareness of the importance and understands the non-technical aspects and effects of the engineer's activity. Furthermore, understands the responsibility for making decisions.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Definition of biomedical engineering, historical outline. The impact of technical progress on the development of medicine over the centuries, the importance of engineering in medicine, the role of the engineer in the modern hospital.	2
Lec2	Man as a biomechanical system: kinematic structure of the bone and joint system, basic information about the biomechanics of the bone and joint system, clarification of the concept mechanobiology of bone tissue, adaptive processes in living tissues, muscles as the drive system of human.	2
Lec3	Biomaterials, definition, classification, requirements for biomaterials, overview metallic, ceramic, polymeric and natural biomaterials.	2
Lec4	Endoprosthesis of the joints of the upper and lower limbs; types of endoprosthesis and their division, biomechanical aspects of interaction between endoprosthesis and bone tissue.	2
Lec5	Systems for the stabilization and treatment of degenerative and traumatic spinal disorders; types of spine stabilizers, intervertebral disc prosthesis.	2
Lec6	Systems for treatment of long bone deformities, External fixators for the treatment of bone fractures and for their elongation, influence of fixator structure on biomechanics of bone regeneration process, intramedullary stabilization.	2
Lec7	Support for mobility of people with disabilities (PD): crutches and walkers, wheelchairs, power standing wheelchair, exoskeletons. Design standards for means of transport for PD, development of modern devices supporting the movement PD.	2
Lec8	Lower limb prostheses, classification, requirements for lower limb prostheses, biomechanics of prostheses, discussing the design of existing prostheses, mechatronical systems on prosthesis, bionic prosthesis.	2

Lec9	Upper limb prostheses, classification, discussing the design of selected prostheses, hand prostheses (types of grips), propulsion systems of multi finger prostheses, bionic hand prosthesis,	2
Lec10	Technical equipment used in rehabilitation, equipment for active and passive rehabilitation of limbs, parapodium and verticalizers, rehabilitation systems utilizing biofeedback.	2
Lec11	Technical support of cardiovascular work, artificial heart, heart valve prostheses.	2
Lec12	Cars for people with disabilities, equipment for loading a wheelchair into a car or on the roof of the car, devices enabling overcoming the stairs by PD, equipment for vertical transport of PD.	2
Lec13	Navigation systems supporting surgical operations, overview of medical navigation types, examples of navigation systems used during surgery.	2
Lec14	Medical robots and manipulators, their genesis and history, examples of construction solutions, telemedicine.	2
Lec15	Medical imaging systems: computed tomography (CT), magnetic resonance (MR), ultrasonography (USG), positron-emission tomography (PET), intravascular ultrasonography (IVUS).	2
		Total hours: 30

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, PEK_K01, PEK_K02	Final Test
P = P		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Biomedical Engineering - basics and applications (volumes: I-X); editor Władysław Torbicz, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2013

SECONDARY LITERATURE

e-journals from resources of WUST Library

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to biomedical engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_W06	C1	Lec1-Lec15	N1
PEK_K01, PEK_K02	K1IB_K02, K1IB_K10	C2	Lec1-Lec15	N1

SUBJECT SUPERVISOR

dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

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): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031008**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student 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. Systems of units. SI system, measurement standards, a hierarchical system of measurement standards.	2

Lec2	Measurement, measurement types, method and measurement principle.	2
Lec3	Errors and their sources. The types of errors. Distributions of errors variability. Methods of estimation and expression of uncertainty in measurement.	2
Lec4	Introduction to Geometrical Product Sepcification (GPS). Types of linear dimensions, tolerances of linear dimensions, fits.	2
Lec5	GPS. Geometric Dimensioning and Tolerancing (GD&T). Types of geometrical deviations, tolerancing of geometrical deviations, determination of geometrical deviations.	4
Lec6	GPS. Surface Geometric Structure. Surface profiles. Parameters of surface profiles.	2
Lec7	GPS. General tolerances for linear and angular dimenison and geometric fatures.	2
Lec8	Tolerating and measurements of machine parts manufactured in the process of: casting, plastic forming, welding, plastics processing.	4
Lec9	Classification of the measuring equipment, the metrological characteristics and methods of assessment	4
Lec10	Fundamentals of coordinate measurement techniques.	2
Lec11	Mehods and means of mechanization and automation of measurements.	2
Lec12	Analysis of dimension. Fundamentals of statistical control of dimensions.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	1
Lab2	Measurements of linear dimensions.	2
Lab3	Measurements of angular dimensions and angles of cones.	2
Lab4	Measurements of geometrical deviations.	2
Lab5	Assessment of geometrical structure of surface.	2
Lab6	Measurement of threads.	2
Lab7	Measurement of cylindrical gears.	2
Lab8	Coordinate masurements of machine parts.	2
		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
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_W11	C1; C2; C3; C4; C5; C6	Wy1 - Wy12	N1; N5
PEK_U01; PEK_U02; PEK_U03	K1IB_U10	C1; C2; C3; C4; C5; C6	La1 - La8	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03	K1IB_K09	C1; C2; C3; C4; C5; C6	La1 - La8	N2; N3; N4; N5

SUBJECT SUPERVISOR

dr inż. Marek Kuran tel.: 27-28 email: marek.kuran@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska II (ZK)**
Name in English: **Engineering graphics II (ED)**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031009**
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. Knowledge of the course of engineering graphics I (GW) is required

SUBJECT OBJECTIVES

C1. Knowledge acquire about the principles of engineering graphic used in structure design
C2. Mastering the presentation by means technical drawing of machines and mechanical systems use of a manual technical drawing and a computer program
C3. Mastering the skills of preparing, reading and interpretation of technical documentation of components and mechanical systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge of the principles on technical drawing of mechanical systems elements (geometry, dimensions, surface microstructure)

II. Relating to skills:
PEK_U01 - He is able to executive and assembly drawings of structural elements and mechanisms using computer tools and manual technical drawing for this purpose.
PEK_U02 - He is able to read and analyze technical drawings of components and subassemblies used in technical equipment.
PEK_U03 - Able to use computer tools for the design of components and systems in the mechanical design .

III. Relating to social competences:
PEK_K01 - He is aware of the engineer role in design and development of new technical devices.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The essence of normalization in the engineering drawing. The principles of rectangular projections. Drawing composition.	2
Lec2	Full sections, views, half section, broken-out sections. Details of elements geometry presentation.	2
Lec3	The principles of dimensioning, dimensional layout, tolerances and dimensional deviations, tolerance dimensions record.	2
Lec4	Microstructure of surface presentation, surface roughness determination. Types of fits, Fit dimensions presentation.	2
Lec5	Graphical presentation of typical releasable joints and non-releasable joints used in machines and mechanical systems.	2
Lec6	Graphical presentation of moveable conection used in mechanical systems.	2
Lec7	Types of engineering drawings: executive drawing, assembly drawing, visual drawing, schematic drawing. Principles of technical documentation drafting.	2
Lec8	Final test.	2
		Total hours: 16
Form of classes – Project		Number of hours
Proj1	skeching of solid rectangular projections on the basis of its axonometric projection.	2
Proj2	Formation of elements geometry via cut and cut-outs of basic solids by means of defined planes.	2
Proj3	Presentation of the constructional form of non-rotating elements in the rectangular projection system. The principles of drawing dimensions.	2
Proj4	Presentation of the constructional form of non-rotating elements; full sections, broken-out sections, offset sections. Dimensioning.	2
Proj5	Engineering drawing of mechanical elements shaft type; crossections, revolved sections, removed sections, half sections, broken-out sections. Dimensioning.	2

Proj6	Engineering drawing of axial symmetrical parts; half sections, aligned sections. Dimensioning.	2
Proj7	Assembly drawing real parts presentation. Micro- and macrostructure of element surface description.	2
Proj8	Test I. (verification of knowledge on the material covered in the exercises 1-6)	2
Proj9	Analysis of complex mechanical systems (part 1). Assembly drawing of the mechanical system. Technical drawing preparation of the main elements of system.	2
Proj10	Analysis of complex mechanical systems (part 2). Assembly drawing of the mechanical system. Prepare technical drawing components cooperating with the main element.	2
Proj11	Project task – discussion of the topic, an initial sketch of the structural node that is the subject of the task	2
Proj12	Project task –preliminary selection of typical elements (bearings, simering), assembly drawing of the machine subassembly	2
Proj13	Project task – technical drawings of machine subassembly components.	2
Proj14	Technical symbolic drawing (schematic drawing).	2
Proj15	Test II. (verification of knowledge on the material covered in the exercises 8-14).	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03	test
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Evaluation for the tasks performed within the classes and evaluation of homework
P = 2/3F1+1/3F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Rydzanicz I., Rysunek techniczny jako zapis konstrukcji. Zadania. WNT, Warszawa 2008.
[2] Rydzanicz I., Zapis konstrukcji. Podstawy. Ofic. Wyd. PWr, Wrocław 2000.

SECONDARY LITERATURE

[1] Dobrzański T., Rysunek techniczny maszynowy. WNT, Warszawa 2013.
[2] Kurs AutoCAD – strona internetowa: http://www.cad.pl/kursy/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering graphics II (ED)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_K01	K1IB_W12	C1	Lec1 - Lec8	N1, N3
PEK_U01, PEK_U02, PEK_U03	K1IB_U07	C2, C3	Proj1 - Proj15	N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo**
Name in English: **Materials Science**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031010**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	2.1		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The basic knowledge of mathematic, ability of creation and interpretation equations and graphs.
2. The basic knowledge of physics.
3. The basic knowledge of chemistry, ability to use of chemical terminology.

SUBJECT OBJECTIVES

C1. Acknowledgements with state, properties and applications of metallic materials, polymers, ceramics and composites.
C2. Acknowledgements with interaction between microstructure, manufacturing and mechanical properties.
C3. Acknowledgements with the selecting materials for applications in specific conditions of mechanical loads and environmental influence.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Knows groups of engineering materials and criteria of their classification.
PEK_W02 - Knows types of the iron alloys, their microstructures, properties and fields of usage.
PEK_W03 - Knows the basis properties and fields of usage polymers, composites and ceramics.

II. Relating to skills:

PEK_U01 - Ability to interpreted the microstructures of iron alloys and non-iron metals.
PEK_U02 - Ability to plan and execute basic metallographic examinations.
PEK_U03 - Ability to choose constructional materials to specified application.

III. Relating to social competences:

PEK_K01 - Ability to work and cooperate in a group, performing the assigned task.
PEK_K02 - Ability to observing principles and habits valid in the academic environment.
PEK_K03 - Ability to information retrieval and their critical analyse.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overall characteristic of materials groups.	2
Lec2	Elements of crystallography, build of real crystals. Defects of crystalline structures.	2
Lec3	Characteristic of phases presented in alloys of metals.	2
Lec4	Iron-cementite equilibrium diagram.	2
Lec5	Non-alloyed steels.	2
Lec6	Classification and natation rules of cast irons.	2
Lec7	Influence of alloying elements on the steel phase transformation.	2
Lec8	Alloyed steels vol. 1.	2
Lec9	Alloyed steels vol. 2.	2
Lec10	The influence of heat treatment on structures, properties and applications of steel.	2
Lec11	Plastical deformation and recrystallisation.	2
Lec12	Alloys of non-iron metals.	2
Lec13	Polymers.	2
Lec14	Ceramics and glass.	2
Lec15	Composite materials.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction. Methods of material testing. Construction and operation of metallographic microscope.	2
Lab2	Macroscopic investigations of surfaces and fractures.	2
Lab3	Microscopic investigations of single- and multiplephases metals.	2

Lab4	Microstructures and properties of iron-carbon diagram alloys.	2
Lab5	Alloying steels with special properties.	2
Lab6	Microstructures and properties of alloys of non-iron metals.	2
Lab7	Macroscopic and microscopic investigations of composites with polymer matrix.	2
Lab8	Summary and passing of laboratory classes.	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. tutorials
N5. self study - self studies and preparation for examination

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K02, PEK_K03	Written exam.
P =		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K02, PEK_K03	Class admission tests.
F2	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	Reports of the performed tasks.
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1]Haimann.R; Metaloznawstwo; Wyd.PWr;2000
[2]Dobrzański.L.A, Podstawy nauki o materiałach,WNT,2002
[3] Blicharski M., Wstęp do inżynierii materiałowej, WNT; 1998.
[4]Dudziński.W, Widanka.K, Ćwiczenia laboratoryjne z materiałoznawstwa,Wyd.PWr;2005

SECONDARY LITERATURE

[1] Dudziński W., Materiały konstrukcyjne w budowie maszyn, Wyd.PWr; 1994
[2] Ashby M. F., Jones D.R.H., Materiały inżynierskie, t. 1 i 2, WNT; 1996.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Materials Science
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W09	C1	Lec1, Lec2, Lec 3	N1, N4, N5
PEK_W02	K1IB_K09	C1, C2, C3	Lec1, Lec3 - Lec12	N1, N4, N5
PEK_W03	K1IB_K09	C1, C3	Lec1, Lec13 - Lec15	N1, N4, N5
PEK_U01	K1IB_U08, K1IB_U22	C1, C2	Lab2 - Lab6	N2, N3, N4
PEK_U02	K1IB_U08, K1IB_U22	C2	Lab2 - Lab6	N2, N3, N4
PEK_U03	K1IB_U08, K1IB_U22	C1, C2, C3	Lab2 - Lab6	N2, N3, N4
PEK_K01	K1IB_K04	C2, C3	Lab2 - Lab7	N3
PEK_K02	K1IB_K01, K1IB_K03, K1IB_K04	C3	Lab1 - Lab7	N3, N4
PEK_K03	K1IB_K03, K1IB_K05, K1IB_K08	C1, C2, C3	Lec1 - Lec15, Lab2 - Lab7	N1, N2

SUBJECT SUPERVISOR

dr inż. Dominika Grygier tel.: 320-38-45 email: dominika.grygier@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Statystyka inżynierska**
Name in English: **Statistics for Engineers**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031013**
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. Have basic knowledge in mathematics confirmed positive assessments on the certificate of completion of secondary school

SUBJECT OBJECTIVES

C1. The acquisition of basic knowledge of probability and mathematical statistics, taking into account the aspects of the application.
C2. Acquiring the ability exploration figures in the field of biomedical engineering
C3. Skills in data reduction with the use of specialized statistical software (STATISTICA, MatLab, Gretl, R) and the possibility of a spreadsheet (Excel).
C4. Acquisition and consolidation of social competencies including emotional intelligence skills involving the cooperation in the group of students aiming to effectively solve problems, taking into account the responsibility, honesty and fairness in the proceedings.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It has a basic knowledge of statistical methods for analyzing databases knows the basic descriptive statistics characterizing the results of measurements of engineering, knows the principle of grouping data and creating a series of distribution

PEK_W02 - Knows basic theoretical distributions of discrete and continuous features, it has a basic knowledge of rules of estimation of confidence intervals for the average value characteristics and its dispersion.

PEK_W03 - He has knowledge of the methods for verifying parametric statistical hypotheses about the mean value, of the equality of two values of the average of the value of variance and the homogeneity of many of variance, you know the basic methods of verification nonparametric statistical hypotheses concerning the significance of differences in the data structure and independence of random variables categorized.

II. Relating to skills:

PEK_U01 - Unable to correctly carry out a statistical analysis of the results of research, formulate hypotheses and, based on tests carried out to draw the appropriate conclusions: able to perform data reduction on the prior corresponding selection of statistics describing the average value, its dispersion and shape of the distribution, it can from raw data to create a series of distribution and illustrate collection of data using the histogram, empirical distribution and graph frameset.

PEK_U02 - Able to fit empirical data and theoretical distribution on the basis of the estimate quantile values for given probabilities, and estimate the probability for given quantile, unable to correctly select the type of statistical test and perform testing hypotheses about the average and distribution features

PEK_U03 - He can analyze the correlation characteristics in multivariate categorical data table can perform regression analysis and correlation of two and more variables to estimate the values of parameters characterizing the strength and shape of the relationship

III. Relating to social competences:

PEK_K01 - Acquisition and consolidation of competence in the field: finding information and its critical analysis, teamwork cooperation on improving the methods for the selection of a strategy to optimally solving problems assigned to the group.

PEK_K02 - He understands 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, develop self-esteem and self-control ability and the responsibility for the results of the actions undertaken.

PEK_K03 - Respect the customs and rules in academia, independent and creative thinking.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Statistical methods of data analysis - the essence of statistical modeling. Descriptive analysis of data: forms of representation of statistical data, measures of association, variability, asymmetry and concentration.	2
Lec2	Preparation and presentation of statistical material. The grouping of data - ranks easy and distribution. Histogram and empirical cumulative distribution.	2
Lec3	Random variables and their distributions. Numerical characteristics of the distribution. Selected discrete and continuous distributions. Inequality Czybyszewa.	2
Lec4	Elements of the theory of estimation - the point estimate. Interval estimation of the mean value and variance. The confidence intervals.	2

Lec5	Parametric statistical hypothesis. Testing hypotheses about the mean value, of the equality of two average values. Testing hypotheses about the rate structure and the equality of two indicators structure. Testing hypotheses about the variance and the equality of two variances.	2
Lec6	Nonparametric hypothesis testing. Chi-squared test, Kolmogorov-Smirnov. Test of independence Pearson chi-square.	3
Lec7	Analysis of correlation and regression. The method of least squares. Pearson correlation coefficients and Spearman. Linear regression function. Multivariate regression analysis and correlation. Estimation of linear multiple regression function. Test of significance for multiple regression coefficients. Estimation of multiple correlation coefficient. The coefficient of determination.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Organizational matters. Introduction to using a spreadsheet. Mathematical and statistical functions Excel. Generating the vector of continuous variables with normal distribution. Descriptive statistics - calculating measures of association, variability, asymmetry and concentration.	2
Proj2	Construction ranks distribution. Graphical presentation of data collection - Histogram and empirical cumulative distribution and box plot.	2
Proj3	Basic distributions encountered in mathematical statistics: the normal distribution, Student, chi-square, F Snedecor. The probability density function and cumulative distribution.	2
Proj4	Point and interval estimation of the expected value, the rate structure (faction), variance and standard deviation.	2
Proj5	Verification of statistical hypotheses. Parametric tests of significance to the expected value and the variance of the general population. Test for two variances, two medium and two indicators of the structure.	2
Proj6	Non-parametric tests of significance - Pearson chi2 compatibility test, compatibility test lambda Kolmogorov,. Test of independence chi2 - kontyngencyjne boards. Mann-Whitney test. Median test and Wilcoxon signed-ranks test. Rank-sum test Kruskal-Wallis	3
Proj7	To assess the relationship between the two variables. Two-dimensional regression analysis and correlation. A scatterplot. The strength of the correlation relationship - the correlation coefficient estimation, test of significance for the correlation coefficient, parameter estimation of linear regression function, significance test for the regression coefficient (slope of the regression line), the confidence interval for the regression coefficient.	2
		Total hours: 15

TEACHING TOOLS USED

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

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	test
F2	PEK_U03, PEK_K01-PEK_K03	presentation
P = 0,5*F1 + 0,5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bobrowski D: Probabilistyka w zastosowaniach technicznych. Warszawa 1986, WNT[2] Nowak R.: Statystyka dla fizyków. Warszawa 2002, Wydawnictwo Naukowe PWN[3] Ostasiewicz W. (red.): Statystyczne metody analizy danych. Wrocław 1999, Wydawnictwo AE we Wrocławiu[4] Zeliaś A., Pawełek B., Wanat S.: Metody statystyczne. Zadania i sprawdziany. Warszawa 2002, PWE

SECONDARY LITERATURE

[1] Bąk I., Markowicz I., Mojsiewicz M., Wawrzyniak K.: Statystyka w zadaniach. Część I i II. Warszawa 2001. Wydawnictwo Naukowo-Techniczne[2] Cieciura M., Zacharski J.: Metody probabilistyczne w ujęciu praktycznym. Warszawa 2007, VIZJA PRESS&IT Sp. z o. o.[3] Dobosz M.: Wspomagana komputerowo statystyczna analiza wyników badań. Warszawa 2001, Akademicka Oficyna Wydawnicza EXIT.[4] Frątczak E., Gach-Ciepiela U., Babiker H.: Analiza historii zdarzeń. Elementy teorii, wybrane przykłady zastosowań. Warszawa 2005, Szkoła Główna Handlowa w Warszawie.[5] Kukiełka L: Podstawy badań inżynierskich. Warszawa 2002, Wydawnictwo Naukowe PWN. [6] Maliński M.: Statystyka matematyczna wspomagana komputerowo. Gliwice 2000, Wydawnictwo Politechniki Śląskiej [7] Paleczek W.: Metody analizy danych na przykładach. Częstochowa 2004, Politechnika Częstochowska[8] Turzeniecka D.: Ocena niepewności wyniku pomiarów. Poznań 1997, Wydawnictwo Politechniki Poznańskiej

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Statistics for Engineers
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between 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	K1IB_W01, K1IB_W32	C1, C2, C4	Wy1, Wy2, Wy3	N1, N2
PEK_W02	K1IB_W01, K1IB_W32	C1, C2, C3	Wy4, Wy5	N1, N2
PEK_W03	K1IB_W01, K1IB_W32	C1, C3	Wy6, Wy7	N1, N2
PEK_U01	K1IB_U01	C1, C2, C3	Pr01, Pr02, Pr3	N3, N4
PEK_U02	K1IB_U01	C1, C2, C3	Pr4, Pr5	N3, N4
PEK_U03	K1IB_U01	C1, C2, C3	Pr5, Pr6, Pr7	N3, N4, N5
PEK_K01	K1IB_K01, K1IB_K10	C4	Wy1, Pr7	N5
PEK_K02	K1IB_K01, K1IB_K10	C4	Wy1, Pr7	N5
PEK_K03	K1IB_K01, K1IB_K10	C4	Wy1, Pr7	N5

SUBJECT SUPERVISOR

dr inż. Artur Kierzkowski tel.: 71 320-20-04 email: artur.kierzkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy zarządzania**
Name in English: **Essentials of management**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031014**
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 basic concepts of management in organisations, including getting to know the process of management.
C2. Acquiring knowledge about the nature and mechanisms of an organisation.
C3. Acquiring knowledge about quality and quality management, as well as the entrepreneurship and building new ventures.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student have knowledge about the essential concepts of management in organisations. Understands the influence of environment on organisations.

PEK_W02 - Student have knowledge about the process of management and is able to characterise the way of implementation of each function of management in organisations.

PEK_W03 - Student understands the concept of quality, quality management and entrepreneurship.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organisation and its types. Resources of organisation. The process of management. Manager and its role in management.	1
Lec2	Organisation and its environment. The process of planning and decision making.	2
Lec3	The process of organising.	2
Lec4	The process of leading. Motivating.	2
Lec5	The process of controlling.	2
Lec6	Quality and the essence of quality management	2
Lec7	Entrepreneurship and the entrepreneur. Building and development of new ventures.	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_W02, PEK_W03	Test.

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Griffin R.W., Podstawy zarządzania organizacjami, Wydawnictwo Naukowe PWN, Warszawa, 2013
2. Koźmiński A.K., Piotrowski W., Zarządzanie. Teoria i praktyka., Wydawnictwo Naukowe PWN, Warszawa, 2010 3. Masłyk-Musiał E., Rakowska A., Krajewska-Bińczyk E., Zarządzanie dla inżynierów, PWE, Warszawa, 2012
3. Masłyk-Musiał E., Rakowska A., Krajewska-Bińczyk E., Zarządzanie dla inżynierów, PWE, Warszawa, 2012

SECONDARY LITERATURE

1. Glinka B., Gudkova S., Przedsiębiorczość, Wolters Kluwer Business, Warszawa 2011
2. DeCenzo D.A., Robbins S.P., Podstawy zarządzania, PWE, Warszawa, 2002
3. Hatch M.J., Teoria organizacji, Wydawnictwo Naukowe PWN, Warszawa, 2002
4. Hopej M., Kamiński R., Struktury organizacyjne współczesnych organizacji, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2010
5. Malara Z., Przedsiębiorstwo w globalnej gospodarce. Wyzwania współczesności, Wydawnictwo Naukowe PWN, Warszawa 2013
6. Miesięcznik Harvard Business Review Polska

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Essentials of management
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W	K1IB_W34	PEK_W01, PEK_W02	Lec1-Lec5	N1
PEK_K	K1IB_K09	PEK_W03	Lec6-Lec7	N1

SUBJECT SUPERVISOR

dr inż. Mateusz Molasy tel.: 713202662 email: mateusz.molasy@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Biomateriały**
Name in English: **Biomaterials**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031015**
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. Completed courses: Mechanics I, Mechanics II, Material Science
2. Basic knowledge of: biophiscs, strength of materials, manufacturing techniques
3. Able to experimentally identify the strength parameters of structural materials and biomaterials.

SUBJECT OBJECTIVES

C1. Obtain knowledge on requirements for biomaterials.
C2. Obtain basic knowledge on materials used in biomedical engineering, systematics of biomaterials.
C3. Mastering the skills to select and carrying out appropriate tests to determining the physical properties of the biomaterials.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has basic knowledge about materials used in biomedical engineering, their structure, physical properties, degree of biocompatibility.
PEK_W02 - Student has basic knowledge of the criteria for selection of biomaterials for medical applications.

II. Relating to skills:
PEK_U01 - It's able to choose and apply experimental methods for determination of biomaterials physical properties.
PEK_U02 - It's able to measure using instruments designed to study physical and structural properties of biomaterials.
PEK_U03 - It's able to interpret the results of experience and compile the results documentation of experimental studies.

III. Relating to social competences:
PEK_K01 - It's aware of the role of the engineer in the development of civilization.
PEK_K02 - It's aware of the importance and understand the non-technical aspects and effects of the activity of an engineer and understands the related responsibility for the decisions taken.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Systematics of biomaterials, requirements for biomaterials.	1
Lec2	Metalic biomaterials: austenitic steel, Co-Cr-Mo alloys; physico-chemical properties, mechanical properties and application.	3
Lec3	Metalic biomaterials: titanium, titanium alloys, physico-chemical properties, mechanical properties and application. Shape memory alloys, examples of applications in dentistry, prosthetics and cardiology.	3
Lec4	Metalic biomaterials: magnesium, physico-chemical properties, mechanical properties and application.	1
Lec5	Degradation of metallic biomaterials in the living organism environment.	3
Lec6	Bioceramics: inert, active; manufacturing technologies, physico - chemical properties, mechanical properties and applications.	3
Lec7	Plastics used in biomedical engineering; systematic of polymers, physico-chemical properties, mechanical properties, examples of plastics applications in medicine.	3
Lec8	Carbon biomaterials carbon: physico-chemical properties, manufacturing technologies, applications	2
Lec9	Bioresorbable materials, mechanisms of biodegradable and bioresorbable, biomechanical design principles of bioresorbable implants and scaffolds for tissue engineering.	1
Lec10	Modification of the biomaterials using surface engineering methods	2
Lec11	Composite Biomaterials: manufacturig technologies, applications. Gradient biomaterials. Biomimetic materials	2
Lec12	The biomaterials used to manufacture of personalized implants by incremental methods.	1

Lec13	Natural biomaterials.	2
Lec14	The interaction between the implant and the tissue; mechanical stimuli as a factor for tissue growth stimulating around the implant.	1
Lec15	Biological evaluation of biomaterials (standard PN-EN ISO 10993).	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction to laboratory safety training. The study of the mechanical properties of implant materials.	1
Lab2	Morphometric study of the properties of porous materials.	2
Lab3	Hardness testing of biomaterials.	2
Lab4	Wettability testing of biomaterial surfaces.	2
Lab5	Measurement of time binding and temperature of bone cement.	2
Lab6	Methods for manufacturing and measurement of hydroxyapatite properties.	2
Lab7	Manufacturing and determination of the physical properties of fiber composites.	2
Lab8	Manufacturing and study of the properties of composite membranes.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. laboratory experiment
N3. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_K01	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, PEK_K02	Reports from laboratories, oral answer

P = F1

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Inżynieria Biomedyczna- Podstawy i Zastosowania. Tom 4. Biomateriały. pod red. Stanisław Błażewicz, Jan Marciniak. Akademicka Oficyna Wydawnicza EXIT, Warszawa 2013

SECONDARY LITERATURE

e-journals from resources of WUST Library

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Biomaterials
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_W10	C1, C2	Lec1-Lec15	N1
PEK_U01, PEK_U02, PEK_U03	K1IB_U08, K1IB_U11, K1IB_U14	C3	Lab1-Lab8	N2, N3
PEK_K01, PEK_K02	K1IB_K01, K1IB_K02	C1, C2, C3	Lec1-Lec15	N1, N2, N3

SUBJECT SUPERVISOR

dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Równania różniczkowe zwyczajne**
Name in English: **Ordinary Differential Equations**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031016**
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. Student is familiar with the differential and integral calculus of function of one variable and other branches of mathematics used in this calculus, particularly linear algebra.
2. Student is able to calculate derivatives of functions of one variable, indefinite and definite integrals using methods by parts and by substitution.
3. Student is able to calculate determinants, eigenvalues and eigenvectors of matrix.

SUBJECT OBJECTIVES

C1. To gain basic knowledge of first-order and second-order ordinary differential equations, and systems of differential equations
C2. To learn how to choose the appropriate method of solving ordinary differential equations and systems of differential equations.
C3. To develop and consolidate the ability to access information and its analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has theoretical knowledge of differential equations and knows methods of their solving.
PEK_W02 - Student has knowledge about methods of solving of systems of differential equations
PEK_W03 - Student has knowledge about applying differential equations as the mathematical model for a physical phenomenon.

II. Relating to skills:
PEK_U01 - Student is able to formulate theorems and definitions of differential equations in oral and written, friendly manner,
PEK_U02 - Student is able to solve first-order and second-order differential equations.
PEK_U03 - Student is able to solve systems of differential equations.

III. Relating to social competences:
PEK_K01 - Student understands the necessity of systematical work on all tasks and can estimate the time needed for solving the exercise.
PEK_K02 - Student knows the scope of his/her knowledge and abilities, is able to identify lack of knowledge and complete it using the literature.
PEK_K03 - Student acts ethically and understands the importance of intellectual honesty.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	First-order differential equations: the basic definitions. Issues from various fields leading to differential equations. First-order differential equations: the equations with separated variables and homogeneous equations.	2
Lec2	First-order linear homogeneous and heterogeneous differential equations. Method of variation of constant.	2
Lec3	Orthogonal curves. Second-order equations. Reducible second-order equations.	1
Lec4	Orthogonal curves. Second-order equations. Reducible second-order equations.	2
Lec5	Second-order linear heterogeneous differential equations with constant coefficients. Method of variation of constants. Method of undetermined coefficients.	2
Lec6	Systems of differential equations. Method of elimination. Homogeneous linear system of equations with constant coefficients.	2
Lec7	Heterogeneous linear system of equations with constant coefficients. Method of variation of constants.	2
Lec8	Test.	2
		Total hours: 15
Form of classes – Classes		Number of hours
Cl1	Reminder on differential and integral calculus. Solving first-order differential equations with separated variables and homogeneous equations.	2

Cl2	Solving first-order linear homogeneous and heterogeneous differential equations.	2
Cl3	Solving reducible second-order differential equations.	2
Cl4	Solving second-order linear homogeneous differential equations with constant coefficients.	1
Cl5	Solving second-order linear heterogeneous differential equations with constant coefficients with method of undetermined coefficients.	2
Cl6	Solving second-order linear heterogeneous differential equations with constant coefficients with method of variation of constants.	2
Cl7	Solving heterogeneous linear systems of equations with constant coefficients.	2
Cl8	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_W03	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_U02 - PEK_U03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M. D. Greenberg, Ordinary differential equations, John Wiley & Sons, 2012.
2. R. Carlson, Linear ordinary differential equations, Society for Industrial and Applied Mathematics, Philadelphia 1997.
3. R. E. O'Malley, Thinking about ordinary differential equations, Cambridge University Press, 1997.
4. A. Jeffrey, Linear algebra and ordinary differential equations, CRC Press, 1993.
5. G. Birkhoff, G. C. Rota, Ordinary differential equations, John Wiley & Sons, 1989.
6. R. M. M. Mattheij, J. Molenaar, Ordinary differential equations in theory and practice, John Wiley and Sons, 1996.
7. R. K. Miller, A. N. Michel, Ordinary differential equations, Academic Press, 1982.

SECONDARY LITERATURE

1. J. H. Hubbard, B. H. West, Differential equations: a dynamical systems approach, Cambridge University Press, Cambridge 2003.
2. N. Finizio, G. Ladas, Ordinary differential equations with modern applications, Wadsworth Publ. Co., 1989.

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

Subject educational effect	Correlation between subject 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	K1IB_W01	C1		N1, N3, N4
PEK_U01-PEK_U03	K1IB_U01	C2		N2, N3, N4
PEK_K01-PEK_K03	K1IB_K01	C3		N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Dorota Aniszewska tel.: 320-27-90 email: dorota.aniszewska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania**
Name in English: **Manufacturing techniques**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031018**
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	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. Students should have a basic knowledge of mathematics, physics and materials sciences and basic properties of engineering materials. Has a basic knowledge concerning metallurgical processes of treatment of ores, production of steel and non-ferrous metals, has a basic knowledge about mechanical properties of engineer materials, organized knowledge about types of metallic engineer materials, its composition, properties, applications and rules of right choice.
2. Student should read and interpret drawings and diagrams used in the technical documentation.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the manufacture techniques: welding, casting, plastic working and machining.
C2. Acquiring the ability to select an appropriate bonding technology, casting, plastic forming and machining from the viewpoint of mechanization and automation.
C3. Obtaining and keeping of social competences concerning ability to cooperate in the student’s group with a goal to solve problems effective way. Responsible, honest and serious approach to new duties, respecting customs of academic society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student can recognize and characterize basic methods of welding, casting, plastic working and machining.

PEK_W02 - Student is able to propose a method of production for a particular product with specific geometry and material characteristics.

PEK_W03 - Student can describe the structure of production stations and select their components.

II. Relating to skills:

PEK_U01 - Student is able to choose the right technology of bonding, casting, plastic working and cutting of basic engineering materials.

PEK_U02 - Student is able to choose the station and instrumentation used to carry out the manufacturing process.

PEK_U03 - Student can critically define basic possibilities of mechanization and automation of manufacturing processes.

III. Relating to social competences:

PEK_K01 - Shows ability necessary to cooperate in a team with a goal to improve methods of right strategy of optimal solving of problems.

PEK_K02 - Is able to assess properly ratios, explain and justify his own point of view with use of a knowledge concerning basic matters of material science.

PEK_K03 - Respects customs and rules of academic society.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Safety in welding. Types of welds and joints. Gas torch welding. Soldering and brazing.	2
Lec2	Basic information about arc welding. Shielded manual metal arc welding. Gas shielded tungsten and metal arc welding. Submerged arc welding.	2
Lec3	Selected methods of spot, linear and butt welding materials.	2
Lec4	Selected methods of thermal cutting.	2
Lec5	Effect of plastic forming process on the properties of the product.	2
Lec6	Sheet metal forming processes.	2
Lec7	Processes of forming lumps. Analysis of the rolling, extrusion, forging and drawing.	2
Lec8	Metal Forming Tools.	2
Lec9	Selected machining methods.	2
Lec10	Selected methods of abrasive machining.	2
Lec11	Selected methods of electrodischarge machining.	2
Lec12	EHS in foundry practice. Characteristics of synthetic molding sand. Casting patterns. Technology of full form.	2
Lec13	Form and core technology. Hand and machine manufacturing of foundry molds and cores.	2

Lec14	Techniques for manufacturing castings in chemically and thermally hardened molds.	2
Lec15	Manufacture of castings in permanent mould. Die - metal mould casting. Pressure die casting. Centrifugal casting.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Gas torch welding. Soldering and brazing.	2
Lab2	Shielded manual metal arc welding. Gas shielded tungsten and metal arc welding. Submerged arc welding.	2
Lab3	Resistance and friction welding.	2
Lab4	Oxygen and plasma thermal cutting. Weld stresses and deformations.	2
Lab5	Cold deformation and annealing of metals.	2
Lab6	Punching-cutting, bending and stamping.	2
Lab7	Rolling the metal sheets and profiles.	2
Lab8	Manufacturing the metal products in the process of drawing.	2
Lab9	Turning and drilling.	2
Lab10	Methods of abrasive machining.	2
Lab11	Milling, electrodischarge machining and making threads and gears.	2
Lab12	Characteristics of synthetic molding sand. Casting patterns. Technology of full form.	2
Lab13	Hand and machine manufacturing of foundry molds and cores.	2
Lab14	Manufacture of castings in molds from chemically and thermally hardened (CO_2 process, shell molds).	2
Lab15	Manufacture of castings in permanent mould. Die - metal mould casting. Pressure die casting. Centrifugal casting.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

F1	PEK_W01 - PEK_W03	final test
P = F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Ambroziak A. (red.): Techniki Wytwarzania. Spawalnictwo. Laboratorium. PWr, Wrocław 2011, http://www.dbc.wroc.pl/
2. Pilarczyk J. (red.): Poradnik Inżyniera. Spawalnictwo. T. I i II, WNT Warszawa, 2003, 2005
3. Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000
4. Tabor A. Odlewnictwo wyd. „Akapit" Kraków 1996
5. Murza-Mucha P., Techniki wytwarzania – Odlewnictwo. PWN, Warszawa 1978
6. Granat K. Laboratorium z odlewnictwa, skrypt PWr, Wrocław 2007
7. Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skr. P.Warsz. Warszawa 1981
8. Gronostajski J., Obróbka plastyczna metali, Wrocław 1974Morawiecki M., Sadok L., Wosiek E., Teoretyczne podstawy technologicznych procesów przeróbki plastycznej, Wyd. Śląsk, Katowice 1981 http://www.metalplast.pwr.wroc.pl/instrukcje.html
9. Żebrowski Henryk, tytuł: Techniki wytwarzania - Obróbka wiórowa ścierna i erozyjna, wydawnictwo: Oficyna Wyd. PWr, 2004
10. Cichosz Piotr i inni, tytuł: Techniki wytwarzania - Obróbka Ubytkowa -Laboratorium, wydawnictwo: Oficyna Wyd. PWr, 2002
11. Cichosz Piotr i inni, tytuł: Techniki wytwarzania - Obróbka Ubytkowa - Laboratorium cz. II, wydawnictwo: Oficyna Wyd. PWr, 2008

SECONDARY LITERATURE

1. Klimpel A.: Spawanie, Zgrzewanie i Ciecie Metali., WNT, Warszawa, 1999
2. Lewandowski J. L.; Tworzywa na formy odlewnicze, wyd.: „Akapit" Kraków 1997
3. Błaszkowski K. Technologia formy i rdzenia, Warszawa 1990
4. Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986
5. Romanowski P., Poradnik obróbki plastycznej na zimno, Wydawnictwo Naukowo- Techniczne, Warszawa 1976. Erbel S., Kuczyński K., Marciniak Z., Obróbka plastyczna, PWN, Warszawa 1981

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing techniques
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W1-PEK_W3	K1IB_W23	C1-C2	Lec1-Lec15	N1,N2,N5
PEK_U01 - PEK_U03	K1IB_U25, K1IB_U27	C1-C3	Lab1-Lab15	N3,N4
PEK_K01 - PEK_K03	K1IB_K04, K1IB_K05	C3	Lab1-Lab15	N3,N4

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów I**
Name in English: **Strength of Materials I**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031019**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of statics and fundamentals of mechanics – forces, reactions, constraints, Newton’s laws. More specifically the familiarity with the following concepts is required: moment of a force at a point, balance/reduction of an arbitrary spatial force system, definitions of internal forces in a member, vector algebra and mass geometry. The ability to calculate the following quantities: internal force in a member, moment of static and moment of inertia of composite figures and simple solids, the parallel and rotary transformation of the coordinate system.

SUBJECT OBJECTIVES

C1. Technical problem solving based on mechanics.
C2. Performing strength analyses of machine components.
C3. Teamwork and following academic principles.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows: foundations of tensor analysis and its applications in the solid mechanics,
PEK_W02 - limitations of solutions of geometrically linear structures, when to superimpose displacements, what is the stability of the compressed member and what load leads to its loss,
PEK_W03 - the most useful failure criteria hypotheses and their applications,

II. Relating to skills:
PEK_U01 - Student has practical skills in: performing the parallel and rotational transformation as well as calculating the eigenvalues of the stress, strain or moment of inertia tensors,
PEK_U02 - calculating of the stress and displacement in a member with a compact or a thin-walled cross-section loaded with tension–compression, torsion, shear or bending force as well as stress in welded, riveted, bolted joints.
PEK_U03 - designing a member resistant to buckling in the elastic and elastic-plastic regions.

III. Relating to social competences:
PEK_K01 - Social competencies: independent research and critical evaluation of the found sources,
PEK_K02 - objective evaluation of arguments, rational explanation and justification of the student's viewpoint using knowledge of the strength of materials,
PEK_K03 - conforming to the academic principles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Basic notions. Experimental foundations of the discipline. Strength design of straight members in tension.	2
Lec2	Stress theory.	2
Lec3	Theory of strain. Engineering measurements of strain.	2
Lec4	Physical relationships between stress and strain.	2
Lec5	Torsion of circular shafts.	2
Lec6	Torsion of members of arbitrary cross-section. Thin-walled members.	2
Lec7	Shearing of joints.	2
Lec8	Symmetric bending of straight members. Internal forces and stresses.	2
Lec9	General case of bending. Unsymmetrical bending. Shearing centre.	2
Lec10	Displacements in beams. Deflection line of a beam.	2
Lec11	Buckling of the compresion rod.	2
Lec12	Strain energy, spherical and deviatoric parts of tensor, shear energy.	2
Lec13	Failure criteria and combined modes of loading.	2
Lec14	Energy methods for determining displacements in statically determinate and indeterminate member systems.	2
Lec15	Stress concentration. Permissible stress. Factor of safety.	2
		Total hours: 30
Form of classes – Classes		Number of hours

Cl1	Statically indeterminate cases in stretching/compressing.	2
Cl2	Plane stress. Mohr’s circle.	2
Cl3	Engineering strain measurement.	2
Cl4	Shafts in torsion – strength and stiffness.	1
Cl5	Thin-walled members in torsion – strength and stiffness.	1
Cl6	Written test.	1
Cl7	Bending. Stress field. Deflection line of a beam.	2
Cl8	Buckling of compressed members.	2
Cl9	Applications of failure criteria hypotheses.	1
Cl10	Written test.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. homework
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	Exam, written test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03.	Oral examination, written test 1, written test 2.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] J. Misiak: Mechanika techniczna. Statyka i wytrzymałość materiałów, t1. WNT, 1996.
[2] R. Żuchowski: Wytrzymałość materiałów, Oficyna Wydawnicza PWr., 1996.
[3] Z. Dyląg, A. Jakubowicz, Z. Orłoś: Wytrzymałość materiałów. WNT, 1997.
[4] Z. Brzoska: Wytrzymałość materiałów. PWN, 1979.
[5] M.E. Niezgodziński, T. Niezgodziński: Wytrzymałość materiałów, PWN, 1981.
[6] R. Kurowski, Z. Parszewski: Zbiór zadań z wytrzymałości materiałów, PWN, 1966.
[7] T. Rajfert, Rżysko J.: Zbiór zadań ze statyki i wytrzymałości materiałów, PWN, 1976.

SECONDARY LITERATURE

[1] S.P. Timoshenko: Historia wytrzymałości materiałów, Arkady, 1966.
[2] S. Katarzyński, S. Kocańda, M. Zakrzewski: Badania własności mechanicznych metali, WNT, 1967.
[3] J. Walczak: Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności, PWN, 1973.
[4] E. Rusiński: Mikrokomputerowa analiza ram i nadwozi pojazdów i maszyn roboczych, W K Ł, 1990.
[5] W. Śródka: Trzy lekcje metody elementów skończonych, Oficyna Wydawnicza P.Wr., 2004.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of Materials I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_W08	C1	L1 - L15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1IB_U06, K1IB_U08	C2, C3	Cl1 - Cl9	N2, N3
PEK_K01, PEK_K02, PEK_K03	K1IB_K02	C3	L1 - L15	N1, N4

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Śródka tel.: 713204070 email: wieslaw.srodka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elementy i układy elektroniczne**
Name in English: **Elements and electronic circuits**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031020**
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

C1. Gain knowledge about the construction, operation and properties of basic electronic systems used for medical applications and development trends in the field.
C2. Learning how to start and measurements of the simple electronic circuits
C3. Improving the presentation of experimental results in a transparent manner

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student can describe the structure and operation of basic electronic circuits used in medical applications.

PEK_W02 - The student knows the basic methods and techniques in the design of analog circuits

II. Relating to skills:

PEK_U01 - The student can, in accordance with the set specifications and using appropriate methods, design elementary electronics.

PEK_U02 - Students can perform a simple electronic circuit, run it and measure its basic parameters.

PEK_U03 - The student is able to write in a clear report of the experiments

III. Relating to social competences:

PEK_K01 - Student can work in a group.

PEK_K02 - Acquires the ability to take responsibility for assigned tasks

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification and parameters of biomedical signals their measurement and processing of A / C.	3
Lec2	Power supply systems in medical devices.	3
Lec3	Patient safety and medical equipment.	2
Lec4	Operational amplifiers and their applications in medical apparatus.	5
Lec5	Construction of stimulation devices (pacemaker, defibrillator, neuroprotein, etc.).	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction: - introduce students with the principles of safety in the laboratory;- introduce students with support equipment	3
Lab2	Takes four measurement exercises from the list in the Electronic Systems Laboratory: Operational Amplifier - basic configurations; Operational amplifier - active filter; Instrumentation Amplifier; EC transistor amplifier; Keys transistor; Linear voltage regulator; Flip-flops - monostable, astable. Transistor - impulse work.	12
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. tutorials
N4. self study - preparation for laboratory class
N5. 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
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	Preliminary small exam and / or project evaluation given electronic circuit.
F2	PEK_U02 PEK_U03	The implementation of the system, running the system, measurement and report on the measurements.
P = 0,49F1+0,51F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

U. Tietze, Ch. Schenk, Electronic Circuits --- Handbook for Design and Applications, 2008;
D.Prutchi, M.Norris: Design and development of medical electronic instrumentation. A pratical perspective of the design, construction and test of medical devices. Wiley-Interscience 2005;
Course materials on the website

SECONDARY LITERATURE

C Kitchen L Counts, A Designers Guide to Instrumentation Amps, 2004 Analog Devices

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Elements and electronic circuits
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_W19, K1IB_W21	C1	Lec1 - Lec5	N1 - N3
PEK_U01, PEK_U02, PEK_U03	K1IB_U18, K1IB_U19	C2, C3	lab.1 - lab.2	N3 - N5

SUBJECT SUPERVISOR

dr inż. Remigiusz Mydlikowski email: remigiusz.mydlikowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska I (GW)**
Name in English: **Engineering graphic I (DG)**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031022**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge of the fundamental theorems of Euclidean geometry
2. Student has ability to use of the drawing utensils.
3. Student has ability to draw basic geometric structures.

SUBJECT OBJECTIVES

C1. Knowledge of the theoretical and practical basis of the Monge descriptive projection method of the geometric structures on the drawing's plane as the basis for design recording (engineering drawing).
C2. Knowledge in the field of the geometric structures restitution based on Monge's projections.
C3. Preparation for the design recording (engineering drawing) application.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can practically apply the principles of the Monge's projection method to map the elements and geometric structures (including solids) on the drawing plane.
PEK_U02 - Student can set the size of the dimensions characterized measuring tasks of geometry.
PEK_U03 - Student can provide restitution of the geometric structure on the basis of Monge's projection and submit the result by axonometric projection.

III. Relating to social competences:

PEK_K01 - Student is to work independently and solve problems involving Monge projection method.

PROGRAMME CONTENT

Form of classes – Classes		Number of hours
Cl1	Information on the drawing utensils and principles of the geometric structures drawing. Projection of a point and straight line, the mapping of a plane using her traces, identification of the basic elements localization in space using two orthogonal projection planes.	2
Cl2	Belonging of the basic geometric elements, completion of the missing projection; particular localization of the geometric elements.	2
Cl3	Edge as common element of two planes. Breakdown point as common element of straight line and plane. Particular cases of a common elements.	2
Cl4	Edge between flat figures (auxiliary projection planes application); breakdown point of the flat figure by straight line. Identification and construction of the parallel and orthogonal relationship between basic geometrical elements.	2
Cl5	Rotation and revolved section of the basic geometrical elements (rotation of a line's segment and plane); application of the localization transformation for measuring tasks (determination of the real size of a line's segment, angle, flat figure).	2
Cl6	Determination of the projections of plane geometrical structures with selected parameters and the desired position in space (increasing of revolved section of a plane figure). Application of the reference system transformation in measuring tasks and identification of the position (angle relative to the projecting plane, distance of the point from the plane, setting the points projections at a set distance from the plane).	2
Cl7	Test K1 (includes classes's 1 - 6 material).	2
Cl8	The mapping of the elementary solids using Monge's projection, points and lin's segments belonging to the solid's walls identification; determination of the cross sections of polyhedra with projection planes.	2
Cl9	Determination of the polyhedra cross sections cutted by arbitrary planes. Determination of the cross section of the solids with surfaces. Solid's breakdown points by lines (use of auxiliary cutting planes containing penetrating straight line) determination.	2

Cl10	Developed view of a polyhedron and solid containing ruled surface. Cutting of the solid with projection planes as a modification of the initial form of solid - cutting of the polyhedron.	2
Cl11	Cutting of a solid of revolution. Polyhedra transmission lines determination.	2
Cl12	Solids (containing surfaces) transmission lines determination.	2
Cl13	Solid mapping onto three orthogonal projectionl planes. Solid modyfying using projection plane.	2
Cl14	Solid mapping using axonometric projection. Determination of the missing solid projection modified by cutting planes. Relationship between Monge's projection and axonometric projection.	2
Cl15	Test K2 (includes classes's 8 - 14 material).	2
		Total hours: 30

TEACHING TOOLS USED

N1. problem exercises
N2. tutorials
N3. self study - preparation of the projects (sheets)

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	test no. 1, good rating is nedeed (min.3.0)
F2	PEK_U01, PEK_U02, PEK_U03	test no. 2, good rating is nedeed (min.3.0)
F3	PEK_K01	evaluation of n projects (sheets) preparation, n= min.4 - max. 8, good rating of each project is nedeed, F3 = (P1+...+ Pn)/n
P = [(F1+F2)/2]*4/5+F3*1/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Lewandowski Z., Geometria wykreślna, PWN, Warszawa 1980 (i późniejsze wydania),
[2] Otto F., Otto E., Podręcznik geometrii wykreślnej, PWN, Warszawa 1998,
[3] Zbiór zadań z geometrii wykreślnej, red. Nowakowski T., Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 2001,
[4] Bieliński A., Geometria wykreślna, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005

SECONDARY LITERATURE

[1] Szerszeń S., Nauka o rzutach, PWN, Warszawa 1974 (i późniejsze wydania),
[2] Przewłocki S., Geometria wykreślna w budownictwie, Wyd. Arkady, Warszawa 1997,
[3] Bogaczyk T., Romaszkiewicz-Białas T., 13 wykładów z geometrii wykreślnej, Oficyna Wyd. Politechniki Wrocławskiej, Wrocław 1997,
[4] Błach A., Geometria. Przegląd wybranych zagadnień dla uczniów i studentów. Arkady, Warszawa 1998.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering graphic I (DG)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between 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	K1IB_U07	C1-C3	Cl1-Cl6, Cl8-Cl14	N1, N2, N3
PEK W01 PEK W02 PEK W03	K1IB_W12	C1-C3	Cl1-Cl6, Cl8-Cl14	N!, N2
PEK K01	K1IB_K06	C1-C3	Cl1-Cl6, Cl8-Cl14	N1, N2, N3

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031023**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the complex functions and differential equations.

SUBJECT OBJECTIVES

C1. Getting knowledge about the basic description methods of automatic systems.
C2. Getting knowledge about the basic analysis methods of automatic systems.
C3. Getting knowledge about the basic synthesis methods of automatic systems.
C4. Learning to design control systems.
C5. The practical skills to build and run basic automation systems.
C6. Skills to evaluate the performance of control systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of basic methods for describing automation systems.
PEK_W02 - Knowledge of basic methods to analyze automation systems.
PEK_W03 - Knowledge of methods to synthesize automation systems.

II. Relating to skills:
PEK_U01 - Can define the mathematical description of the automation system.
PEK_U02 - Able to analyze the function of the automation system.
PEK_U03 - Can design automation system.

III. Relating to social competences:
PEK_K01 - Can broaden their knowledge by using additional aids.
PEK_K02 - Can think and act in a creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, basic terms, the structure of control systems and their classification.	2
Lec2	Description of linear automation systems: differential equations, transfer function, time characteristics.	2
Lec3	Description of linear automation systems: the frequency response, the frequency characteristics.	2
Lec4	Dynamic objects: proportional, inertial, differential.	2
Lec5	Dynamic objects: Integral, oscillating, delay.	2
Lec6	Stability. Theorem of stability, properties of stable and unstable systems.	2
Lec7	Description of discrete systems. The differential equation, transfer function, frequency responce, time characteristics.	2
Lec8	Automatic control. Requirements. Static control. Astatic control.	2
Lec9	Controllers: PI, PD, PID	2
Lec10	Nonlinear systems. Methods of description and analysis.	2
Lec11	Discrete automatic control.	2
Lec12	Boolean algebra	2
Lec13	Logic combinational systems.	2
Lec14	Logic sequential systems.	2
		Total hours: 28
Form of classes – Laboratory		Number of hours
Lab1	Charakterystyki statyczne i dynamiczne elementów automatyki	2
Lab2	Frequency characteristics of automatic objects.	2
Lab3	Badania symulacyjne elementów automatyki w środowisku Matlab-Simulink	2

Lab4	On-off control. 2 Lab5	2
Lab5	Elements and contactor-relay systems.	2
Lab6	Logic combinational systems	2
Lab7	Modeling and programming of sequential processes.	2
Lab8	Modeling and programming of complex processes. Credit.	1
		Total hours: 15

TEACHING TOOLS USED
N1. self study - self studies and preparation for examination N2. self study - preparation for laboratory class

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Greblicki W., Podstawy automatyki. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2006.
Praca zbiorowa, tytuł: Laboratorium podstaw automatyki i automatyzacji,wydawnictwo: Oficyna Wydawnicza Politechniki Wrocławskiej, rok: 2005

SECONDARY LITERATURE

Kaczorek T., Dzieliński A., Dąbrowski W., Łopatka R., Podstawy teorii sterowania., WNT Warszawa 2009.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of Automatic Control
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_W20	C1-C3	Lec1-Lec15	N1
PEK_U01 - PEK_U03 PEK_K01 - PEK_K02	K1IB_U17, K1IB_U19	C4-C6	Lab1=Lab8	N2

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie elementów i zespołów mechanicznych I**
Name in English: **Designing of the mechanical elements and assemblies I**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031024**
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

SUBJECT OBJECTIVES

C1. Mastering the basics of the design of components and assemblies and their applications, particularly in biomedical devices.
C2. Mastering the basic design elements and mechanical components and the selection of standardized components and finished components.
C3. Preparation for self-construction of mechanical components and assemblies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - As a result of the classes students should be able to characterize the design and construction process of the element or mechanical assembly.

PEK_W02 - As a result of the course the student should be able to recognize and describe the operation of basic components and mechanical assemblies.

PEK_W03 - As a result of the course students should be able to identify appropriate design tools.

II. Relating to skills:

PEK_U01 - As a result of the course students should be able to apply the rules of construction methodology to solve the design task in the design of elements and mechanical assemblies.

PEK_U02 - As a result of the course the student should be able to perform the necessary calculations of elements and assemblies (taking into account relevant criteria), assign appropriate geometry to the designed objects, select the material and draw up the technical documentation.

PEK_U03 - As a result of the course students should be able to analyze existing technical solutions and make decisions about the use of normalized and delivered elements in the project.

III. Relating to social competences:

PEK_K01 - As a result of the classes, students should be aware of the role of the mechanical constructor in recognizing and satisfying social needs with technical means.

PEK_K02 - As a result of the classes students should develop the ability to critically evaluate existing technical solutions and evaluate their own activities.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Designing target, design and construction process, definitions, goals and principles of the designing, methods of the concept searching for solving a design task.	2
Lec2	Algorithm of the design and construction process, role of the designing assumptions and limitations, criteria for selecting the solution of the task; ergonomics and standardization in designing.	2
Lec3	Strength calculations – immediate strength, fatigue strength, permissible stress and strain, fatigue graphs.	2
Lec4	Stress concentration factor, safety factor. Typical construction materials, materials used in biomedical engineering.	2
Lec5	Tolerances and fits, recording methods; effect of treatment on material surface condition.	2
Lec6	Permanent fastening in machine construction (welded, pressure welded, glued, riveted, thermocompression bonding, forced-in joint) - their characteristics, typical solutions, calculations.	2
Lec7	Temporary fastening in machine construction (screw joint, pin joint, key joint) - their characteristics, examples of solutions, calculations.	2
Lec8	Shafts and axles: two-supported axes and shafts, shafts loaded with torque, torque and bending moment - principles of calculation, deflection and twisting angles, critical shaft speeds, the role of balancing.	2

Lec9	Plain bearings: hydrostatic, hydrodynamic, self-lubricating; materials associations, basis of calculations, examples of bearing node solutions. Lubrication and sealing.	2
Lec10	Rolling bearings: types, markings, selection (bearing capacity, durability), bearing catalogs. Examples of bearing design, lubrication and sealing.	2
Lec11	Spring components used in mechanical constructions: springs, torque rods, metal-rubber elements, the basis of calculations.	2
Lec12	Clutches - types, examples of solutions, selection, basis of calculations.	2
Lec13	Brakes - types, examples of solutions, selection, basis of calculation.	2
Lec14	Lever, cam, crank, thread mechanisms - examples of solutions; applications, basic calculations.	2
Lec15	Examples of application of the discussed elements and assemblies in the construction of medical devices, including rehabilitation equipment.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction. Performing a sketch of a machine element (checking of the ability to write the construction form of the object).	1
Proj2	Project No. 1 - elaboration of the design assumptions of the medical device (eg rehabilitation) project, formulation of the criteria for solution choose for detailed designing, proposal algorithm of the design and engineering.	2
Proj3	Presentation of the Project No 1.	2
Proj4	Project No. 2 - execution of the fatigue calculations for selected machine element.	2
Proj5	Project No. 3 - design of the permanent fastening of the indicated rehabilitation device elements.	2
Proj6	Project No 4 - design of temporary fastening of the selected biomedical device elements.	2
Proj7	Project No. 5 - design of the mechanical assembly: two-supported shaft together with bearings (on the example of the drive shaft, eg passive rehabilitation device).	4
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK W01, PEK W02, PEK W03, PEK K01, PEK K02	written-oral examination; P1 - assessment from the written part of the examination, min. sufficient (3.0); P2 - score from the written part of the exam, min. sufficient (3.0).
P = (P1+P2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK U01, PEK U02, PEK U03, PEK K02	projects 1,2,3,4,5 - with each project min. sufficient (3.0)
P = (F1+F2+F3+F4+F5)/5		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Z. Osiński, Podstawy konstrukcji maszyn, PWN, Warszawa, 1999.
[2] Dietrych M., Podstawy konstrukcji maszyn, WNT, Warszawa, 1995.
[3] E. Mazanek, Przykłady obliczeń z podstaw konstrukcji maszyn, WNT, Warszawa 2005.

SECONDARY LITERATURE

[1] W. Chomczyk, Podstawy konstrukcji maszyn - elementy, podzespoły, i zespoły maszyn i urządzeń, WNT, Warszawa, 2008.
[2] Poradnik mechanika, praca zbiorowa, wersja polska - oprac. J. Potrykus, Wyd. REA, Warszawa, 2008.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Designing of the mechanical elements and assemblies I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W	K1IB_W24	C1	Lec1 - Lec15	N1, N5

PEK_U	K1IB_U05, K1IB_U06, K1IB_U27	C2, C3	Proj1 - Proj7	N1 - N4

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technika mikroprocesorowa**
Name in English: **Microprocessors science**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031025**
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. Theoretical computer science.
2. Electronic digital circuits, digital signals and digital signal processing.

SUBJECT OBJECTIVES

C1. Understand the basics and principles of operation of the basic memory elements leant on the principles of theoretical computer science.
C2. Understand the principles of integrated circuits, microprocessors control and their peripheral devices.
C3. Understand basic programming principles of microprocessors.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student knows the basics of microprocessors construction and their peripheral devices.

PEK_W02 - The student knows the basics of microprocessors programming.

II. Relating to skills:

PEK_U01 - Students can program a simple microprocessor-based systems.

PEK_U02 - Student can choose and operate microprocessor peripherals.

III. Relating to social competences:

PEK_K01 - Student is able to interact and work in a group.

PEK_K02 - Student is able to think logically and act in a creative way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to components and electronic circuits.	2
Lec2	Components of semiconductor electronics.	2
Lec3	Integrated circuits architecture.	2
Lec4	The structure and components forming codes in the programming language.	4
Lec5	Organization of microprocessors memory.	2
Lec6	Microprocessor memory addressing modes.	2
Lec7	Organization of the microprocessor core, arithmetic - logic unit (ALU)	2
Lec8	Arithmetic-logic operations. Examples.	2
Lec9	Microprocessor stack.	2
Lec10	Programmable launch of microprocessor peripheral devices.	2
Lec11	The module PWM - pulse width modulation.	2
Lec12	Microprocessor interrupt system.	2
Lec13	Counters, timers and microprocessor clocks.	2
Lec14	Microprocessor analog-to-digital converter.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Familiarization with the microprocessor, diagram of the boot board and programming environment.	3
Lab2	Configuration of the I/O space of the microprocessor, methods of addressing.	3
Lab3	Arithmetic-logic operations, working on the 8 and 16-bits registers.	3
Lab4	Configuration and operation with the microprocessor stack.	3
Lab5	Programmable run of microprocessor peripheral devices.	3
		Total hours: 15

TEACHING TOOLS USED

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

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	average of the laboratory signs
P =		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microprocessors science
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W1, PEK_W2	K1IB_W19	C1, C2	Lec1-Lec5	N1
PEK_U01, PEK_U02	K1IB_U18, K1IB_U23	C2, C3	Lab1-Lab5, Lec6-Lec14	N2

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wytrzymałość materiałów II**
Name in English: **Strength of Materials II**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031026**
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		90		
Form of crediting	Crediting with grade		Crediting with grade		
Group of courses					
Number of ECTS points	1		3		
including number of ECTS points for practical (P) classes			3		
including number of ECTS points for direct teacher-student contact (BK) classes	0.6		2.1		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of fundamentals of solid mechanics: tensor analysis, static laws, concepts of displacement, strain and stress dependencies between these quantities in an elastic medium, the ability to calculate displacements and stress in a member.

SUBJECT OBJECTIVES

C1. Technical problem solving based on mechanics.
C2. Performing strength analyses of machine components.
C3. Teamwork and following academic principles.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student knows: how to determine stress and displacement in pipes and thick-walled tanks, the theory of thin-walled axially symmetric shells loaded with pressure,
PEK_W02 - the basics of fatigue of material, rheology and fracture mechanics,
PEK_W03 - the fundamental concepts, equations and ideas of finite element method applied to a trass or to a linear elastic shield.

II. Relating to skills:

PEK_U01 - performing basic strength tests,
PEK_U02 - measuring the plain state of strain using tensometers (strain gauges),
PEK_U03 - determining the basic elasticity constants: Young modulus, Poisson ratio and Kirchhoff modulus.

III. Relating to social competences:

PEK_K01 - independent research and critical evaluation of the found sources,
PEK_K02 - objective evaluation of arguments, rational explanation and justification of the student's viewpoint using knowledge of the strength of materials,
PEK_K03 - conforming to the academic principles.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Axially symmetric thin-walled shells.	1
Lec2	Single- and multi-layer thick-walled cylinders.	2
Lec3	Differential equation of thin plate.	2
Lec4	Material fatigue – basic calculations.	2
Lec5	Time and temperature dependent loads – relaxation, creep.	2
Lec6	Basic concepts of fracture mechanics.	2
Lec7	FEM – member and shell elements. Examples of applications of FEM.	2
Lec8	Written test	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Experimental determination of the mass moment of inertia.	2
Lab2	Static tensile test.	2
Lab3	Static compression test.	2
Lab4	Investigation of stress concentration - experimental determination of the shape factor.	2
Lab5	Buckling of the compresion rod.	2
Lab6	Study of bending beams.	2
Lab7	The two-dimensional state of stress - stress testing in hook model.	2
Lab8	Experimental analysis of the thin-walled tank strains.	2
Lab9	Torsion of the rods and tubes.	2

Lab10	Creeping of selected construction materials.	2
Lab11	Determination of the stress intensity factor by optical methods.	2
Lab12	Hardness measurement.	2
Lab13	Impact test	2
Lab14	Fatigue testing of biomaterials.	2
Lab15	Realization of overdue topics, course credit.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] J. Misiak: Mechanika techniczna. Statyka i wytrzymałość materiałów, t1. WNT, 1996.
[2] R. Żuchowski: Wytrzymałość materiałów. Oficyna Wydawnicza P.Wr., 1996.
[3] Z. Dyląg, A. Jakubowicz, Z. Orłoś: Wytrzymałość materiałów. WNT, 1997.
[4] Z. Brzoska: Wytrzymałość materiałów. PWN, 1979.
[5] M.E. Niezgodziński, T. Niezgodziński: Wytrzymałość materiałów. PWN, 1981.
[6] R. Kurowski, Z. Parszewski: Zbiór zadań z wytrzymałości materiałów. PWN, 1966.
[7] T. Rajfert, Rżysko J.: Zbiór zadań ze statyki i wytrzymałości materiałów. PWN, 1976.

SECONDARY LITERATURE

[1] S.P. Timoshenko: Historia wytrzymałości materiałów. Arkady, 1966.
[2] S. Katarzyński, S. Kocańda, M. Zakrzewski: Badania własności mechanicznych metali. WNT, 1967.
[3] J. Walczak: Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności, PWN, 1973.
[4] E. Rusiński: Mikrokomputerowa analiza ram i nadwozi pojazdów i maszyn roboczych. W K Ł, 1990.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Strength of Materials II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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.	K1IB_W08	C1, C2		N5
PEK_U01, PEK_U02, PEK_U03.	K1IB_U14, K1IB_U21	C2, C3		N1 - N4
PEK_K01, PEK_K02, PEK_K03.	K1IB_K02	C3		N5

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Śródka tel.: 713204070 email: wieslaw.srodka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie elementów i zespołów mechanicznych II**
Name in English: **Designing of the mechanical elements and assemblies II**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031029**
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	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. The student must have knowledge of the fundamentals of the design and construction methodology of mechanical components and assemblies (clutches and brakes).
2. The student should be able to perform calculations, including strength, and to record the form of the components and mechanical assemblies.
3. The student should be aware of the role of the engineer in the process of meeting social needs through technical means, and be able to act in a planned manner, taking into account the conditions of this activity.

SUBJECT OBJECTIVES

C1. Extending the knowledge in the field of construction and methodology of the elements and mechanical assemblies designing.
C2. Application of knowledge in the design of components and assemblies of complex mechanical systems in the implementation of medical device design.
C3. Increasing awareness of social determinants in engineering activities. Mastering the ability to work in a team.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - As a result of the classes the student should be able to describe the structure and explain the principles of operation of the mechanical assemblies.

PEK_W02 - As a result of the classes students should be able to characterize the design and construction process of a complex design task.

PEK_W03 - As a result of the course students should be able to select appropriate design tools for the project task.

II. Relating to skills:

PEK_U01 - As a result of the course student should be able to apply appropriate design tools to solve the design task, taking into account the design methodology of components and mechanical assemblies.

PEK_U02 - As a result of the course student should be able to design a complex mechanical system, eg for transmission of torque.

PEK_U03 - As a result of the classes, the student should be able to select ready-made elements and mechanical assemblies for the project, taking into account the ergonomic and economic aspect of the project activity.

III. Relating to social competences:

PEK_K01 - As a result of the classes, the student should be able to indicate and include in his / her activity priorities for accomplishing the task undertaken.

PEK_K02 - As a result of the course student should be able to work in a team.

PEK_K03 - As a result of the classes students should be able to present the effects of their work using modern presentation techniques.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Torque processing - mechanical gear, general characteristics, types of transmission, basic parameters.	2
Lec2	Belts with friction coupling: types and applications, belt-to-wheel couplings, base for calculations of gears with flat and V-belts, belt selection, belt variators.	2
Lec3	Belt-shaped couplings: applications, the basic calculations of the toothed belt gears, the design and selection of toothed belts.	2
Lec4	Chain transmission - construction solutions, basics of calculations, types and chain selection, chain variators.	2
Lec5	Friction gears - types, characteristics, application; friction wheels materials selection, friction gear calculations, construction solutions.	2
Lec6	Gears - types, basic concepts, meshing geometry, types of teeth contours.	2
Lec7	Gears - cylindrical and bevel gears, load bearing capacity and load conditions, mechanical efficiency.	2
Lec8	Helical gears - types, characteristics, basic calculations. Worm gears.	2
Lec9	Planetary gears - types and design solutions, applications, the basis of calculation.	2
Lec10	Wave transmissions - principle of operation, construction, calculation of transmission ratio. Geamotors - examples of solutions, applications.	2

Lec11	Multistage gearboxes - construction, control and automation. Differential mechanism. Optimization of transmission design - an example.	2
Lec12	Mechanical drive systems - examples of construction solutions, drives in biomedical devices. Hybrid systems.	2
Lec13	Technological iproblems in the components and mechanical assemblies construction.	2
Lec14	The components and assemblies of precision devices design- examples of solutions.	2
Lec15	Final test.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Project No. 1 (individual) - development of a power transmission system for a passive rehabilitation exercises device; formulation of assumptions and identification of structural constraints.	2
Proj2	Project No. 1 - elaboration of the solving the designing target concept, generation of solutions, formulation of the selection criteria for solutions choose for detailed designing.	2
Proj3	Project No. 1 - detailed design - development of a kinematic scheme, identification of the system's components and assemblies loads.	2
Proj4	Project No. 1 - detailed design - strength calculations, materials selection, documentation preparation (final report with necessary drawings).	2
Proj5	Project No. 1 - project presentation.	2
Proj6	Project No. 2 (group) - project of the medical device. Forming of the designing groups, defined rules of their operation; formulation of the project tasks.	2
Proj7	Project No. 2 - elaboration of construction assumptions, generation of the solution of the construction task set variants, definition of the selection criteria and solution for implementation selection.	2
Proj8	Project No. 2 - detailed design - determination of the each device systems kinematic schemes and their design variants.	4
Proj9	Project No. 2 - detailed design - performing calculations (including fatigue) of selected components of the device, selection of prefabricated elements and assemblies.	4
Proj10	Project No. 2 - detailed design - design documentation (assembly drawing, drawings of indicated systems and elements of the designed device).	4
Proj11	Project No. 2 - detailed design - preparation of the final report.	2
Proj12	Project No. 2 - presentation of the projects of each groups.	2
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. tutorials
N3. self study - preparation for project class
N4. project presentation
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; PEk K01;	F - final test, min. sufficient (3.0)
P = F		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Z. Osiński, Podstawy konstrukcji maszyn, PWN, Warszawa, 1999.
[2] Dietrych M., Podstawy konstrukcji maszyn, WNT, Warszawa, 1995.
[3] E. Mazanek, Przykłady obliczeń z podstaw konstrukcji maszyn, WNT, Warszawa 2005.
[4] A. Skoć, J. Spałek., S. Markusik, Podstawy konstrukcji maszyn, t.I/ II. WNT, Warszawa 2008.

SECONDARY LITERATURE

[1] W. Chomczyk, Podstawy konstrukcji maszyn - elementy, podzespoły, i zespoły maszyn i urządzeń, WNT, Warszawa, 2008.
[2] Poradnik mechanika, praca zbiorowa, wersja polska - oprac. J. Potrykus, Wyd. REA, Warszawa, 2008.
[3] L. Kuśmierz, Podstawy konstrukcji maszyn: projektowanie napędów mechanicznych. Wyd. Polit. Lubelskiej, 2011 (wersja cyfrowa: oai:bc.pollub.pl:684).
[4] E. Mazanek, i in., Przykłady obliczeń z podstaw konstrukcji maszyn, t. 2. Łożyska, sprzęgła, hamulce i przekładnie mechaniczne. WNT, Warszawa 2012

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Designing of the mechanical elements and assemblies II
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_W24	C1	Lec1 - Lec14	N1, N2

PEK_U01, PEK U02, PEK U03	K1IB_U13, K1IB_U26, K1IB_U27	C2	Proj1 - Proj12	N2 - N5
PEK_K01, PEK K02, PEK K03	K1IB_K06, K1IB_K08	C3	Lec1 - Lec14, Proj6 - Proj12	N1 - N5

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technika mikroprocesorowa**
Name in English: **Microprocessors science**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031031**
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. Knowledge of the microprocessors core, memories and peripheral devices.
2. Knowledge of programmable startup of microprocessor peripheral devices.

SUBJECT OBJECTIVES

C1. Understanding the bases for the construction and operation of the basic microprocessor peripherals.
C2. Use of the acquired knowledge and expertise on startup of peripheral devices of the microprocessor, to render them right functionality.
C3. Acquire the ability to solve the problems independently in the field of microprocessor technology in biomedical engineering.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student has an orderly, hands-on understanding of how to anticipate the size of the microprocessor input / output ports.
PEK_W02 - The student has a structured, hands-on with the practical knowledge of how to purposely start the devices from the microprocessor input / output ports.

II. Relating to skills:
PEK_U01 - Student can programmatically determine how the microprocessor works with devices from the input /output ports.
PEK_U02 - According to the needs student is able to run the relevant microprocessor peripheral devices.
PEK_U03 - The student is able to analyze the correct action of the microprocessor peripheral devices.

III. Relating to social competences:
PEK_K01 - Student can think and act logically.
PEK_K02 - Student can think and act in a creative way.
PEK_K03 - The student is able to solve problems independently and cooperate in the group.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	The development of microprocessor I/O ports on the basis of the undertaken problem.	2
Proj2	Time management, Timer and Counter modes.	2
Proj3	Microprocessor interrupt startup and their handling.	2
Proj4	Pulse Width Modulation device, PWM modes.	2
Proj5	Stepper motor control by PWM module.	2
Proj6	Analog-to-Digital Converter device, startup and its handling.	2
Proj7	Communication with the user. Startup and operation of the LCD display.	3
		Total hours: 15

TEACHING TOOLS USED

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

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 defense
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rafał Baranowski, Mikrokontrolery AVR ATmega w praktyce, Wydawnictwo BTC, Warszawa 2005

SECONDARY LITERATURE

Włodzimierz S Erdmann, Biomechanika: podstawy dla kierunku inżynieria biomedyczna,Gdańsk : Wydawnictwo Politechniki Gdańskiej 2015
Tomasz Francuz, AVR. Układy peryferyjne, Wydawnictwo Helion.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Microprocessors science
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between 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	K1IB_U17, K1IB_U18	C1, C2	Proj1, Proj2, Proj4, Proj6	N1, N2
PEK_U02	K1IB_U17, K1IB_U18	C2	Proj3, Proj4, Proj5	N1,N2
PEK_U03	K1IB_U17, K1IB_U18	C2, C3	Proj1, Proj2, Proj3, Proj4, Proj5, Proj6, Proj7	N3
PEK_W01	K1IB_U17	C1, C2	Proj1, Proj2, Proj4, Proj6	N1, N2
PEK_W02	K1IB_U18	C2, C3	Proj2, Proj3, Proj4, Proj5, Proj6, Proj7	N1, N2, N3
PEK_K01	K1IB_U17, K1IB_U18	C1, C2, C3	Proj1, Proj2, Proj3, Proj4, Proj5, Proj6, Proj7	N1, N2, N3

PEK_K02	K1IB_U17, K1IB_U18	C1, C2, C3	Proj1, Proj2, Proj3, Proj4, Proj5, Proj6, Proj7	N1, N2, N3
PEK_K03	K1IB_U17, K1IB_U18	C1, C2, C3	Proj1, Proj2, Proj3, Proj4, Proj5, Proj6, Proj7	N1, N2, N3

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Lasery i ich zastosowanie w medycynie**
Name in English: **Lasers and their application in medicine**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031037**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge of physics and optics
2. Show interest in issues related to laser applications

SUBJECT OBJECTIVES

C1. Explain the construction and principle of operation of the laser
C2. Familiarization with the types of lasers, their advantages and limitations
C3. Presenting a wide range of laser applications, with particular emphasis on their application in medicine

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Can discuss the construction and principle of operation of the laser
PEK_W02 - Can list the laser types and carry out their characterization
PEK_W03 - Is able to discuss about the laser applications

II. Relating to skills:

PEK_U01 - Can select the elements necessary for the operation of the laser
PEK_U02 - Can analyze the parameters of the laser beam
PEK_U03 - Can choose the type of laser for a specific application

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Theoretical background of laser principle of operation	2
Lec2	Gas and solid state lasers	2
Lec3	Diode and fiber lasers	2
Lec4	Laser beam parameters important from the point of view of laser applications	2
Lec5	Lasers in the manufacture of medical components	2
Lec6	Laser measurements applications in medicine	2
Lec7	Application of lasers in medical procedures	2
Lec8	Written assessment	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the laboratory	1
Lab2	Analysis of laser construction	2
Lab3	Diagnosis of the laser beam	2
Lab4	Laser cutting	2
Lab5	Laser cladding and welding	2
Lab6	Surface structuring by laser and scanning head	2
Lab7	Laser measurements applications in medicine	2
Lab8	Application of lasers in medicine	2
		Total hours: 15

TEACHING TOOLS USED

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

B. Ziętek, "Lasers", Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 2008.

SECONDARY LITERATURE

E. Kannatey-Asibu, "Principles of Laser Materials Processing", Wiley, 2009.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Lasers and their application in medicine
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W02	C1	Lec1	N1

PEK_WO2	K1IB_W02	C2	Lec2, Lec3, Lec4	N1
PEK_WO3	K1IB_W02	C3	Lec5, Lec6, Lec7	N1
PEK_U01	K1IB_U05	C1	Lab2	N2
PEK_U02	K1IB_U05	C2	Lab3	N2
PEK_U03	K1IB_U05	C3	Lab4, Lab5, Lab6, Lab7, Lab8	N2

SUBJECT SUPERVISOR

dr inż. Adrian Zakrzewski tel.: 320 38 61 email: adrian.zakrzewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki obrazowania medycznego**
Name in English: **Methods of medical imaging**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBM031038**
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	Examination				
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 on physics of imaging

SUBJECT OBJECTIVES

C1. Introduction to methods of medical imaging
C2. Teaching of basics of maging setups construction
C3. Teaching of basics of data analysis methods in imaging systems

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has knowledge on methods of medical imaging
PEK_W02 - Student has knowledge on construction of imaging setups
PEK_W03 - Student has knowledge on data analysis methods in imaging systems

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	History of imaging techniques	2
Lec2	X-ray imaging. X-ray lamp construction. Standard radiogram and fluoroscopy	2
Lec3	Computed tomography - phyisical basics, setup construction, data analysis	2
Lec4	Magnetic Resonance Imaging - phyisical basics, setup construction, data analysis	4
Lec5	Ultrasound imaging - physical basics, setup construction, data analysis, 2D/3D /4D imaging	4
Lec6	Impedance tomography - physical basics, setup construction, data analysis	2
Lec7	Magnetic Resonance Imaging Tractography	2
Lec8	Methods of elastography imaging	2
Lec9	Endoscopy and laparoscopy- physical basics, setup construction, data analysis	4
Lec10	PET/SPECT imaging - physical basics, setup construction, data analysis	2
Lec11	Intraoperatiive imaging - fluorescence, MRI, ultrasound imaging, fluoroscopy	2
Lec12	Test	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Juliusz Lech Kulikowski, Antoni Nowakowski i inni: Obrazowanie biomedyczne, ("Biocybernetyka i Inżynieria Biomedyczna 2000". Tom 8) Wydawnictwo: Akademicka Oficyna Wydawnicza Exit
2. Krzysztof Iniewski (Editor): Medical Imaging: Principles, Detectors, and Electronics, Wiley 2009

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Methods of medical imaging
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W06, K1IB_W16	C1	Lec1-Lec11	N1, N2
PEK_W02	K1IB_W06, K1IB_W11, K1IB_W16	C2	Lec1-Lec11	N1, N2
PEK_W03	K1IB_W06, K1IB_W11, K1IB_W16	C3	Lec1-Lec11	N1, N2

SUBJECT SUPERVISOR

dr inż. Ewelina Świątek-Najwer tel.: 71 320-21-93 email: ewelina.swiatek@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): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031041**
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. Engineering knowledge in mechanics and biomedical engineering.
2. Able to obtain technical information from various sources (journals, internet, database), also in foreign languages.
3. Student can speak in the field of science and technology, formulate and justify its position, participate in the discussion, prepare and present the presentation.

SUBJECT OBJECTIVES

C1. To acquire the technical skills of preparing the diploma thesis.
C2. Acquire the skills to formulate your own position and presentation of your own work.
C3. Ability to conduct discussions on engineering problems.
C4. Mobilizing students for timely completion of the diploma thesis.
C5. Preparing students for the diploma exam.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can specify the partial purposes needed to accomplish a defined engineering task.
PEK_U02 - The ability of creative thinking and acting in solving engineering problems.
PEK_U03 - Expanding the ability to discuss engineering issues.

III. Relating to social competences:

PEK_K01 - Developing the awareness of the responsibility for
PEK_K02 - Student understand the importance of corectly defining the priorities needed to perform an engineering task.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Overview of the purpose and scope of the seminar, assignation of student's presentation timetable.	1
Sem2	Presentation of the thesis topics, discussion on the presented issues.	13
Sem3	Summary and credit of the seminar.	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem discussion

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03, PEK_K01	Rating for active participation in problem discussions and job presentations.
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
Biomedical Engineering

Subject educational effect	Correlation between 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	K1IB_U01, K1IB_U05, K1IB_U26, K1IB_U27, K1IB_U31	C1-C5	Sem1-Sem3	N1, N2
PEK_K01, PEK_K02	K1IB_K03, K1IB_K04, K1IB_K05	C1-C5	Sem1-Sem3	N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy informatyki**
Name in English: **Foundations of Computer Science**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031101**
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 on mathematical analysis and logics

SUBJECT OBJECTIVES

C1. Introduction to algorithms
C2. Teaching of basics on non-object-oriented language of programming C
C3. Teaching and exercises in implementing algorithms in C.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has knowledge necessary to create efficient algorithms

PEK_W02 - Student has knowledge of syntax of non-object-oriented C programming language

II. Relating to skills:

PEK_U01 - Student can create algorithms and descript them in a form of block diagrams

PEK_U02 - Student can implement algorithms in non-object-oriented C programming language

III. Relating to social competences:

PEK_K01 - Student can work independently and in a team

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic concepts in informatics and algorithimics	2
Lec2	Introduction to algorithimics. Block diagrams of algorithms	2
Lec3	Examples of algorithms, creation of block diagrams for algorithms	2
Lec4	C language. Basic rules of coding in C. Types of variables. Arithmetic, logical, bit operators. Conditional statements in C language	2
Lec5	Loops, tables and methods in C	2
Lec6	Pointers in C language. Recursion. Examples of algorithms implementations.	2
Lec7	Structures in C.	2
Lec8	Test	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Creation of algorithm block diagrams - exercises	2
Lab2	Exercises in programming in C language using conditional instructions and logical operators	2
Lab3	Exercises in programming in C language using loops	2
Lab4	Exercises in programming in C language using functions	2
Lab5	Exercises in programming in C language using pointers. Application of passing of function argument by reference	2
Lab6	Exercises in programming in C language using data structures	2
Lab7	Implementation of unidirectional list in C language	2
Lab8	Implementation of bidirectional list in C language	2
Lab9	Implementation of tree structures in C language	2
Lab10	Implementation of selected algorithms in C language	2
Lab11	Self-project	8
Lab12	Credit for the course	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J.Gręboszc: Symfonia C++ standard, Edition 2000.
2. Wirth Niklaus: Algorithms + Data Structures = Programs. Prentice-Hall (1976)

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Foundations of Computer Science
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W21	C1	Lec1-Lec3	N1
PEK_W02	K1IB_W21	C2	Lec4-Lec7	N1
PEK_U01	K1IB_U23	C1	Lab1-Lab15	N2, N3
PEK_U02	K1IB_U23	C2, C3	Lab1-Lab15	N2, N3
PEK_K01	K1IB_K04	C3	Lab1-Lab15	N2, N3

SUBJECT SUPERVISOR

dr inż. Ewelina Świątek-Najwer tel.: 71 320-21-93 email: ewelina.swiatek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wprowadzenie do informatyki**
Name in English: **Introduction to computer science**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031102**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

C1. Familiarize students with the basics of creating algorithms and data processing
C2. Familiarize students with the basics of programming in C# language
C3. Familiarize students with the idea of procedural programming

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Can define and recognize basic data types, structures and an arithmetic and logical operations in C# programing language

PEK_W02 - Can explain basic sorting and searching algorithms

PEK_W03 - Can describe the issue of constructing classes, inheritance and polymorphism

II. Relating to skills:

PEK_U01 - Can formulate an algorithm for solving the real problem

PEK_U02 - Can create the program for data processing an analysis in C#

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Review of modern programming languages	3
Lec2	The idea of procedural programming	2
Lec3	Memory management in native and managed languages (C ++, C #, Java)	2
Lec4	Basic input/output operations in C #	2
Lec5	Data types, structures, containers, and basic arithmetic-logic operations in C#	4
Lec6	The idea of object oriented programming	2
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Introduction to the programming environment	2
Lab2	Input /output operations on the console and data files	4
Lab3	The application of basic structures and containers for storing data	4
Lab4	Implementation of simple sorting, browsing, searching algorithms using standard libraries	4
Lab5	Text file operations, searching, modifying text using the string class	4
Lab6	Dynamic memory allocation	4
Lab7	Create simple classes	4
Lab8	An inheritance and polymorphism	4
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. C#. Praktyczny kurs ,Marcin Lis, Wydawnictwo Helion, 2016
2. C# 6.0 w pigułce, O'Reilly, Wydawnictwo Helion, 2016

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Introduction to computer science
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W	K1IB_W21	C1, C2, C3	Lec1-Lec6	N1,N4
PEK_U	K1IB_U23	C1, C2, C3	Lab1-Lab8	N2,N3

SUBJECT SUPERVISOR

dr inż. Magdalena Żuk tel.: 320-21-93 email: magdalena.zuk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska 3D**
Name in English: **3D Engineering Graphics**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031103**
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. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Skills in the field of 3D modeling of the parts and assemblies
C2. Skills in range research and analysis of the parts and assemblies on the virtual models (virtual prototyping)
C3. Skills in range of technical drawing based on 3D models

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Students should be able to build 3D models of parts and assemblies
PEK_U02 - Students should be able to build 3D models of the parts and assemblies and verify models and their parameters
PEK_U03 - Students should be able to make 2D technical drawing based on a 3D model

III. Relating to social competences:

PEK_K01 - Student gains the skills to take responsibility for their work

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - Advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	Basic solid modeling - Advanced operations on 2D sketches - function relationships of parameters, solid modeling with rotation, solid editing - shell models	2
Proj5	Basic solid modeling - solid modeling with rotation, one and multibody modeling	2
Proj6	Advanced solid operations - sweep, loft, split, scroll	2
Proj7	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj8	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj9	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj10	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj11	Projekt zespołu: analiza poprawności funkcjonalnej zespołu (analizy parametrów, analiza kinematyczna, analiza kolizji) usuwanie błędów projektowych, analizy obciążeń	2
Proj12	The project of assembly: loads analysis, reactions and forces at the nodes, the presentation of the model	2
Proj13	The project of assembly: 2D technical drawings of parts - manufacturing parts drawings	2
Proj14	The project of assembly: 2D technical drawings of assembly - assembly drawings	2

Proj15	Completion of the course: work during classes	2
		Total hours: 30

TEACHING TOOLS USED

N1. project presentation
N2. problem discussion
N3. self study - preparation for project class
N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01	test, participate in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1]Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
[2]Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE

[1]http://autodesk-inventor-pl.typepad.com/
[2]http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
3D Engineering Graphics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between 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	K1IB_U07	C1, C2	Pr1 - Pr12	N1, N2, N3, N4

PEK_U03	K1IB_U07	C3	Pr13, Pr14	N3, N4

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Wizualizacja 3D w inżynierii biomedycznej**
Name in English: **3D visualization of biomedical engineering**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031104**
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. Requirement of knowledge of the course "Engineering Graphics - Descriptive Geometry"
2. Requirement of knowledge of the course "Engineering Graphics: Engineering Drawing "
3. Requirement of handling skills of computer hardware

SUBJECT OBJECTIVES

C1. Skills in the field of 3D modeling of the parts and assemblies
C2. Skills in range research and analysis of the parts and assemblies on the virtual models (virtual prototyping).
C3. Skills in range of visualisation of the parts and assemblies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student should be able to build 3D models of parts and assemblies.
PEK_U02 - Student should be able to build 3D models of the parts and assemblies and verify models and their parameters.
PEK_U03 - Student should be able to make visualisation of the parts and assemblies.

III. Relating to social competences:

PEK_K01 - Student gains the skills to take responsibility for their work.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to solid modeling - basic solid modeling operations, the rules of creation of a 2D sketch, fittings in the sketch (geometric and dimensional fittings)	2
Proj2	Basic solid modeling - Advanced operations on 2D sketches, solid modeling with extrude methods	2
Proj3	Solid Modeling Basics - operations on solids: chamfering, rounding, tilting walls, constructions (point, axis, plane), the creation of the ribs, the holes wizard, duplication of the solid operations	2
Proj4	Basic solid modeling - Advanced operations on 2D sketches - function relationships of parameters, solid modeling with rotation, solid editing - shell models	2
Proj5	Basic solid modeling - solid modeling with rotation, one and multibody modeling	2
Proj6	Advanced solid operations - sweep, loft, split, scroll	2
Proj7	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj8	The project of assembly: the concept, the construction of the parts by using the known solid modeling methods	2
Proj9	The project of assembly: parts assembling, parts editing in an assembly, a library of standard parts	2
Proj10	The project of assembly: parts modeling in the assembly environment, the adaptability of the parts	2
Proj11	Projekt zespołu: analiza poprawności funkcjonalnej zespołu (analizy parametrów, analiza kinematyczna, analiza kolizji) usuwanie błędów projektowych, analizy obciążeń	2
Proj12	The project of assembly: loads analysis, reactions and forces at the nodes, the presentation of the model	2
Proj13	The visualisation of the parts and assemblies.	2
Proj14	The visualisation of the parts and assemblies.	2
Proj15	Completion of the course: work during classes	2

	Total hours: 30

TEACHING TOOLS USED

N1. project presentation
N2. problem discussion
N3. self study - preparation for project class
N4. independent work on the computer under the tutor supervision

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01	test, participate in problem discussions
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]Stasiak Fabian, Autodesk Inventor. START!, ExpertBooks 2008
[2]Stasiak Fabian, Zbiór ćwiczeń Autodesk Inventor 2012, ExpertBooks 2012

SECONDARY LITERATURE
[1]http://autodesk-inventor-pl.typepad.com/
[2]http://autodesk-inventor-pl.blogspot.com/

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
3D visualization of biomedical engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between 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	K1IB_U07	C1, C2	Pr1 - Pr12	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Tadeusz Lewandowski tel.: 71 320-24-65 email: tadeusz.lewandowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zastosowanie programu MATLAB w zagadnieniach inżynierskich**
Name in English: **The application of MATLAB in Engineering**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031106**
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	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 of programming fundamentals
2. Mathematical knowledge, including issues from algebra and analysis

SUBJECT OBJECTIVES

C1. Learn the programming principles in Matlab for engineering and scientific calculations
C2. Acquire the ability to create scripts in Matlab for basic engineering calculations, data processing and visualization
C3. Acquire the ability to use Matlab for solving engineering problem

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - The student can define and recognize basic mathematical operations and programming structures in the Matlab computational .

PEK_W02 - The student is able to propose a method for solving a real problem using Matlab.

PEK_W03 - The student can explain operation of basic instructions in Matlab.

II. Relating to skills:

PEK_U01 - Can write a script twith functions, loops, conditional statements, mathematical operations, including operations on matrices and vectors.

PEK_U02 - Can use computer graphics tools to visualize calculation results and measurement data.

PEK_U03 - Can develop an algorithm for performing numerical calculations.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to Matlab package	2
Lec2	Variables, data types and strucures	2
Lec3	Vector and matrix operations	2
Lec4	Mathematical operations	2
Lec5	Loops and conditional statements	2
Lec6	Functions and scripts	2
Lec7	Data visualisation, two and three dimensional plots	4
Lec8	Data import and saving	2
Lec9	Basic statistical instructions	2
Lec10	Basic numerical procedures: approximation and interpolation	2
Lec11	Integration and numerical differentiation	2
Lec12	Solving equations and systems of equations	2
Lec13	The application of MATLAB in engineering	2
Lec14	Test	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction to Matlab package	2
Proj2	Simple operation on variables, vectors and matrixes	4
Proj3	Mathematical operations	2
Proj4	Apllication of loops, conditional statements and fucntions	4
Proj5	Data visualisation	4
Proj6	Application of Matlab for statistical calculations	4
Proj7	Basic numerical procedures	4

Proj8	Solving selected engineering problem using Matlab package	6
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (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 =		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Matlab dla naukowców i inżynierów, Rudra Pratap, Wydawnictwo Naukowe PWN, Warszawa 2015
2. Algorytmizacja i programowanie w Matlabie, Kazimierz Banasiak, Wydawnictwo BTC, Legionowo 2017
3. https://www.mathworks.com

SECONDARY LITERATURE

MATLAB. Praktyczny podręcznik modelowania, Waldemar Sradomski, Helion, 2015

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
The application of MATLAB in Engineering
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W	K1IB_W21	C1	Lec1-Lec13	N1
PEK_U	K1IB_U23	C2,C3	Proj1-Proj8	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Magdalena Żuk tel.: 320-21-93 email: magdalena.zuk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napęd hydrauliczny**
Name in English: **Hydraulic drive**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031107**
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	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. Student posses basic knowledge of fluid mechanics.
2. Student can solve diferential equations of mathematical models of hydraulis components and systems.
3. Student possess basic knowledge of hydrostatic drive systems.

SUBJECT OBJECTIVES

C1. Students acquaintance with simple and advanced hydraulic components.
C2. Students acquaintance with hydraulic drive systems.
C3. Students acquaintance with control and regulation methods selected parameters of hydraulic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - In the result of lesson student has knowledge for description of basic hydraulic systems in vehicles and heavy duty machines

PEK_W02 - In the result of lesson student has knowledge for design of hydraulic drive systems.

PEK_W03 - In the result of lesson student has knowledge for description hydraulic components for control or regulation selected parameters.

II. Relating to skills:

PEK_U01 - In the result of lesson student is able to design hydraulic system with control system - make suitable calculations and on their basis student is able to select suitable hydraulic components with proper dimensions and properties.

PEK_U02 - In the result of lesson student is able to make measurements of hydraulic components and systems and describe results and formulate proper conclusions.

PEK_U03 - In the result of lesson student is able to build and start and analyse working hydraulic and electrohydraulic drive system.

III. Relating to social competences:

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

PEK_K02 - Student can plan measurements and project preparation.

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements, list of references.	1
Lec2	Hydraulic systems properties.	2
Lec3	Speed regulation of hydraulic motor during fast and working movement.	2
Lec4	Hybrid hydraulic systems.	2
Lec5	Cavitation effect, calculaction of sucking line of hydraulic pump.	2
Lec6	Hydraulic brake systems.	2
Lec7	Hydraulic ABS system	2
Lec8	Hydraulic systems of travel mechanism.	2
Lec9	Steering servomechanisms.	2
Lec10	Multipumps systems.	2
Lec11	Synchronisation of hydraulic actuators movement.	2
Lec12	Hydropneumatic suspension, vibration dampers.	2
Lec13	Load-sensing hydraulic systems.	3
Lec14	Thermal balance of hydraulic systems.	2
Lec15	Design of hydraulic drive.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction - laboratory topics presentation, check form, requirements. Laboratory regulations and industry safety.	2
Lab2	Characteristic hydraulic power unit	2
Lab3	Methods of power losses reduction in hydraulic systems.	2
Lab4	Serial and papralel connection of hydraulic actuators.	2
Lab5	Sequence control of hydraulic motors.	2
Lab6	Methods of safety increasing in hydraulic systems - controlled check valve.	2
Lab7	Hydraulic systems with check valves and flow regulator.	2
Lab8	Functions of hydraulic accumulator.	2
Lab9	Control of hydraulic system with proportional reliefe valve.	2
Lab10	Load-sensing system tests.	2
Lab11	Comparison tests of speed control and regulation systems for hydraulic actuator.	2
Lab12	Volumetric control.	2
Lab13	Regulation with constant power in hydraulic system.	2
Lab14	Tests of dynamics processes in hydraulic systems.	2
Lab15	Check.	2
		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. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Kollek W.: Gear pumps (in polish). Zakład Narodowy im. Ossilońskich, Wrocław 1996.
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Osiecki A.: Hydrostatic drive of machines (in polish). WNT, Warszawa 1996.
Garbacik A., Szewczyk K.: Hydraulic drive and control. Basics of systems designing (in polish). Skrypt Politechniki Krakowskiej, Kraków 1998.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984

SECONDARY LITERATURE

Jędrzykiewicz Z.: Design of hydrostatic systems. Basics (in polish). Skrypt 1313. AGH Kraków 1992.
Pizoń A.: Hydraulic and electrohydraulic control and regulation system (in polish). WNT, 1987.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydraulic drive
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W12, K1IB_W20, K1IB_W22	C2 C3	Lec1 Lec4 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N1
PEK_W02	K1IB_W02, K1IB_W12, K1IB_W18, K1IB_W22	C1 C2	Lec1 Lec2 Lec5 Lec14 Lec15	N1 N3
PEK_W03	K1IB_W20, K1IB_W22	C1 C2 C3	Lec1 Lec3 Lec6 Lec7 Lec9 Lec11 Lec13	N1
PEK_U01	K1IB_U05, K1IB_U23, K1IB_U26	C1 C2 C3	Lab4 Lab9 Lab10 Lab11 Lab12 Lab14	N2 N4

PEK_U02 PEK_U03	K1IB_U09, K1IB_U23, K1IB_U24	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab12 Lab13	N2 N4
PEK_K01- PEK_K03	K1IB_K04, K1IB_K07	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N2 N4

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Hydrostatyczne układy napędowe**
Name in English: **Hydrostatic drive systems**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031108**
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	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. Student possess basic knowledge of fluid mechanics.
2. Student can solve diferential equations of mathematical models of hydraulis components and systems.
3. Student possess basic knowledge of classic mechanics.

SUBJECT OBJECTIVES

C1. Students acquaintance withbasic lows of hydrostatic drive systems.
C2. Students acquaintance with hydraulic components and their working principle.
C3. Students acquaintance with configuration of simple hydrostatic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - In the result of lesson student should be able to define requirements for hydraulic fluids of hydrostatic drive systems.

PEK_W02 - In the result of lesson student should be able to describe working pinciple of basic components of hydrostatic system.

PEK_W03 - In the result of lesson student should be able to characterize of working of basic hydrostatic drive systems.

II. Relating to skills:

PEK_U01 - In the result of lesson student should be able to analyse operation of hydrostatic components and systems.

PEK_U02 - In the result of lesson student should be able to calculate basics parameters of hydrostatic drive system.

PEK_U03 - In the result of lesson student should be able to interpret basic characteristic of hydrostatic components and systems.

III. Relating to social competences:

PEK_K01 - In the result of lesson student should possess ability of information analysis with diferent complex level.

PEK_K02 - In the result of lesson student should possess ability of objective argument evaluate, efficient explanation and justification own opinion with help of knowledge of hydrostatic drive systems.

PEK_K03 - In the result of lesson student should possess ability of follow the rules valid in academic environment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, lecture range presentation, check form, requirements. Basic symbols of hydraulic components.	2
Lec2	Hydraulic fluids - 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 instalation 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	Positive displacement pumps - systematics, characteristics, efficiencies.	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	Hydraulic motors - classification, characteristics, efficiencies.	2
Lec13	Designing of the hydrostatic power systems.	2

Lec14	The heat balance of hydraulic systems. Components and systems of the microhydraulics.	2
Lec15	Exam	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Experimental determination properties of working fluid - bulk modulus.	2
Lab2	Experimental determination resistance character in hydraulic pipes - linear resistance.	2
Lab3	Local resistences in hydraulic systems. Orifice as a local resistance - cavitation effect.	2
Lab4	Experimental determination pump characteristic.	2
Lab5	Static characteritics of conventional directional control valve.	2
Lab6	Characteristics of the throttle valve	2
Lab7	Determination of viscosity of selected liquids.	2
Lab8	Cavitation characteristics of displacement units.	2
Lab9	Filtration and liquid purity.	2
Lab10	Resistances in straight and curved microcables	2
Lab11	Methods of damping the pressure pulsations in fluid systems	2
Lab12	Evaluation of the ac power / compressor acoustic state in the silence chamber.	2
Lab13	Static and dynamic characteristics of the maximum valve	2
Lab14	Serial and parallel coupling of resistances	2
Lab15	Completion of the course	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Kollek W.: Basics of design of hydraulic drives and control (in polish). Oficyna Wydaw. Polit. Wrocławskiej, 2004 .
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Osiecki A.: Machines hydrostatic drive (in polish). WNT, Warszawa 1996.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.

SECONDARY LITERATURE

Szydelski Z.: Hydraulic drive and control in vehicles and heavy duty machines. WNT 1980.
Kollek W.: Basics of hydraulic drive theory. NOT, Wrocław 1978.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Hydrostatic drive systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W08, K1IB_W12	C1	Lec1,Lec2,Lec3, Lec4	N1,N2
PEK_W02	K1IB_W02, K1IB_W18, K1IB_W20	C2	Lec5,Lec6,Lec7, Lec8,Lec9	N1,N2
PEK_W03	K1IB_W02, K1IB_W20, K1IB_W22	C3	Lec10,Lec11, Lec12,Lec13, Lec14,Lec15	N1,N2
PEK_U01	K1IB_U05, K1IB_U09	C1,C2	Lab1,Lab2, Lab4,Lab5, Lab7,Lab9	N3,N4,N5

PEK_U02	K1IB_U09, K1IB_U23, K1IB_U24	C3	Lab3,Lab4, Lab5,Lab10, Lab11,Lab14	N3,N4,N5
PEK_U03	K1IB_U23, K1IB_U24, K1IB_U26	C1,C3	Lab6,Lab8, Lab12,Lab13, Lab15	N3,N4,N5
PEK_K01-PEK_K03	K1IB_K04, K1IB_K07	C1-C3	Lab1-Lab15	N1-N5

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-27-16 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy wspomagania operacji medycznych**
Name in English: **Systems for computer aided surgery**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031109**
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				
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 and abilities in matrix calculations
2. Basic knowledge in physics

SUBJECT OBJECTIVES

C1. Introduction to computer aided surgery systems functionality
C2. Acquiring knowledge on data analysis algorithms applied for computer aided surgery
C3. Acquring knowledge on newest technologies of imaging and visualization for computer aided surgery

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has basic knowledge on computer aided surgery systems functionality
PEK_W02 - Student has basic knowledge on algorithms applied in computer aided surgery systems
PEK_W03 - Student has basic knowledge on new imaging and visualization technologies in computer aided surgery systems

II. Relating to skills:
PEK_U01 - Student can elaborate presentation on course subject basing on self found materials from polish and english sources
PEK_U02 - Student can discuss on course subject
PEK_U03 - Student can solve problems related to computer aided surgery applying tracking systems, design algorithms of surgical instruments localization and reference frames.

III. Relating to social competences:
PEK_K01 - Student can work independently and in a group

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Analysis of disadvantages in traditional approach in surgery. Introduction to computer aided surgery systems	2
Lec2	Types of tracking systems applied in computer aided surgery	3
Lec3	Image-aided and imgae-free surgery. Algorithms in computer aided surgery: transformations of coordinate systems, matching procedure, instruments calibration.	3
Lec4	Computer aided orthopaedic surgery: advantages, systems examples	2
Lec5	Computer aided ENT surgery: advantages, systems examples	2
Lec6	Computer aided oncological surgery in maxillo-facial region: advantages, systems examples	2
Lec7	Computer aided neurosurgery: advantages, systems examples	2
Lec8	New technologies in computer aided surgery: virtual and augmented reality	3
Lec9	New methods of imaging in computer aided surgery (fluorescence imaging, elastografia, navigated free hand ultrasound probe)	3
Lec10	Medical images fusion - algorithms, applications examples	2
Lec11	Accuracy of computer aided surgery systems	2
Lec12	Advantages and disadvantages of computer aided surgery	2
Lec13	Test	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Simulators and training platforms to educate medical staff	2
Proj2	Principles of tracking systems functionality, examples of systems and accuracy analysis	2

Proj3	Examples of computer aided orthopaedic surgery systems	2
Proj4	Examples of computer aided ENT surgery systems	2
Proj5	Examples of computer aided neurosurgery systems	2
Proj6	Examples of virtual and augmented reality applications in computer aided surgery	2
Proj7	Examples of intraoperative imaging (fluorescence, fluoroscopy, ultrasound)	2
Proj8	Credit for the course	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

F1	PEK_U01, PEK_U02, PEK_K01	evaluation of student's presentation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Fujie, Masakatsu G. (Ed.): Computer Aided Surgery, Springer, 2016.

2. Scuderi, Giles R., Tria, Alfred J. (Eds.): Minimally Invasive Surgery in Orthopedics, Springer 2010

SECONDARY LITERATURE

1. Editors: Furht, Borko (Ed.): Handbook of Augmented Reality, Springer 2011.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Systems for computer aided surgery
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W06, K1IB_W16, K1IB_W22	C1	Lec1, Lec2, Lec4, Lec5, Lec6, Lec7, Lec11, Lec12	N1
PEK_W02	K1IB_W06, K1IB_W16, K1IB_W22	C2	Lec3, Lec10	N1
PEK_W03	K1IB_W06, K1IB_W16, K1IB_W22	C3	Lec8, Lec9	N1
PEK_U01	K1IB_U20, K1IB_U26, K1IB_U32, K1IB_U33	C1-C3	Proj1 - Proj8	N2
PEK_U02	K1IB_U20	C1-C3	Proj1 - Proj8	N2
PEK_U03	K1IB_U20	C1-C3	Proj1 - Proj8	N2
PEK_K01	K1IB_K10	C1-C3	Proj1 - Proj8	N2

SUBJECT SUPERVISOR

dr inż. Ewelina Świątek-Najwer tel.: 71 320-21-93 email: ewelina.swiatek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Systemy nawigacji na sali operacyjnej**
Name in English: **Tracking systems in the operating room**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031110**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge and abilities in matrix calculations
2. Basic knowledge in physics

SUBJECT OBJECTIVES

C1. Introduction to tracking systems functioning in the operation room
C2. Introduction to tracking system selection to particular surgery, its conditions, required precision and applied imaging
C3. Introduction to adjusting the instruments to work with navigation system

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has basic knowledge on computer tracking systems for aiding surgeries
PEK_W02 - Student knows the rules for selection of system to control location and orientation of surgical instruments to particular conditions of surgery, required precision and applied imaging
PEK_W03 - Student knows the mechanisms of instruments adaptation and methods to calibrate instruments for precise localization of tip of tool and orientation of selected axis of tool in the surgical area.

II. Relating to skills:
PEK_U01 - Student can elaborate presentation on course subject basing on self found materials from polish and english sources
PEK_U02 - Student can discuss on course subject
PEK_U03 - Student can solve problems related to computer aided surgery applying tracking systems, design algorithms of surgical instruments localization and reference frames.

III. Relating to social competences:
PEK_K01 - Student can work independently and in a group

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	History of navigation in technology. Need for application of tracking in various technology areas, particulary in medicine and surgery	2
Lec2	Overview of tracking systems. Mechanical tracking systems: robotic arm, gyroscope, accelerometers, other	2
Lec3	Overview of tracking systems. Optical tracking systems: visibile light and infrared light	2
Lec4	Overview of tracking systems. Electromagnetic tracking systems: stable and variable field	2
Lec5	Overview of tracking systems. Ultrasound tracking systems	2
Lec6	Test 1	2
Lec7	Rules to select a tracking system to surgery conditions. Examples of computer aided surgery systems	6
Lec8	Rules to adapt surgical instruments to work with tracking system	2
Lec9	Methods to calibrate surgical instruments for precise localization and orientation of tool axis in the operating area	4
Lec10	Analysis of advantages and disadvantages of tracking systems in the operation room. Evaluation of precision, time of surgery, need for adaptation of operation room and staff training	4
Lec11	Test 2	2
		Total hours: 30
Form of classes – Project		Number of hours

Proj1	Comparative analysis of existing optical tracking systems in the visible and infrared light. Analysis of accuracy, disadvantages and advantages of applications. Examples of adaptation in the operation room and ideas to apply such systems in other surgeries.	2
Proj2	Comparative analysis of existing electromagnetic tracking systems. Analysis of accuracy, disadvantages and advantages of applications. Examples of adaptation in the operation room and ideas to apply such systems in other surgeries.	2
Proj3	Comparative analysis of existing ultrasound tracking systems. Analysis of accuracy, disadvantages and advantages of applications. Examples of adaptation in the operation room and ideas to apply such systems in other surgeries.	2
Proj4	Comparative analysis of existing mechanical tracking systems: accelerometers, gyroscopes and mechanical arms. Analysis of accuracy, disadvantages and advantages of applications. Examples of adaptation in the operation room and ideas to apply such systems in other surgeries.	2
Proj5	Analysis of calibration methods for navigated surgical tools. Own methods of calibrations for exemplary instruments	4
Proj6	Discussion about advantages and disadvantages of tracking system application in the operation room.	2
Proj7	Course credit	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test 1
F2	PEK_W02, PEK_W03	test 2
P = (F1+F2)/2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Fujie, Masakatsu G. (Ed.): Computer Aided Surgery, Springer, 2016.
2. Scuderi, Giles R., Tria, Alfred J. (Eds.): Minimally Invasive Surgery in Orthopedics, Springer 2010

SECONDARY LITERATURE

internet sources: webpages of manufacturers

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Tracking systems in the operating room
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W06, K1IB_W16, K1IB_W22	C1	Lec 1- Lec 6, Lec 10	N1
PEK_W02	K1IB_W06, K1IB_W16, K1IB_W22	C2	Lec 7	N1
PEK_W03	K1IB_W06, K1IB_W16, K1IB_W22	C3	Lec 8 - Lec 9	N1
PEK_U01	K1IB_U20, K1IB_U26, K1IB_U32, K1IB_U33	C1-C3	Proj. 1 - Proj 7	N2
PEK_U02	K1IB_U20	C1-C3	Proj. 1 - Proj 7	N2
PEK_U03	K1IB_U20	C1-C3	Proj. 1 - Proj 7	N2
PEK_K01	K1IB_K10	C1-C3	Proj. 1 - Proj 7	N2

SUBJECT SUPERVISOR

dr inż. Ewelina Świątek-Najwer tel.: 71 320-21-93 email: ewelina.swiatek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projekt urządzenia biomechanicznego**
Name in English: **Design of the biomechanical device**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031111**
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	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. Student has basic knowledge in the designig of components and assemblies of the mechanical devices, construction of the control systems for machines and devices and human biomechanics.
2. Student has mastered the ability to represent mechanical components and assemblies using technical drawings (handwritten and AutoCad).
3. Student can act systematically carrying out the task entrusted.

SUBJECT OBJECTIVES

C1. Mastering the skills of designing complex biomechanical devices.
C2. Mastering the ability to work in a team.
C3. Increase knowledge of the devices designing particularly for biomedical engineering devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can design complex biomechanical device designing the necessary components and assemblies and choosing the finished systems and assemblies.
PEK_U02 - Student is able to work with other participants in the designing and construction process, performing various roles in the team.
PEK_U03 - Student can perform the technical documentation of the projected device and evaluate its innovativeness on the basis of an analysis of existing solutions.

III. Relating to social competences:

PEK_K01 - Student can identify and take into account in its action priorities for implementation tasks undertaken.
PEK_K02 - Student can work in a team.
PEK_K03 - Student can present the effects of his work using modern presentation techniques.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction - formulation of the problem requiring a technical solution (biomedical engineering); information on the principles of the project realisation and evaluation; preliminary discussion on the designing tasks; homework # 1 - prepare a short information about the selected method for finding a solution to a design problem and identifying existing solutions.	3
Proj2	A discussion of the techniques for finding a solution concept and choosing one to implement in a design team. Formulation of the project's initial assumptions and evaluation criteria. Conduct a session to generate conceptual solutions to the problem and choose the concept to implement. Homework # 2 - structuring the design process (developing a proposal for an algorithm describing the design process).	3
Proj3	Analysis of the prepared algorithms and setting checkpoints of the design process. Selecting the design teams. Homework # 3 - detailed analysis of the design task (elaboration of proposals for design assumptions and evaluation criteria for the solution of a given design task).	3
Proj4	Generating solution concept of the individual tasks and choice conception to realization. Homework 4 - develop a schedule of tasks and the list of information necessary to perform a given task, and provided by the other teams participating in the project.	3
Proj5	Determining of the project schedule, choosing the task coordinator, presentation of the solutions adopted for the particular tasks. Homework # 5 - work in teams.	3
Proj6	Teamwork, exchange of the informations, presentation of the project progress, consultations.	3
Proj7	Continued work in teams, a presentation of the proposed detailed solutions and calculations (including FEM).	3
Proj8	Continued work in teams, a presentation of the proposed detailed solutions and calculations (including FEM).	3

Proj9	Presentation of the progress of work in teams - teams evaluation.	3
Proj10	Continued work in teams, presentation of proposed detailed solutions and evaluation of their integration possibility.	3
Proj11	Continued work in teams, analysis of the materials and technology of the designed components and assemblies.	3
Proj12	Continued work in teams, cost analysis of the projected equipment prototype production, presentation of the teams results.	3
Proj13	Continuation of the teams results presentation Forming of the final report editorial team. Verification of the documentation of individual designing tasks.	3
Proj14	Continuation of the documentation review. Discussion on the possibility of the proposed device development, the scope of the prototype examination, or select a different solution to the problem.	3
Proj15	Presentation of the project, the evaluation of its innovation, project evaluation	3
		Total hours: 45

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. problem discussion
N3. project presentation
N4. report preparation
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_K01	Participation in discussions; evaluation of the homeworks: F1 = (Z1 + ... + Z4) / 4
F2	PEK_U01, PEK_U03, PEK_K02	Preparation for classes and evaluation of the calculation part - at least sufficient (3.0)
F3	PEK_U02, PEK_K03	Presentation of the project - evaluation at least sufficient (3.0)
P = 1/10*F1+3/5*F2+3/10F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bedziński R., i in. Biomechanika i inżynieria rehabilitacyjna, t. 5, Biocybernetyka i Inzynieria Biomedyczna, red. Nalęćz M., PAN, Warszawa, 2004.
[2] Dietrych M., Podstawy konstrukcji maszyn, PWN, Warszawa, 1989.
[3] Pawlicki G., Podstawy inżynierii medycznej, Wyd. PW, Warszawa, 1997.
[4] Prochowski L., Mechanika ruchu, WKiŁ, Warszawa, 2016.

SECONDARY LITERATURE

[1] Mazanek E. (red.), Przykłady obliczeń z podstaw konstrukcji maszyn, WNT, Warszawa, 2008.
[2] Bober T., Zawadzki J., Biomechanika układu ruchu człowieka, Wyd. BK, Wrocław, 2006.
[3] Pahl G., Beitz W., Nauka konstruowania, WNT, Warszawa, 1984.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of the biomechanical device
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between 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	K1IB_U05, K1IB_U08, K1IB_U13, K1IB_U17, K1IB_U26, K1IB_U32	C1, C2, C3	Proj1-Proj 14	N1-N5
PEK_K01, PEK_K02, PEK_K03	K1IB_K04, K1IB_K05, K1IB_K10	C2	Proj1-Proj 14	N1-N5

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projekt urządzenia wspomagającego lokomocję człowieka**
Name in English: **Design of the human locomotion supporting device**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031112**
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. Student has basic knowledge in the designig of components and assemblies of the mechanical devices, construction of the control systems for machines and devices and human movement system biomechanics.
2. Student has mastered the ability to represent mechanical components and assemblies using technical drawings (handwritten and AutoCad).
3. Student can act systematically carrying out the task entrusted.

SUBJECT OBJECTIVES

C1. Mastering the skills of the complex biomechanical devices designing, in particular supporting the human locomotion..
C2. Mastering the ability to work in a team.
C3. Increase knowledge of the devices designing particularly for biomedical engineering devices supporting human locomotion.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student can design complex biomechanical device designing the necessary components and assemblies and choosing the finished systems and assemblies.
PEK_U02 - Student is able to work with other participants in the designing and construction process, performing various roles in the team.
PEK_U03 - Student can perform the technical documentation of the projected device and evaluate its innovativeness on the basis of an analysis of existing solutions.

III. Relating to social competences:

PEK_K01 - Student can identify and take into account in its action priorities for implementation tasks undertaken.
PEK_K02 - Student can work in a team.
PEK_K03 - Student can present the effects of his work using modern presentation techniques.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction - formulation of the problem requiring a technical solution (in support of the human locomotion); information on the principles of the project realisation and evaluation; preliminary discussion on the designing tasks; homework # 1 - prepare a short information about the selected method for finding a solution to a design problem and identifying existing solutions.	3
Proj2	A discussion of the techniques for finding a solution concept and choosing one to implement in a design team. Formulation of the project's initial assumptions and evaluation criteria. Conduct a session to generate conceptual solutions to the problem and choose the concept to implement. Homework # 2 - structuring the design process (developing a proposal for an algorithm describing the design process).	3
Proj3	Analysis of the prepared algorithms and setting checkpoints of the design process. Selecting the design teams. Homework # 3 - detailed analysis of the design task (elaboration of proposals for design assumptions and evaluation criteria for the solution of a given design task).	3
Proj4	Generation of the solution concept of the individual tasks and choice conception to realization. Homework 4 - develop a schedule of tasks and the list of information necessary to perform a given task, and provided by the other teams participating in the project.	3
Proj5	Determining of the project schedule, choosing the task coordinator, presentation of the solutions adopted for the particular tasks. Homework - work in teams.	3
Proj6	Teamwork, exchange of the informations, presentation of the project progress, consultations.	3
Proj7	Continued work in teams, a presentation of the proposed detailed solutions and calculations (including FEM).	3
Proj8	Continued work in teams, a presentation of the proposed detailed solutions and calculations (including FEM).	3

Proj9	Presentation of the progress of work in teams - teams evaluation.	3
Proj10	Continued work in teams, presentation of proposed detailed solutions and evaluation of their integration possibility.	3
Proj11	Continued work in teams, analysis of the materials and technology of the designed components and assemblies.	3
Proj12	Continued work in teams, cost analysis of the projected equipment prototype production, presentation of the teams results.	3
Proj13	Continuation of the teams results presentation Forming of the final report editorial team. Verification of the documentation of individual designing tasks.	3
Proj14	Continuation of the documentation review. Discussion on the possibility of the proposed device development, the scope of the prototype examination, or select a different solution to the problem.	3
Proj15	Presentation of the project, the evaluation of its innovation, project evaluation	3
		Total hours: 45

TEACHING TOOLS USED

N1. problem discussion
N2. self study - preparation for project class
N3. project presentation
N4. report preparation
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_K01	Participation in discussions; evaluation of the homeworks: F1 = (Z1 + ... + Z4) / 4
F2	PEK_U01, PEK_U03, PEK_K02	Preparation for classes and evaluation of the calculation part - at least sufficient (3.0)
F3	PEK_U02, PEK_K03	Presentation of the project - evaluation at least sufficient (3.0)
P = 1/10*F1+3/5*F2+3/10F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] Bedziński R., i in. Biomechanika i inżynieria rehabilitacyjna, t. 5, Biocybernetyka i Inzynieria Biomedyczna, red. Nalęćz M., PAN, Warszawa, 2004.
[2] Dietrych M., Podstawy konstrukcji maszyn, PWN, Warszawa, 2009.
[3] Pawlicki G., Podstawy inżynierii medycznej, Wyd. PW, Warszawa, 1997.
[4] Prochowski L., Mechanika ruchu, WKiŁ, Warszawa, 2016.

SECONDARY LITERATURE

[1] Mazanek E. (red.), Przykłady obliczeń z podstaw konstrukcji maszyn, WNT, Warszawa, 2008.
[2] Bober T., Zawadzki J., Biomechanika układu ruchu człowieka, Wyd. BK, Wrocław, 2006.
[3] Pahl G., Beitz W., Nauka konstruowania, WNT, Warszawa, 1984.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of the human locomotion supporting device
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U	K1IB_U05, K1IB_U08, K1IB_U13, K1IB_U17, K1IB_U26, K1IB_U32	C1,C2,C3	Proj1-Proj14	N1-N5
PEK_K	K1IB_K04, K1IB_K05, K1IB_K10	C2	Proj1-Proj14	N1-N5

SUBJECT SUPERVISOR

dr inż. Ludomir Jankowski tel.: 71 320-21-91 email: Ludomir.Jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechatronika w medycynie**
Name in English: **Mechatronics in medicine**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031115**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge on electronics, mechanics, software engineering

SUBJECT OBJECTIVES

C1. Knowledge on existing mechatronics solutions for medicine and surgery, methods of designing setups aiding human living functions and methods of controlling for these systems
C2. Abilities to select design of setups aiding human living functions
C3. Abilities to select methods of controlling the human living functions

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student knows existing mechatronics solutions for medicine and surgery
PEK_W02 - Student has knowledge on construction of setups aiding human living functions
PEK_W03 - Student has knowledge on algorithms and methods of controlling setups aiding human living functions

II. Relating to skills:

PEK_U01 - Student can select construction of mechatronic solutions to aid lifing functions
PEK_U02 - Student can select controlling algorithms for mechatronic solutions to aid living functions
PEK_U03 - Student can prepare scientific presentation on mechatronic solutions for medicine basing on self-found polish and english materials

III. Relating to social competences:

PEK_K01 - Student can work independently and in a group

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Overview of mechatronic solutions in medicine	2
Lec2	Detection of biosignals: electromiography, mechanomiography, electroencephalography, electrocardiography. Setup constructions. Signals characterization. Methods of data analysis	3
Lec3	Application of biosignals for control of prostheses - EMG	2
Lec4	Brain-computer interface	2
Lec5	Application of computer navigation systems for motion tracking	2
Lec6	Overview of robotic solutions in surgery	2
Lec7	Test	2
		Total hours: 15
Form of classes – Seminar		Number of hours
Sem1	Mechanical construction and control method for uppper limb prostheses	2
Sem2	Mechanical construction and control method for lower limb prostheses	2
Sem3	Examples of medical robots for soft tissue surgery (DaVinci, Robin Heart, Zeus)	3
Sem4	Examples of medical robots for orthopaedic surgery (Caspar, RoboDoc, BlueBelt Technologies)	3
Sem5	Examples of medical robots for neurosurgery (CyberKnife, Evolution 1, JHU - KineMedic, MARS robot (SmartAssist), Minerva, MRI compatible Robot, neuroArm, NeuRobot, NeuroMaster, NeuroMate, Raven, RAMS, Steady Hand System, MEdical RObotics DAtabase, PathFinder, AlphaRobot, Cranio)	3
Sem6	Examples of rehabilitation robots (RENUS-1, PARO, Keepon, Kobie, Rabie, RoboPanda, K-Junior, Khepera, Koala, Pioneers, Cog, Kismet, Pomi, Actroid, Kaspar, Aibo)	2
Sem7	Artificial organs: dialysis systems	2
Sem8	Artificial heart	2

Sem9	Artificial sensory organs	3
Sem10	Construction and control of exoskeletons	2
Sem11	Computerized training systems	2
Sem12	Miniaturized sensors - nanochips	2
Sem13	Credit for the course	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M. Darowski, T. Orłowski, A. Weryński, J. M. Wójcicki: Sztuczne narządy. Biocybernetyka i Inżynieria Biomedyczna 2000. Tom 3, Akademicka Oficyna Wydawnicza Exit
2. Roman Maniewski, Maciej Nałęcz i inni.: Biopomiary, Biocybernetyka i Inżynieria Biomedyczna 2000. Tom 2, Akademicka Oficyna Wydawnicza Exit

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W06, K1IB_W15, K1IB_W22, K1IB_W24	C1	Lec1-Lec6	N1
PEK_W02	K1IB_W15, K1IB_W24	C1	Lec1-Lec6	N1
PEK_W03	K1IB_W06	C1	Lec1-Lec6	N1
PEK_U01	K1IB_U18	C2	Sem1-Sem12	N2
PEK_U02	K1IB_U17	C3	Sem1-Sem12	N2
PEK_U03	K1IB_U32	C1, C2, C3	Sem1-Sem12	N2
PEK_K01	K1IB_K04	C1, C2, C3	Sem1-Sem12	N2

SUBJECT SUPERVISOR

dr inż. Ewelina Świątek-Najwer tel.: 71 320-21-93 email: ewelina.swiatek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Programowanie w C++**
Name in English: **Programming in C++**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031117**
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	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. Basic knowledge of C language (non-object-oriented)

SUBJECT OBJECTIVES

C1. Introduction to object-oriented programming in C++
C2. Teaching and excercises of practical object-oriented programming in C++
C3. Teaching of self work on software projects

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - Student has basic knowledge on object-oriented programming in C++

PEK_W02 - Student knows syntax of C++ language and applied optimization mechanisms

II. Relating to skills:

PEK_U01 - Student can develop software project in object-oriented C++ language

PEK_U02 - Student can implement code in object-oriented C++ language

III. Relating to social competences:

PEK_K01 - Student can work independently and in a group

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to object-oriented programming. Advantages of object-oriented programming	2
Lec2	Functions names overloading	2
Lec3	Dynamic allocation of memory	2
Lec4	Types of classes in C++ and their implementations	2
Lec5	Methods in classes: private, public and protected	2
Lec6	Friendly classes	2
Lec7	Polymorphism	2
Lec8	Test 1	2
Lec9	Inheritance	2
Lec10	Unions	2
Lec11	Project patterns	2
Lec12	Encapsulation	2
Lec13	Multithreading	2
Lec14	Interfaces	2
Lec15	Test 2	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Configuration of programming environment	2
Proj2	Excercises on functions names overloading and dynamic allocation of memory	2
Proj3	Excercises on implementation of various types of classes with various types of methods	6
Proj4	Excercises on implementation of friendly classes	2
Proj5	Application of polymorphism	2
Proj6	Excercises of inheritance implementation	2

Proj7	Excercises on unions implementation	2
Proj8	Excercises using projects patterns	2
Proj9	Excercises on implementation of encapsulation	2
Proj10	Excercises on implementation of multithreading	2
Proj11	Excercises on implementation of interfaces	2
Proj12	Self-project	4
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test 1
F2	PEK_W02	test 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_U02, PEK_K01	self-project note
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

- Nicolai M. Josuttis: C++. Programowanie zorientowane obiektowo. Vademecum profesjonalisty, Helion
- Jerzy Gręboszz: Symfonia C++ standard Programowanie w języku C++ orientowane obiektowo, Wydawnictwo: Edition 2000

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Programming in C++
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1IB_W21	C1	Lec1-Lec7	N1
PEK_W02	K1IB_W21	C1	Lec9-Lec14	N1
PEK_U01	K1IB_U23	C2, C3	Lab1_Lab12	N2, N3
PEK_U02	K1IB_U23	C2, C3	Lab1_Lab12	N2, N3
PEK_K01	K1IB_K04	C2, C3	Lab1_Lab12	N2, N3

SUBJECT SUPERVISOR

dr inż. Ewelina Świątek-Najwer tel.: 71 320-21-93 email: ewelina.swiatek@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Praca dyplomowa**
Name in English: **Diploma thesis**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **IBM031152**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)				1	
Number of hours of total student workload (CNPS)				390	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				13	
including number of ECTS points for practical (P) classes				13	
including number of ECTS points for direct teacher-student contact (BK) classes				13.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Passed courses from previous semesters (1 -6). Possible deficit ECTS points not bigger than allowed by the resolution of the Council of Mechanical Faculty.

SUBJECT OBJECTIVES

C1. Conducting analyzes and research on the topic of diploma thesis.
C2. Gathering material for the individual chapters of diploma thesis, editing of diploma thesis
C3. Preparing the presentation of diploma thesis results.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Deepening the skills acquired in completed courses.
PEK_U02 - Ability to draw up a timetable for thesis work.

III. Relating to social competences:

PEK_K01 - Ability to work independently according to accepted timetable.

PROGRAMME CONTENT

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. 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, PEK_K01	problem discussion
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Agreed with the promoter, suitable for the topic of work

SECONDARY LITERATURE

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

Subject educational effect	Correlation between 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	K1IB_U26, K1IB_U29, K1IB_U32, K1IB_U34	C1, C2, C3		N1, N2
PEK_K01	K1IB_K07	C1, C2, C3		N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Jarosław Filipiak tel.: 71 320-21-50 email: jaroslaw.filipiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napędy elektryczne**
Name in English: **Electrical drives**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **IBR041028**
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. He has basic knowledge of physics, including electrodynamics and electromagnetism.
2. He has basic knowledge in electrical engineering, with particular emphasis on DC and AC circuits.
3. Can correctly and effectively apply knowledge from the differential and integral calculus functions of one variable to the qualitative and quantitative analysis of mathematical problems related to the studied engineering discipline.

SUBJECT OBJECTIVES

C1. Familiarize students with basic eletrical machines in modern motors.
C2. To familiarize students with basic theories of motion theory and the fundamentals of control theory in electrical drives.
C3. To acquaint the student with the methods of control in modern mechatronic systems, including medical devices.
C4. Acquisition of practical knowledge and skills of research and analysis of the operation of selected automated propulsion systems with DC and AC motors.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He has knowledge of the basic components of the converter and its operating conditions and is able to define and describe them. Can distinguish and explain the principles of operation and static characteristics of basic electric motors and work machines.

PEK_W02 - It can characterize and explain the different methods of controlling the speed of DC motors and alternating current motors.

PEK_W03 - He can discuss the basic structures of speed control and torque of DC and AC motors in open and closed systems.

II. Relating to skills:

PEK_U01 - Is able to calculate the basic quantities characterizing the work of DC motors and AC.
He can choose measuring instruments for various power motors used in selected propulsion systems

PEK_U02 - It can measure the static and dynamic characteristics of different propulsion systems, analyze and interpret the results.

PEK_U03 - He can perform simulations of the selected drivetrain in Matlab / Simulink based on the supplied utility software. He can perform analysis of the results of simulation and experimental studies of selected DC and AC drives controlled in closed systems.

III. Relating to social competences:

PEK_K01 - He is able to work together and work in a team with different roles.

PEK_K02 - He can think and act in an entrepreneurial way.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Definition and components of the propulsion system, characteristics of motors and work machines, areas of operation of the propulsion system	2
Lec2	Equation of motion, dynamic and fixed states, static equilibrium. The effect of the type of mechanical connection on the form of the motion equation.	2
Lec3	DC motor drive systems.	2
Lec4	Linear controllers. Anty wid - up systems.	2
Lec5	Cascade control of DC motor drive system. Theory and dynamical properties.	2
Lec6	Induction motor drives. Construction and operation principle, static characteristics, speed control methods, braking methods.	2
Lec7	Scalr control of induction motor drive system.	2
Lec8	Vector control of induction motor - DTC and DFOC methods.	4
Lec9	Brushless DC machines.	2
Lec10	Electric drives for special vehicles.	2
Lec11	Electric drives and position control systems in complex mechatronic systems.	2
Lec12	Electrical drives with Elastic coupling.	2
Lec13	Sensorless induction motor drives with increase safety.	2
Lec14	Development trends in electric propulsion. Examination.	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction - general information about labolatory set-up; An overview of the principles of measuring electrical and mechanical quantities with analog and digital instruments; OSH training.	2
Lab2	Shaping the characteristics of a DC motor in various operating states.	2
Lab3	Study of a DC drive system with a powered by a reversible rectifier.	2
Lab4	Testing of starter systems of induction motors.	2
Lab5	Scalar control of induction motor with pover converter.	2
Lab6	Matlab Simulink for modeling complex propulsion systems.	2
Lab7	Linear controllers - anty wind-up systems.	2
Lab8	Synthesis of 2nd order dynamic object control using module criterion and symmetry.	2
Lab9	Control of power convertr using PWM method.	2
Lab10	Cascade control of DC motor.	2
Lab11	DC motor drive system with elasting coupling.	2
Lab12	Field Oriented Control of Induction Motor.	2
Lab13	Direct Torque Control of Induction Motor.	2
Lab14	Electrical drives with synchronous motors - PMSM	2
Lab15	Examination	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	written exam
F2	PEK_W01 - PEK_W03, PEK_K01	presence at lectures
P = 0.1*F2+0.9*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	preparation for laboratory class
F2	PEK_U01 - PEK_U03	Activity in class
F3	PEK_U01 - PEK_U03	report preparation
P = 0,6*F1+0,3*F2+0,1*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Napęd elektryczny, praca zbiorowa pod red. Z. Grunwalda, WNT, 1987
Napęd elektryczny – laboratorium, praca zbiorowa pod red. T. Orlowskiej-Kowalskiej, Oficyna Wyd. P.Wr., 2000
Kaźmierkowski M.P., Tunia H., Automatyka napędu przekształtnikowego. PWN, 1987

SECONDARY LITERATURE

Koczara W., Wprowadzenie do napędu elektrycznego, Oficyna Wydawnicza Politechniki Warszawskiej, 2012
Zawirski K. Automatyka napędu elektrycznego. PP
Orlowska-Kowalska T., Bezczujnikowe układy napędowe z silnikami indukcyjnymi. Oficyna Wydawnicza P.Wr., Wrocław, 2003

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Electrical drives
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W	K1IB_W17, K1IB_W18	C1, C2. C3, C4	Lec1-Lec14	N5
PEK_U	K1IB_U11, K1IB_U17, K1IB_U18	C1, C2, C3, C4	Lab1-Lab15	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Mateusz Dybkowski email: mateusz.dybkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYKI OBCE**
Name in English:
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **JZL100707, JZL100708**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U	K1IB_U33	wg kart przygotowanych przez SJO. (Katalog ogólnouczelniany)		
PEK_K	K1IB_K01	wg kart przygotowanych przez SJO. (Katalog ogólnouczelniany)		

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza matematyczna I**
Name in English: **Mathematical Analysis I**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
Subject code: **MAT001644**
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	2.1			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Exposition of basic elementary functions and their properties.
C2. Exposition of basic notions and theorems of differential calculus of functions of a single variable.
C3. Introduction of the concept of the definite integral, its basic properties and methods of calculation.
C4. Presentation of practical applications of methods of differential and integral calculus of functions of a single variable.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - knows the graphs and properties of basic elementary functions,
PEK_W02 - knows basic notions and theorems of differential calculus of functions of a single variable,
PEK_W03 - knows the concept of the definite integral, its properties and the basic applications.

II. Relating to skills:

PEK_U01 - can solve typical equations and inequalities with elementary functions,
PEK_U02 - can examine a function and draw its graph,
PEK_U03 - PEK_U3 can evaluate typical indefinite integrals and calculate definite integrals,
PEK_U4 can apply differential and integral calculus to solve practical problems.

III. Relating to social competences:

PEK_K01 - understands the need for systematic and independent work on mastery of course material.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Definition of a function. Basic examples: linear, quadratic and polynomial functions. Rational functions. Composition of functions. Transformations of graphs of functions.	3
Lec2	Injective functions. The inverse function and its graph. Power and exponential functions and their inverses. Properties of logarithms.	2
Lec3	Trigonometric functions. Unit (trigonometric) circle. Inverse trigonometric functions.	2
Lec4	Sequences of real numbers. Finite and infinite limit of a sequence. Basic theorems on limits of sequences. Indeterminate expressions. The number e.	3
Lec5	The limit of a function at a point and the limit at infinity. Examples of the limits of certain indeterminate expressions. Asymptotes.	2
Lec6	Continuity of a function at a point and on an interval. Basic properties of continuous functions. Approximate solutions of equations.	2
Lec7	The derivative of a function. Geometrical and physical interpretations of the derivative. Tangent line. Differential of a function. Derivatives of basic elementary functions. Differentiation rules.	2
Lec8	Lagrange’s theorem. Intervals of monotonicity of a function. De l’Hospital’s rule.	2
Lec9	Local and global extrema. Examples of optimization problems.	2
Lec10	Definition and basic properties of indefinite integral. Basic rules. The substitution rule and integration by parts.	2
Lec11	Definition and basic properties of definite integral. Fundamental theorem of calculus (Newton-Leibniz theorem).	2
Lec12	Applications of integral calculus (e.g. average value of a function, area of a flat region, volumes of solids of revolution, arc length etc.)	2
Lec13	Integration of rational and trigonometric functions.	2

Lec14	Examples of applications of methods of mathematical analysis of a single variable (e.g. Taylor's theorem , convexity and inflection points of a function or other applications typical for the field of study).	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Elements of mathematical logic (logical connectives, quantifiers). Determination of the domain of a function. Even and odd functions.	2
Cl2	Composition of functions. Transformations of graphs of functions. Polynomial and rational equations and inequalities.	2
Cl3	The inverse function. Typical equations and inequalities with exponential and logarithmic functions.	2
Cl4	Trigonometric and inverse trigonometric functions. Unit (trigonometric) circle. Typical trigonometric equations and inequalities.	2
Cl5	Monotonicity and boundedness of sequences. Computing proper and improper limits of sequences.	2
Cl6	Limits of functions. Asymptotes.	2
Cl7	Continuity of a function. Approximate solutions of equations.	2
Cl8	Derivative of a function. Rules of differentiation. Tangent line. Differentials and their applications.	2
Cl9	De l'Hospital's rule. Intervals of monotonicity of a function.	2
Cl10	Determining local and global extrema of a function.	2
Cl11	Evaluation of indefinite integrals of elementary functions. Integration by parts and by substitution.	2
Cl12	Calculating definite integrals. Area of a flat region as an application of definite integral.	2
Cl13	Applications of definite integral.	2
Cl14	Integration of rational and trigonometric functions.	2
Cl15	Test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. Lecture - traditional method.
N2. Classes - traditional method (problems sessions and discussion).
N3. Student's self-study with the assistance of mathematical packages.
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1]G. Decewicz, W. Żakowski, Matematyka, Cz.1, WNT, Warszawa 2007.
[2]M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2015.
[3]M. Gewert, Z. Skoczylas, Analiza matematyczna 1. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2015.
[4]W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. I, PWN, Warszawa 2006.

SECONDARY LITERATURE

[1]F. Leja, Rachunek różniczkowy i całkowy, PWN, 2012.
[2]R. Leitner, Zarys matematyki wyższej dla studiów technicznych, cz.1-2, WNT, Warszawa 2006.
[3]M. Zakrzewski, Markowe wykłady z matematyki. Analiza, Oficyna Wydawnicza GiS, Wrocław 2013.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mathematical Analysis I
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W	K1IB_W01, K1IB_W32	C1-C4		N1-N4
PEK_U	K1IB_U01	C1-C4		N1-N4

PEK_K	K1IB_K01	C1-C4		N1-N4

SUBJECT SUPERVISOR

dr Jolanta Sulkowska email: jolanta.sulkowska@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK ZAJĘCIA SPORTOWE**
Name in English: **Block of Sports Activities**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **WFW000000BK**
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)					
Form of crediting		Crediting with grade			
Group of courses					
Number of ECTS points					
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Classes	Number of hours

Cl1		2
		Total hours: 2

TEACHING TOOLS USED

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

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE
SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Block of Sports Activities
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K	K1IB_K10	wg kart przygotowanych przez SWFiS (katalog ogólnouczelniany)		wg kart przygotowanych przez SWFiS (katalog ogólnouczelniany)

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Jak zbudować firmę Bio-Tech**
Name in English: **How to build high-tech enterprise**
Main field of study (if applicable): **Biomedical Engineering**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **ZMZ000390**
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. lack (course for beginners)

SUBJECT OBJECTIVES

C1. Obtaining knowledge on building of start-up
C2. Knowing instruments (strategies, models and methods) regarding building of start-up

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows how to build start-up
PEK_W02 - Familiarity with instruments (concepts, methods, models) of building start-up

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Student is able to think and to act in the enterprising way
PEK_K02 - Student understands legal-social and economic effects of engineering activity

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to entrepreneurship	1
Lec2	Start-ups and spin-offs/outs	2
Lec3	Business strategy (vision, mission. Core values, external analysis, internal analysis, choosing strategic options, evaluation of strategic options	4
Lec4	Business models	1
Lec5	Model Customer Development	1
Lec6	Recognising Market	1
Lec7	Market verification	1
Lec8	Creating Customer Base	1
Lec9	Building start-up	1
Lec10	Colloquium	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

F1	PEK_W01 PEK_W02	Colloquium
P = F1=1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. S. Blank, B. Dorf, „Podręcznik Startupu. Budowa wielkiej firmy krok po kroku”, Wydawnictwo Helion, Gliwice 2013.
2. Grażyna Gierszewska, Barbara Olszewska, Jan Skonieczny, „Zarządzanie strategiczne dla inżynierów”, PWE, Warszawa 2013
3. A. Maurya, „Metoda Running Lean. Iteracja od planu A do planu, który da Ci sukces”, Wydawnictwo Helion, Gliwice 2013.
4. E. Ries, „Metoda Lean Startup”, Wydawnictwo Helion, Gliwice 2012.
5. W. Ksprzak, K. Pelc, „Innowacje. Strategie techniczne i rozwojowe”, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2012.

SECONDARY LITERATURE

1. Walter Isaacso, „Steve Jobs”, Insignis Media, Kraków 2011
2. Leander Kahney, „Jony Ive. Geniusz, który zaprojektował najsłynniejsze produkty Apple”, Insignis Media, Kraków 2014

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
How to build high-tech enterprise
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Biomedical Engineering

Subject educational effect	Correlation between subject 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	K1IB_W30, K1IB_W31	C1, C2	Lec1-Lec9	N1, N2
PEK_K01 PEK_K02	K1IB_K06, K1IB_K08	C1, C2	Lec1-Lec9	N1, N2

SUBJECT SUPERVISOR

Jan Skonieczny email: jan.skonieczny@pwr.edu.pl