Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Fizyka**
Name in English: **Physics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
Subject code: **FZP001067 (FZP001070)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15	15		
Number of hours of total student workload (CNPS)	90	60	30		
Form of crediting	Examination	Crediting with grade	Crediting with grade		
Group of courses					
Number of ECTS points	3	2	1		
including number of ECTS points for practical (P) classes		2	1		
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Competences in subjects Mathematics and Physics with Astronomy for graduate of the Secondary School.

SUBJECT OBJECTIVES

C1. C1. Gain basic knowledge from selected areas of classical and modern Physics.
C1.1. Principles of kinematics, dynamics and law of conservation of impulse, energy and momentum.
C1.2. Vibration and wave motion.
C1.3. Basics of Phenomenological and Statistical Physics.
C1.4. Electrostatics, Magnetostatics and Electromagnetic Induction.
C1.5. Specific theory of relativity.
C1.6. Quantum physics, physics of the atom, physics of the atomic nucleus.
C2. C2. Gain skills on qualitative understanding of selected principles and laws of Classical and Modern Physics as well as quantitative analysis selected phenomena from this area of knowledge.
C3. C3. Acquire experience of basic measurements methods and techniques of selected physical quantities and gain skills in:
C3.1. Performing basic measurements of physical quantities.
C3.2. Numerical analysis and processing of experimental data with evaluation of measurement uncertainties.
C3.3. Preparation of written report from performed measurements with application of used software.
C4. C4. Development of social competences including emotional intelligence involving the ability to work in a student group. Fixation of sense of responsibility and honesty in academe and society.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - PEK_W01 knows: a) basics of the vector calculus in the Cartesian coordinate system, c) basics of the unit analysis, the physical quantity concept and the rules of instant estimation of values; the importance of physics in the surrounding world and the everyday life as well as discoveries and achievements of a selected classical and modern physics for the progress of the civilization,
PEK_W02 - has a basic knowledge on the dynamics of the progressive movement, has a knowledge on: a) the conception of the mass and force, b) the condition of applicability of the Newton laws and the correct writing of the equations of motion, c) the formulation of the second law of dynamics using the concept of momentum, d) the formulation of the momentum conservation law.
PEK_W03 - has a knowledge on fields of conservative forces, is able to determine the following physical quantities: the work and the power of a mechanical force, the kinetic and potential energies; knows: a) the law of work and kinetic energy, b) relationship between conservative forces and the potential energy, c) is able to formulate the law of conservation of the mechanical energy.
PEK_W04 - is able to define: the torque, the angular momentum and the moment of inertia for the material points, the system of the material points and the rigid body, the kinetic energy of the system of the material points and the rigid body in the rotary movement, knows the second law of the dynamics for the rotation of a rigid body about a fixed axis, is able to formulate and prove the law of the angular-momentum conservation for: the single particle, the system of the material points, and the rigid body.
PEK_W05 - has a knowledge on the dynamics of the periodic motion, and the detailed knowledge of: a) the harmonic motion of the simple and physical pendula, the particle performing the harmonic oscillations in the vicinity of the balanced state, b) the damped oscillations, c) the forced oscillations and the mechanical resonance.
PEK_W06 - has a knowledge of the wave motion and has the detailed knowledge of: a) basic properties of the mechanical waves (including the sound) and their sources, b) the monochromatic plane wave equations and basic physical quantities of the wave motion, c) velocities connected to the wave motion, d) relations between the wave velocity (including the sound) and the elastic properties of the medium, the mechanical energy transported by the waves, e) the transportation of the mechanical energy by the waves, f) the dependence between the wave intensity and the distance from the wave source, g) the Doppler effect, h) the acoustic-wave interference and the clumping.
PEK_W07 – has a basic knowledge on the principles of the phenomenological thermodynamics, knows basic thermodynamic concepts, the heat transportation and its description, the functions of the thermodynamic state, the thermodynamic processes (the ideal gas, the ideal gas equation), has detailed knowledge on; a) the

thermodynamic temperature scale, b) the conversions of the ideal gas, c) the internal energy and the entropy of the system, d) the work made by gas and the heat exchange in thermodynamic processes of the ideal gas, e) methods of evaluation of the changes of the entropy of the ideal gas, f) the thermodynamics of the heat engines and their efficiency in the direct and reverse cycles, g) the Bolzmann-Planck entropy (the statistical interpretation of the entropy), h) the Bolzmann (barometric formula) and Maxwell distribution functions, i) the average square velocity of the particles of the ideal gas, the microscopic interpretation of the temperature and pressure of the ideal gas; the principle of the equal partition of the heat energy.
PEK_W8 - knows basic mathematical tools of the vector-field analysis: the operators of gradient, divergence, rotation, knows the Gauss-Ostrogradskii and Stokes theorems.
PEK_W9 - has a basic knowledge on the properties of the gravitational and electro-magnetic fields, has a knowledge on the generation of the gravitational, electrostatic, and magnetostatic fields; has a knowledge on the magnetostatics particularly in; a) the impact of the magnetic field on the electric charges and the current carrying conductors (the Lorentz force), b) the Biot-Savart and Ampere laws and their applications for determining the intensity and induction of the magnetic fields of the selected sources (linear and circular current-carrying conductors, coil), c) the definition of unit of the magnetic field intensity; is able to describe quantitatively the potential energy of the magnetic dipole and the torque acting on the magnetic dipole in an external magnetic field; has a knowledge on the energy and the energy density of the electromagnetic field. Furthermore, he/she has a knowledge on the electromagnetic induction phenomenon (knows the Faraday law and the Lenz rule), has a knowledge on the Maxwell equations (the integral form of them) and the material equations.
PEK_W10 has a basic knowledge on the properties of the electromagnetic waves (including the light) and their applications, in particular, knows the concept of the flat monochromatic electromagnetic wave and: a) the wave spectrum, b) the dependence of the refration index on the relative electric and magnetic permeabilities of the medium; has knowledge on the energy and momentum transportation with the waves, the Poynting vector, the interaction of the incident wave with a surface; has a basic knowledge concerning: a) dispersion phenomena, the total internal reflection, method of polarizing the light, the Malus law, b) the light interference in thin film systems, c) the light diffraction, d) the resolution efficiency of the optical systems (the Reyleigh criterion), e) aberrations in the optical systems and animal (human) eyes and correction methods.
PEK_W11- has a knowledge on the special theory of relativity and its applications. In particular he/she knows and understands the Einstein's postulates, the Lorentz transformations and resulting consequences (time dilation, length contraction). Has a basic knowledge on the relativistic dynamics, in particular, knows the concepts of the relativistic momentum of the particle, the relativistic kinetic an total energies, knows the relativistic equation of motion and the relativistic momentum and energy relationship, the equivalence of the mass and the energy and the need to apply the results of the special theory of relativity in the global positioning systems.
PEK_W12- has a basic knowledge on the fundamentals of the quantum physics, the physics of the atom, the solid state physics and some applications; has a detailed knowledge on: a) the black-body radiation, b) the Bohr model of the Hydrogen atom (the energy and angular momentum quantization) and quantum energy levels of the electron in the atom (Franck-Hertz experiment), c) the fotoelectric and Compton effects, d) the interaction of the light with the matter and the fundamentals of the laser working, e) particle-wave duality of the light and the elementary particles (de Broglie hypothesis, the matter waves), f) the Heisenberg uncertainty principle, g) the wave function and its interpretation, h) the (stationary and time dependent) Schrodinger equations, i) the Schrodinger equation of the particle in the infinitely-deep potential wall, j) the quantum tunelling and its applications, k) spin and spin magnetic moment of the electron (Stern-Gerlach experiment), m) the Pauli exclusion principle, quantum numbers of the electrons in the atoms, electronic configurations of the elements of the Mendeleev table, n) specific properties of solids
PEK_W13- has a knowledge on the fundamentals of the physics of the atomic nucleus, in particular, knows indicators that characterize the nucleus and the nuclear forces, has a knowledge concerning a) the bound energy of the nucleons and its importance for the nuclear energy generation, nuclear synthesis b) the laws of the the radiative decay, c) date determination using the isotopes, d) physical principles of the imaging with nuclear magnetic resonance.
PEK_W14- has a knowledge on the basics of the elementary-particle physics and astrophysics, in particular, knows: a) the basic types of the fundamental interactions, b) the standard model of the elementary particles (leptons, quarks, hadrons, Higgs Boson); c) the structure and types of the matter in the Universe and the standard model of the Universe expansion (the big band, the Hubble law, the cosmic background radiation, the dark matter, the predictable future of the Universe).

II. Relating to skills:
PEK_U01 - PEK_U01 - is able to: a) efficiently apply vector calculus used in physics, b) define and use the conceptions of the instantaneous velocity, the tangential, radial and total acceleration and the orientations of them

in the space.
PEK_U02 - can: a) prove the law of the momentum conservation, b) correctly formulate the vector equation of motion and its scalar version in the Cartesian coordinate system, c) solve (ie determine time dependence of basic kinematic quantities) scalar equations of motion taking into account the initial conditions, d) solve problems concerning the collision dynamics using the principle of the momentum conservation.
PEK_U03 - is able to; a) verify the conservative nature of the forces, b) derive and apply the law of conservation of the mechanical energy, c) apply the law of conservation of the mechanical energy to solve problems, d) calculate the mechanical work and the power of the fixed and variable forces, the kinetic and potential energies, changes in the kinetic energy of the particle / body with the theorem on the work and the kinetic energy, e) determine the force vector knowing the analytic form of the potential energy.
PEK_U04 – can derive the law of conservation of momentum of the system of material points, correctly write and solve the equation of the rotational motion with fixed rotation axis and of the translational-rotational motion of the rigid body. Can determine: a) torque, b) angular momentum of single particles and rigid bodies, c) kinetic energy of the rotational motion, work and power in the rotational motion, e) change of the kinetic energy of the rotational motion using the theorem on the work and the kinetic energy; moreover can apply the law of the conservation of the angular momentum to writing and solving specific problems in the rigid-body dynamics.
PEK_U05 - is able to properly describe and analyze equations of periodic motion of: a) pendulums: mathematical, physical as well as particles under potential force, performing small oscillations around the position of equilibrium, b) damping oscillations, c) sinusoidal driving force oscillations. Can determine: periods of vibration, time dependencies of kinematic and dynamic quantities of periodic vibrations, characterize the phenomenon of mechanical resonance and explain its importance (positive and negative) in mechanical elements.
PEK_U06 - can: a) write the wave equation for the monochromatic mechanical plane wave, b) determine values of the basic physical quantities of the wave motion (length and frequency, wave vector, repetition rate, phase velocity, velocity of media particles), c) quantitatively characterize the energy transported by the mechanical waves, and the Doppler, interference and beats phenomena, d) interpret and calculate the loudness level of the sound sources.
PEK_U07 – is able to use the first and the second law of thermodynamics for quantitative and qualitative description of different processes of ideal gas and determine values: a) the heat added to the system, the work done by the ideal gas, changes of the internal energy in gas processes, b) the efficiency of the heat engines working in the direct or reverse cycle. Can: analyze and draw graphics representing processes of the ideal gas, derive the Mayer formula and the equation of the adiabatic process, calculate the heat transfer between materials. He/she can: a) evaluate the dependence of the pressure on the height using the Bolzmann distribution function, b) derive the mean square value of the velocity of the particles in an ideal gas, c) derive the state equation of the ideal gas, d) apply the principle of the equal partition of the heat energy, e) explain the microscopic nature of the temperature and pressure of the ideal gas.
PEK_U08 – can efficiently use mathematical tools of the vector-field analysis to solve simple problems of the electromagnetism.
PEK_U09 – is able to: a) point out the sources of the gravitational and electromagnetic fields, b) derive the Newton and Coulomb laws from the Gauss laws and show the potential character of the gravitational/electrostatic field, c) apply the knowledge of the gravitational field for quantitative and qualitative characteristics of the field, produced by the mass or the system of masses. In particular has skills enabling the calculation of the vectors of the gravitational field intensity for the spherically symmetric mass distribution and the gravitational potential energy, the potential energy of electric/magnetic dipole and torque that acts on the dipole in an external electromagnetic field, the density of energy of the electromagnetic field, on the basis of the Gauss law. He/she is able to describe: a) the magnetostatic field quantitatively (determine the magnetic induction and intensity using the Biot-Savart and Ampere laws) for specific sources of the field (linear and circular current carrying conductor, the coil), b) the motion of the electric charges in the magnetic field (the cyclotron, a selector of the particle velocity, the mass spectrometer), c) determine the force that acts on the conductor with the current placed in the magnetic field, d) to determine the unit of the electric current intensity; has skills enabling the application of the knowledge on the electromagnetic induction to the qualitative and quantitative characterization of the current generators; is able to clarify the non-potential character of the electric field induced by the variable magnetic field; to explain the meaning of the Lenz rule and to characterize the phenomenon of the electromagnetic induction in the context of the energy conservation law; is able to correctly and precisely explain the meaning of the Maxwell equations (in the integral form) and material equations.
PEK_U10 – is able to apply the knowledge on the physics of the electromagnetic waves and optics (the laws of the geometric optics) to explain and quantitatively analyze specific optical phenomena (the total internal reflection, the interference, the diffraction, the polarization, the dispersion) as well as to quantitatively characterize the resolution ability of optical instruments, wave field, and the energy transportation by waves.

PEK_U11 – is able to apply the knowledge of the special theory of relativity for interpretation of its consequences, in particular to characterize relationships between kinematic and dynamic quantities, measured in two moving relative to each other inertial frames of reference. In particular can a) explain longitudinal, relativistic Doppler effect, b) explain the physical meaning of the formula E = mc2, c) quantitatively analyze the kinematics and dynamics of the linear motion of body under influence of constant force, d), justify the need of applying the special theory of relativity in the global positioning satellite systems.
PEK_U12 – can apply the knowledge on the fundamentals of the quantum physics to the analysis of simple problems and to the quantitative interpretation of specific topics and physical effects which take place on the nanometer or subnanometer scale of the lengths. In particular he/she is able to: a) present the quantization of the energy levels in the Bohr model of the Hydrogene atom, b) explain the importance of the fotoelectric effect and of the experiments by Compton, Franck-Hertz, Stern-Gerlach in the development of the quantum mechanics, c) explain the particle nature of the light, d) explain the particle-wave duality of the light and of the elementary particles, e) explain the wave-function interpretation, f) solve one-dimensional stationary Schrodinger equation of the particle in an infinite potential wall, g) point out the applications of the tunneling effect.
PEK_U13 – can: a) explain physics of the energy generation in the nuclear reactors and tokomaks on the basis of the nucleon-bounding energy, b) indicate and characterize positive and negative aspects of the nuclear energetics, c) characterize the types of the radiative decays, d) characterize the fusion of light nuclea insight the Sun, e) estimate the age of the materials on the basis of the radiative decay law, f) explain physical aspects of imaging the tissues and organs using the magnetic resonance
PEK_U14 – can characterize: a) types of the fundamental interactions, b) the standard model of the elementary particles, c) structure and types of the matter in the Universe, e) the standard model of the expanding Universe.
PEK_U15 – can use simple apparatus to measure values of physical quantities and perform simple and complex measurements of physical quantities using the manual of the test-bench.
PEK_U16 – can elaborate the results of measurements, perform the analysis of the measurement uncertainties and edit the report of the measurements made in the Laboratory of the Fundamentals of Physics using the knowledge PEK_W01 - PEK_W14, skills PEK_01 - PEK_U14, and computational tools (the text editors, office packages, computational environments).

III. Relating to social competences:

PEK_K01 - PEK_K01 – Searching and objective and critical analysis of information or arguments, rational explanation and justification of their point of view using the knowledge of physics.
PEK_K02 – understanding the need for self- assessment and self-education, including improvement of attention concentration on important issues, developing the capacity for self-knowledge and acquired skills and ability to self- assessment, self-control and responsibility for the results of actions taken.
PEK_K03 – independent and creative thinking
PEK_K04 – work in a team and relying on improving methods for the selection of a strategy to optimally solve the tasks assigned to the group.

PROGRAMME CONTENT	
Form of classes – Lecture	Number of hours

Lec1	Lec 1 Organizational matters. The physical quantities, their role in everyday life and in civilization progress. The bases of kinematics, reference frames, curvilinear motion. (1h) Lec 1,2 Physical quantities. Bases of kinematics and Newton's dynamics. Equations of motion (2h) Lec 2 Work and mechanical energy. The law of conservation of mechanical energy (1h) Lec 3 Dynamics of the material points system. The principle of conservation of momentum. Collisions.(2h) Lec 4,5 Kinematics and dynamics of rotational motion of the rigid body. The principle of conservation of the angular momentum. (4h) Lec 6,7 Oscillations around stable equilibrium state. (3h) Lec 7,8 Basic properties of mechanical waves. Elements of acoustics. Wave energy. (2h) Lec 8,9 First and second principles of thermodynamics. Ideal gas conversions. Entropy. Real gases (2h) Lec 9,10,11 Gravitational interactions, central field, potential and energy of gravitational field. (2h) Lec 11,12 Magnetostatic field. Interaction of magnetic field with current currying conductor. (2h) Lec 12,13 Electromagnetic induction. Maxwell equations. Electromagnetic waves. (3h) Lec 14 Elements of relativistic kinematics and dynamics. (2h) Lec 15 Physics of the atom, atomic nucleus, elementary particles. Elements of astrophysics (2h)	30
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Cl. 1, 2, 3,4 Solving selected problems of dynamics of the linear, curvilinear, and rotary motion, with use of mechanical work, kinetic and potential energy, and laws of conservation of mechanical energy, momentum and angular momentum. (4h) Cl. 5 Test - evaluation of educational effects relating to skills: PEK_U01, PEK_U06, PEK_K01, PEK_K03 (1h) Cl. 6,7,8 Analyzing and solving problems of kinematics and dynamics of oscillations and wave movement.(3h) Cl. 9,10 Solving problems of thermodynamics. (2h) Cl. 11,12 Analyzing and solving problems of electrodynamics and theory of relativity. (2h) Cl. 13,14 Analyzing and solving problems of quantum physics. (2h) Cl. 15 Test – evaluation of educational effects relating to skills: PEK_U07, PEK_U12, PEK_K01, EK_K03 (1h)	15
		Total hours: 15
Form of classes – Laboratory		Number of hours

Lab1	Lab 1 Introduction to LPF: issues of organization and conducting of classes, introduction of student 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. Performance of simple measurements.(2h) Lab 2 Making measurements using analog and digital gauges. Statistical processing of simple and complex results of measurements, estimation of simple and complex measurement uncertainty, graphical presentation of the results of measurements and measurement uncertainty, preparation of the report.(2h) Lab 3 Making measurements of selected mechanical quantities +++, developing reports (2h) Lab 4 Making measurements of selected thermodynamical quantities +++, developing reports (2h) Lab 5 Making measurements of selected electromagnetic quantities +++, developing reports (2h) Lab 6 Making measurements of selected optical or quantum quantities +++, developing reports (2h) Lab 7 Supplementary classes, crediting test concerning principles of calculation of measurements uncertainties (2h) Lab 8 Crediting of laboratory exercises. (1h)	15
		Total hours: 15

TEACHING TOOLS USED

N1. N1. Lecture with multimedia presentations (Power Point), demonstrations and showing physical phenomena. N2. Exercises - solving and discussing physical problems. N3. Laboratory exercises - performance and discussion of measurements. Processing of measurements results and estimation of their uncertainties. Evaluation of reports from performed laboratory measurements. N4. Own work - solving problems in frames of preparation to exercises. N5. Own work - preparation of laboratory experiments and measurements. N6. Own work - individual studies of material presented during lecture. N7. Consultations. N8. Laboratory exercises and problems solving - written tests.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01-PEK_W14	Written/oral exam.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U14 PEK_K01 - PEK_K03	Oral answers, discussions, written tests.
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_U14 PEK_K01 - PEK_K04	Oral answers, written tests and reports of laboratory exercises.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] D. Halliday, R. Resnick, J. Walker, Podstawy fizyki, tomy 1.2., Wydawnictwo Naukowe PWN, Warszawa 2003; J. Walker, Podstawy fizyki. Zbiór zadań, PWN, Warszawa 2005 i 2011.

[2] Paul A. Tipler, Ralph A. Llewellyn, Fizyka współczesna, Wydawnictwo Naukowe PWN, Warszawa 2012;

[3] I.W. Sawieliew, Wykłady z fizyki, tom 1. i 2., Wydawnictwa Naukowe PWN, Warszawa, 2003.

[4] W. Salejda, Fizyka a postęp cywilizacyjny (45,35 MB), Metodologia fizyki (1,1MB); available at http://www.if.pwr.wroc.pl/index.php?menu=studia&left_menu=jkf

SECONDARY LITERATURE

[1] J. Massalski, M. Massalska, Fizyka dla inżynierów, cz. 1. i 2., WNT, Warszawa 2008.

[2] J. Orear, Fizyka, tom 1. i 2., 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;

[5] K. Sierański, K. Jezierski, B. Kołodka, Wzory i prawa z objaśnieniami, cz. 1. i 2., Oficyna Wydawnicza SCRIPTA, Wrocław 2005; K. Sierański, J. Szatkowski, Wzory i prawa z objaśnieniami, cz. 3., Oficyna Wydawnicza SCRIPTA, Wrocław 2008.

[6] Witryna dydaktyczna Instytutu Fizyki PWr w zakładce Jednolite kursy fizyki znajdują się zalecane e-materiał dydaktyczne.

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. 12. z 2008 r.

[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.A. Serway, Physics for Scientists and Engineers with Modern Physics, 8th Ed., Brooks/Cole, Belmont 2009;

[4] [4] P.A. Tipler, G. Mosca, Physics for Scientists and Engineers, Extended Version, W. H. Freeman 2007.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Physics** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechanical Engineering and Machine Building**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01÷ PEK_W14	K1MBM_W02	C1, C2, C4	Lec1-Lec9	N1, N6
PEK_W07	K1MBM_W06	C1, C2, C4	Lec8, Lec9	N1, N6
PEK_W01÷PEK_W04	K1MBM_W07	C1, C2, C4	Lec1-Lec5	N1, N6
PEK_U01÷PEK_U14	K1MBM_U01	C1, C2	Cl1-Cl5	N1, N2, N4, N6, N7
PEK_U15÷PEK_U16	K1MBM_U12	C3	La1-La8	N3, N5, N6, N7, N8
PEK_U01÷PEK_U16	K1MBM_U04	C1, C2, C3, C4	Cl1-Cl15 La1-La8	N4, N5, N6
EK_U01÷PEK_U05	K1MBM_U08	C1, C2	Cl1-Cl8	N2, N4, N6, N7, N8
PEK_U07	K1MBM_U10	C1, C2	Cl9, Cl10	N2, N4, N6, N7, N8
PEK_K01÷PEK_K04	K1MBM_K01, K1MBM_K02, K1MBM_K03, K1MBM_K04, K1MBM_K05, K1MBM_K06, K1MBM_K07	C4	Lec1-Lec5 Cl1-Cl15 La1-La8	N1÷N8
PEK_U06, PEK_U07	K1MBM_U06	C2	Cl7	N2, N4, N7, N8
PEK_U08, PEK_U09	K1MBM_U06	C2	La1-La8	N3, N5, N7, N8
PEK_K01 PEK_K04	K1MBM_K02	C1, C2, C3	Lec1-Lec13 Cl1-Cl8 La1-La8	N1-N7

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK KURSÓW HUMANISTYCZNYCH**
Name in English: **Block of humanistic courses**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
Subject code: **HMH100035BK**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		30
		Total hours: 30

TEACHING TOOLS USED
N1.

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

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE
SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **Block of humanistic courses** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechanical Engineering and Machine Building**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1MBM_W29, K1MBM_W30	wg kart opracowanych przez SNH		wg kart opracowanych przez SNH

SUBJECT SUPERVISOR
doc. dr inż. Grzegorz Pękalski tel.: 320-27-61 email: grzegorz.pekalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK KURSÓW HUMANISTYCZNYCH (Ochrona własności)**
Name in English:
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **HMH100035BK.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		15
		Total hours: 15

TEACHING TOOLS USED

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

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE
SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Mechanical Engineering and Machine Building**				
Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W	K1MBM_W28	wg kart opracowanych przez SNH		wg kart opracowanych przez SNH

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **BLOK JĘZYKI OBCE**
Name in English:
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
Subject code: **JZL1007007, 100708**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K1MBM_U03, K1MBM_U36, K1MBM_U42, K1MBM_U44	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO
PEK_K01	K1MBM_K01	wg kart przygotowanych przez SJO		wg kart przygotowanych przez SJO

SUBJECT SUPERVISOR

doc. dr inż. Grzegorz Pękalski tel.: 320-27-61 email: grzegorz.pekalski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Algebra z geometrią analityczną**
Name in English: **Algebra and Analytic Geometry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
Subject code: **MAT001405 (MAT001433)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Exposition of basic theorems and algorithms concerning the theory of linear equations.
C2. Exposition of basic notions concerning matrix calculus, eigenvalues and eigenvectors of matrices.
C3. Exposition of rudiments of the theory of complex numbers, polynomial and rational functions.
C4. Exposition of rudiments of analytic geometry in R3.

SUBJECT EDUCATIONAL EFFECTS
I. Relating to knowledge: PEK_W01 - PEK_W01 knows basic methods of solving systems of linear equations, PEK_W02 knows basic properties of complex numbers, PEK_W03 knows basic algebraic properties of polynomials, PEK_W04 knows characterizations of lines, planes and conic sections, PEK_W05 knows definitions of eigenvalues and eigenvectors of matrices **II. Relating to skills:** PEK_U01 - PEK_U01 can add and multiply matrices and calculate determinants, PEK_U02 can solve systems of linear equations, PEK_U03 can carry out calculations with use of complex numbers, PEK_U04 can find line and plane equations in the space R3. **III. Relating to social competences:**

PROGRAMME CONTENT		
Form of classes – Lecture		Number of hours
Lec1	Mathematical induction. Newton’s binomial formula.	1
Lec2	The notion of a matrix. Operations on matrices. Transposition. Examples of matrices (triangular, symmetric, diagonal etc.).	2
Lec3	The determinant of a matrix. The Laplace expansion. Cofactor of an element of a matrix. Minors. Properties of determinants. Calculation of determinants by elementary row and column operations. Cauchy’s theorem. Nonsingular matrix.	3
Lec4	Inverse matrix. Computation of inverse matrix by cofactors or by elementary row operations. Properties of inverse matrices. Matrix equations. Rank of a matrix. Applications of determinants, their connections with rank and invertibility.	2
Lec5	Systems of linear equations. Rouché–Capelli theorem. Cramer’s formulas. Gaussian elimination. Solving arbitrary systems of linear equations.	3
Lec6	Complex numbers. Operations on complex numbers in algebraic form. Complex conjugate. Modulus. Argument.	2
Lec7	Geometric interpretation of a complex number. Polar form of a complex number. De Moivre’s formula. Roots of complex numbers.	2
Lec8	Polynomials. Polynomial remainder theorem. Fundamental theorem of algebra. Roots of polynomials with real coefficients.	2
Lec9	Linear and quadratic factors of a real polynomial. Decomposition of a polynomial into factors. Rational functions. Real partial fractions with irreducible denominators. Partial fraction decomposition of a real rational function.	2
Lec10	Analytic geometry in the space R3. Operations on vectors. Length of a vector. Scalar product, cross product and triple product of vectors - computing area and volume.	2
Lec11	Planes. Normal to a plane. Equations of a plane. Relative location of planes.	1

Lec12	Line in the space. Equations of a line (parametric, directional). Line as an intersection of planes. Relative location of two lines. Relative location of a line and a plane. Orthogonal projection of a point onto a line or a plane.	3
Lec13	Conic sections. Circle. Ellipse. Hyperbola. Parabola	2
Lec14	Applications of linear algebra. Eigenvalues and eigenvectors of a matrix.	3
		Total hours: 30

Form of classes – Classes		Number of hours
Cl1	Transformation of algebraic expressions. Newton's binomial formula. Operations on matrices.	1
Cl2	Calculation of matrix determinants with use of their properties. Laplace expansion. Computation of an inverse matrix. Solving matrix equations. Cramer's formulas. Gaussian elimination. Solving of arbitrary systems of linear equations. Rozwiązywanie równań macierzowych.	3
Cl3	Operations on complex numbers in algebraic form. Polar form. Geometric interpretation. Powers and roots of complex numbers. Solving simple equations and inequalities.	4
Cl4	Finding roots of polynomials. Decomposition of a polynomial into irreducible components. Partial fraction decomposition of a real rational function.	2
Cl5	Vector operations. Scalar, cross or triple product of vectors and their applications to calculating area and volume. Solving problems in analytic geometry in R3 – finding equations of lines and planes, finding projections of vectors etc.	4
Cl6	Test.	1
		Total hours: 15

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_W05	exam
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U04	oral presentations, quizzes, tests
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

[1] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2015.
[2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2014.
[3] P. Kajetanowicz, J. Wierzejewski, Algebra z geometrią analityczną, PWN 2008.
[4] M. Zakrzewski, Markowe wykłady z matematyki, Algebra z geometrią, Oficyna Wyd. GiS, Wrocław 2015.

SECONDARY LITERATURE

[1] B. Gleichgewicht, Algebra, Oficyna Wydawnicza GiS, Wrocław 2004.
[2] A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963.
[3] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003.
[4] F. Leja, Geometria analityczna, PWN, Warszawa 1972.
[5] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W05	K1MBM_W01	C1 - C4	Lec1-Lec14	N1, N4
PEK_U01 - PEK_U04	K1MBM_U05	C1 - C4	Cl1-C15	N2, N3, N4

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza matematyczna I**
Name in English: **Mathematical Analysis I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **university-wide**
Subject code: **MAT001644 (MAT001648)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	3			
Number of hours of total student workload (CNPS)	150	90			
Form of crediting	Examination	Examination			
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					

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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_W01	C1-C4	lec	N1-N4

PEK_U01-PEK_U04	K1MBM_U05	C1-C4	Cl	N1-N4
PEK_K01	K1MBM_K01, K1MBM_K04	C1-C4	Lec,Cl	N1-N4

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza matematyczna II**
Name in English: **Mathematical analysis II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MAT001645.**
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					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

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

Form of classes – Classes		Number of hours
Cl1		2
Cl2		2
Cl3		1
Cl4		2
Cl5		2
Cl6		1
Cl7		2
Cl8		2
Cl9		1
		Total hours: 15

TEACHING TOOLS USED

N1.
N2.
N3.
N4. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1]M. Gewert, Z. Skoczylas, Analiza matematyczna 2. Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2016.
[2]F. Leja, Rachunek różniczkowy i całkowy, PWN, Warszawa 2012.
[3]W.Żakowski, W.Kołodziej, Matematyka, cz. II, WNT, Warszawa 2014.

SECONDARY LITERATURE
[1]M. Gewert, Z. Skoczylas, Analiza matematyczna 2. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2016.
[2]W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Cz. II, PWN, Warszawa 2006.
[3]R. Leitner, Zarys matematyki wyższej dla studiów technicznych, Cz. 1-2, WNT, Warszawa 2006.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_W01	C1-C3		N1-N4
PEK_U01-PEK_U03	K1MBM_U05	C1-C3		N1-N4
PEK_K01	K1MBM_K01, K1MBM_K04	C1-C3		N1-N4

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia w produkcji przemysłowej**
Name in English: **Ecology in industrial manufacturing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM0000000**
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)	60				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	2				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.2				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has systematized secondary school knowledge of biology, chemistry and physics; knows the principles of engineering drawing; can interpret the basic relationship between human activity and the behaviour of living organisms and the whole environment; understands the necessity of developing industry and implementing novel solution in the construction, operation and modernization of machines in accordance with the principles of sustainable development and the protection of natural resources and the environment.

SUBJECT OBJECTIVES

C1. The student is to learn about the structure and functioning of living nature, the effect of ecotoxins, and the greenhouse effect; to acquaint herself/himself with the hazards arising from the escalation of human industrial activity and with the legal regulations concerning environmental protection; to understand the environmental management systems, the ISO 14000 standard.
C2. The student is to acquaint herself/himself with the hazards involved in and the ways of acquiring energy from conventional and renewable sources and the principles of waste management – waste minimization and recycling, the LCA method.
C3. The student is to acquaint herself/himself with the principles of constructing, operating and modernizing machines, conducive to the protection of natural resources and the environment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows and understands the hazards arising from the greenhouse effect, the development of technology, energy acquisition and waste production and recycling.
PEK_W02 - The student understands the necessity of introducing environmental regulations; knows the environmental management systems; has knowledge relating to the implementation of ISO 14000.
PEK_W03 - The student knows and understands the hazards arising from the escalation of human activity; knows the principles and advantages of implementing the environment-friendly rules of constructing and operating machines.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, literature, what everyone can do to protect the environment.	2
Lec2	The sources of hazards arising from industrial activity and from the operation of machines, ecotoxins, the greenhouse effect, energy acquisition.	2
Lec3	The sources of hazards arising from industrial activity and from the operation of machines, ecotoxins, the greenhouse effect, energy acquisition.	2
Lec4	Environmental management, environmental management systems.	2
Lec5	Environmental management issues and the current standards: BS, EMAS, ISO 14000 and other.	2
Lec6	Environment-friendly methods and consequences of acquiring energy from conventional sources, hazards, trends.	2
Lec7	Environment-friendly methods of acquiring energy from renewable sources	2
Lec8	Waste minimization, recycling, rational and eco-friendly methods of managing wastes; examples of recycling in selected branches of industry.	2
Lec9	Examples of recycling in selected branches of industry, recycling in the automotive industry.	2
Lec10	Waste management, waste sources, waste processing, energy recovery, safe storage, waste management monitoring.	2
Lec11	Environment-friendly materials in machine operation – oils, lubricants, greases.	2
Lec12	Biodegradability, toxicity, carcinogenicity and mutagenicity of consumable materials; polychlorinated biphenyls.	2
Lec13	New environment-friendly techniques in machine operation; sparing lubrication techniques, lubrication management in industry; seals and their effectiveness; the energy aspects of machine operation.	2
Lec14	The environmental aspects of the construction, use and modernization of machines.	2
Lec15	Final test	2
		Total hours: 30

TEACHING TOOLS USED

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Konspekty przekazane przez prowadzącego,
2. Lewandowski W: Proekologiczne odnawialne źródła energii, WNT W-wa 2010,
3. Mackenzie A., i inni: Ekologia, PWN W-wa 2009,
4. Nierzwicki W: Zarządzanie środowiskowe, Polskie Wyd. Ekonomiczne, W-wa 2006,
5. Rosik-Dulewska Cz: Podstawy gospodarki odpadami, PWN2007

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

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

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRAKTYKA**
Name in English: **Professional Training**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM000000 (MMM010000).**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U	K1MBM_U02, K1MBM_U38, K1MBM_U40			
PEK_K	K1MBM_K03, K1MBM_K04			

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Grafika inżynierska - geometria wykreślna**
Name in English: **Engineering graphics - descriptive geometry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031001 (MMM031301)**
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. 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, such as division of a line's segment into n equal parts, plotting a regular hexagon.

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 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:
PEK_W01 - Student has ordered knowledge on geometric structure mapping onto drawing's plane using Monge's projection method and elementary knowledge in the field of axonometry.
PEK_W02 - Student can indicate an appropriate solution algorithm of mapping of the position and the relationship of the geometric formations in the space, as well as identifying the measures relationship.
PEK_W03 - Student can interpret the drawing, made by the Monge's method, showing localization of the element or geometric structure in the space.

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 projectrion 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 – Lecture		Number of hours
Lec1	Basic definitions and principles of the parallel, rectangular projection by Monge's projection, the mapping of basic geometric elements (points, line, plane).	2
Lec2	Common elements - edges and breakdown points; parallel and perpendicular elements.	2
Lec3	Transformation of the position (rotation, revolved section, increasing of the revolved section) and the reference system transformation (additional projection plane).	2
Lec4	Solids - definitions; solid section as a set of common elements of the solid cutting plane, solid's breakdown points by a straight line.	2
Lec5	Cutting of the solids with projecting planes set - a modification of the initial solid's view, developed views.	2
Lec6	Penetration of the solids - transmission lines definition, the use of auxilliary cutting planes and reference system transformation.	2
Lec7	Projection in the three orthogonal planes; axonometry basis; completion of the missing solid projection - use of the axonometric projection.	2
Lec8	Final test.	1
		Total hours: 15

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 ofrevolved 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 materal)	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.	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 materal)	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1		15
		Total hours: 15

TEACHING TOOLS USED

N1. problem lecture
N2. problem exercises
N3. tutorials
N4. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01- PEK_W03,	Final 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,	test no. 1, good rating is needed (min. 3.0)
F2	PEK_U01, PEK_U02, PEK_U03,	test no. 2, good rating is needed (min. 3.0)
F3	PEK_K01	evaluation of n (sheets) projects preparation, n = min. 4 - max. 8, good rating of each project is needed, F2 = (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 (and later edition),
[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 (and later edition),
[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 graphics - descriptive geometry
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W14	C1, C2, C3	Lec1, Lec2-Lec7	N1, N3
PEK_UO1, PEK_UO2, PEK_UO3	K1MBM_U14	C1-C3	Cl1-Cl6, Cl8-Cl14	N2. N3. N4
PEK_K01	K1MBM_K05	C1-C3	Cl1-Cl6, Cl8-Cl14	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: **Technologie informacyjne**
Name in English: **Information technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031003 (MMM031303)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. none

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic principles of construction of modern computers, knows the rules of binary arithmetic (integer and non-integer), understand the causes of errors in the numerical calculations.
PEK_W02 - The student knows the basic principles of designing algorithms.
PEK_W03 - The student knows the basic principles of editing technical documents (style, including illustration, making presentations).

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The program. Requirements. Outline of the history of the development of counting and computer systems.	2
Lec2	Elements of a computer system.	2
Lec3	Binary logic, basic arithmetic operations, computers calculations,	2
Lec4	The operating system and its role. Different types of software (operating system, utility, ...)	2
Lec5	Algorithms. The basic algorithmic structures (for review, the division of tasks, dynamic programming, recursion, ...).	6
Lec6	Correctness of algorithms, "difficult" task.	2
Lec7	Programming languages: simple examples.	2
Lec8	Interesting use of computers (engineering graphics calculations)	4
Lec9	General information about technical publications	3
Lec10	Internet and related problems. Law and Internet.	3
Lec11	Test	2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01	test
F2	PEK_W02	test
F3	PEK_W03	test
P = (F1+F2+F3+F4+F5)/5		

PRIMARY AND SECONDARY LITERATURE

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

SECONDARY LITERATURE
2. Computers Ltd.: What They Really Can't Do (Popular Science) by David Harel (Dec 11, 2003)
3. Computer Networking: A Top-Down Approach (6th Edition) by James F. Kurose and Keith W. Ross (Mar 5, 2012)
4. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin and Greg Gagne (Jul 29, 2008)
5. Algorithms + Data Structures = Programs (Prentice-Hall Series in Automatic Computation) by Niklaus Wirth (Feb 1976)

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W04	C1, C2	Lec1, Lec2, Lec3, Lec4	N1
PEK_W02	K1MBM_W04	C2	Lec5, Lec6, Lec7, Lec8	N1
PEK_W03	K1MBM_W04	C3	Lec9, Lec10	N1

SUBJECT SUPERVISOR

dr inż. Wojciech Myszka tel.: +48(71)3202790 email: Wojciech.Myszka@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): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031004 (MMM031304)**
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 trends and management concepts.
C2. Acquiring knowledge about the nature and mechanisms of an organization.
C3. Acquiring knowledge about the regularity and management tools, as well as the analysis of management problems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student is able to characterize different trends occurring in the evolution of organization and management theory, and to describe the most important concepts of both traditional and modern management.
PEK_W02 - The student is able to characterize basic mechanisms of organization, to distinguish between types of organizational structures, to list components of the organization and its environment.
PEK_W03 - The student is able to describe how to implement various functions in the organization and management style.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Management - its essence and meaning.	2
Lec2	The management process. Manager, managing at different levels and areas of the organization.	2
Lec3	Evolution of the management theory.	2
Lec4	The environmental context of management. Planning and decision making.	2
Lec5	The organizing process.	2
Lec6	The leading process.	2
Lec7	The controlling process.	2
Lec8	Test.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Griffin R.W., Management. 11th Edition, South-Western Cengage Learning 2013
2. Coulter M., Robbins S.P., DeCenzo D., Fundamentals of Management. Global Edition. 8th Edition, Pearson, 2013
3. DuBrin A.J., Essentials Of Management. 9th Edition, South-Western Cengage Learning, 2012

SECONDARY LITERATURE
1. Kinicki A., Williams B.K., Management. A practical introduction. 5th Edition, McGraw-Hill, 2010
2. McKee A., Management. A Focus On Leaders, Prentice Hall, 2012
3. Hatch M.J., Cunliffe A.L., Organization Theory. Modern, Symbolic, And Postmodern Perspectives, Oxford University Press, 2013
4. Harvard Business Review. The Magazine

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03,	K1MBM_W31	C1-C3	Lec-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: **Technologia materiałów inżynierskich**
Name in English: **Engineering Materials Technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031005 (MMM031305)**
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	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge concerning physics and mathematics. Ability to use basic measuring equipment like slide caliper.
2. Ability to analyze information included in laboratory instructions
3. Ability to work in a team

SUBJECT OBJECTIVES

C1. Familiarization with metallurgical processes of ore conversion, production of steel and non-ferrous metals.
C2. Familiarization with basic methods of testing of mechanical properties of steel and non-ferrous metals and principles of forming of items with use of powder metallurgy.
C3. Obtaining and reinforcement of social competences connected with a teamwork with a goal to solve problems effectively.
C4. Familiarization with knowledge about basic mechanical properties of engineer materials like tensile strength, compressive strength, impact strength, hardness by participation in testing of given materials.
C5. Familiarization with methods of conducting of non-destructive testing like visual inspection, dye-penetrant examination, magnetic particle testing, radiographic and ultra-sonic testing by participation in testing given parts.
C6. Familiarization with technological tests and forming of items with use of powder metallurgy by participation in an experiment.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of conducted lecture the student should be able to define the basic physical properties of engineering materials, to quote and to describe the ways of processing of ores the metals, to characterize the metallurgical processes of receiving the metals and the alloys of metals.
PEK_W02 - As a result of conducted laboratory the student should be able to define the mechanical properties of metals and the alloys, to describe the method of tests destructive and non-destructive, to characterize the method of carrying out the technological tests.
PEK_W03 - As a result of conducted classes the student should be able to distinguish basic engineering materials, to characterize their physical and mechanical properties, to identify method investigations of properties of engineering materials.

II. Relating to skills:
PEK_U01 - As a result of the lecture the student should be able to analyze processes metallurgical obtaining metal, compare the properties of engineering materials
PEK_U02 - As a result of laboratory classes student should be able to carry out in a limited range the basic test of tensile strength, compressive strength, impact tests, hardness tests and technological tests
PEK_U03 - As a result of the course the student should be able to obtain information from the literature, have the ability to self-learning, carry out measurements, determine the value and to evaluate certainty basic mechanical properties.

III. Relating to social competences:
PEK_K01 - Demonstrates skills needed in teamwork on improving methods of choice of a strategy to optimally solve problems assigned group.
PEK_K02 - Is able objectively evaluate the arguments rationally explain and justify his own point of view using the knowledge of the basics of engineering materials.
PEK_K03 - Respects the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organization of groups. General information about properties of engineer materials	3

Lec2	Refractory materials and fuels in pyrometallurgy.	2
Lec3	Metallurgy of iron. Ore treatment, blast furnace process, production of steel	2
Lec4	Metallurgy of copper. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of copper and its alloys	2
Lec5	Metallurgy of zinc. Ore treatment, pyrometallurgical and hydrometallurgical processes of production of zinc and its alloys	2
Lec6	Metallurgy of aluminum. Treatment of ores, production of aluminum oxide and distillation of aluminum.	2
Lec7	Production of high melting metals with use of powder metallurgy and methods of production of parts with use of metallic powders.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Organization of groups, safety. Tensile test of metals	3
Lab2	General information about metals and alloys.	2
Lab3	Compression test and impact test	2
Lab4	Hardness measurement	2
Lab5	Non-destructive testing	2
Lab6	Technological tests	2
Lab7	Production of machine parts with use of powder metallurgy	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. report preparation
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, PEK_K01-PEK_K03	oral answers, short tests
P = średnia z F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Z. Mirski. Technology and engineering materials testing, laboratory. Wrocław University of Technology Publishing House, 2010.
2. Krynicki L., L. Sozański. Technology of metals. Publisher University of Technology, 1994.

SECONDARY LITERATURE

Supplementary materials for exercises No. 1-5. W10 library (building B4, III floor)

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W03	K1MBM_W10	C1, C2	Le1 - Le7	N1, N5
PEK_W02, PEK_W03	K1MBM_W10	C4, C5, C6	Le1 - Le7	N2, N3, N4
PEK_U01, PEK_U03	K1MBM_U20	C4, C5, C6	Lab1 - Lab7	N2, N5
PEK_U02, PEK_U03	K1MBM_U20	C4, C5, C6	Lab1 - Lab7	N2, N3, N4
PEK_K01, PEK_K03	K1MBM_K04	C3	Lab1 - Lab7	N2, N5
PEK_K02, PEK_K03	K1MBM_K04	C3	Lab1 - Lab7	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Piotr Białucki tel.: 42-71 email: piotr.bialucki@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): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031007 (MMM031307)**
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				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of mathematics confirmed positive marks on the upper secondary school leaving certificate

SUBJECT OBJECTIVES

C1. Gaining basic knowledge of probability and mathematical statistics takes into account the aspects of application.
C2. Learn how to explore the figures in the field of construction and operation of equipment, organization and management, as well as optimization of design, technology and systems.
C3. Acquiring skills development (reduction) of data using statistical software (STATISTICA, MatLab, Gretl, R) and the possibility of a spreadsheet (Excel).
C4. The acquisition and consolidation of social skills including emotional intelligence involving the ability to work in a group of students with a view to effectively solve problems with regard to accountability, integrity and fairness in the proceedings.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It has a basic knowledge of statistical methods for the analysis of databases of known basic descriptive statistics characterizing the engineering measurements, known principle groupings of data and compilation of the distribution,

PEK_W02 - Knows the basic theoretical distributions of discrete and continuous attributes, has a basic knowledge of the principles of estimating confidence intervals for the average value and its dispersion characteristics, has knowledge of the methods for parametric statistical hypotheses about the average value, the equality of the two values of the average of the value of homogeneity of variance and multiple variance.

PEK_W03 - Knows the basic method of verifying the non-parametric statistical hypotheses regarding the significance of differences in the structure of the data and categorical independent random variables, known methods of correlation and regression analysis for two or more continuous variables and methods for the analysis of time series.

II. Relating to skills:

PEK_U01 - Able to properly perform a statistical analysis of test results, formulate hypotheses, and based on the tests carried out to draw the appropriate conclusions: data reduction can make the right choice before statistics describing the average value, the dispersion and the shape of the distribution, it can from raw data to create a frequency distribution, and illustrate collection of data using a histogram, the empirical distribution function and graph frameset.

PEK_U02 - Able to fit the empirical data and theoretical distribution on the basis of estimated quantile values for selected probabilities, and estimate the probability for selected quantiles, can properly choose the type of statistical test and perform testing hypotheses about the average and distribution characteristics.

PEK_U03 - It can analyze the correlation characteristics in multivariate categorical data table can perform a regression analysis and correlation of two and more variables, estimate the parameters characterizing the strength and shape of the relationship.

III. Relating to social competences:

PEK_K01 - The acquisition and consolidation of competence in the following areas: information retrieval and its critical analysis, team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group.

PEK_K02 - capacity building self-esteem and self-control and responsibility for the results of actions taken

PEK_K03 - independent and creative thinking

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Statistical methods of data analysis - the essence of statistical modeling. The descriptive analysis of the data: the forms of representation of statistical data, measures of association, variability, asymmetry and concentration.	2
Lec2	Development and presentation of statistical data. Grouping data - ranks simple 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. Elements of the theory of estimation - point estimate. Interval estimation of the mean value and variance. The confidence intervals.	2

Lec4	Parametric statistical hypotheses. Testing hypotheses about the average value, the equality of the two average values. Testing hypotheses about the rate structure and the structure of the equality of two ratios. Testing hypotheses about the variance and equality of two variances.	2
Lec5	Nonparametric hypothesis testing. Conformance Test chi-square, Kolmogorov-Smirnov test. Test of independence Pearson chi-square. Based measures based on chi-square. The odds ratio. Nonparametric tests: test Wald-Wolfowitz runs test, Wilcoxon rank-Mann-Whitney test.	2
Lec6	Correlation and regression analysis. The method of least squares. Pearson correlation coefficients and Spearman. Linear regression function. Multivariate regression analysis and correlation. The estimation of linear multiple regression function. The significance test for multiple regression coefficients. Estimation of the multiple correlation coefficient. The coefficient of determination.	2
Lec7	Univariate analysis of variance and post-hoc test: Tukey, Duncan and least significant difference. Kruskal-Wallis test and post-hoc test of Dunn. Methods of analysis of the dynamics of the phenomena - time series. Time series smoothing methods. Analysis of periodic fluctuations. Presentation of selected computer programs supporting statistical analysis STATISTICA, R, Gretl.	3
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Organizational matters. Introduction to using a spreadsheet. Math and statistics Excel. Generate a vector of continuous variables with normal distribution. Descriptive statistics - calculating measures of location, variability, asymmetry and concentration. Construction series distribution. A graphical representation of the data set - the histogram and the empirical distribution function.	3
Proj2	Basic distributions encountered in mathematical statistics: a normal distribution, Student, chi-square, F Snedecor. Probability density function and cumulative distribution. Point and interval estimation of the expected value, the rate structure (fraction), variance and standard deviation.	2
Proj3	Testing of statistical hypotheses. Parametric tests of significance for the expected value and the variance of the general population. The test for two variances for two medium and two indicators of the structure. Student's test for paired test, homogeneity of variance Bartlett's many, many medium homogeneity test (ANOVA).	2
Proj4	Non-parametric tests of significance - compatibility test Pearson's chi-square test, Kolmogorov sensor compatibility,. Test of independence chi-kwadrat2 panels - kontyngencyjne. Mann-Whitney test. Median test and Wilcoxon signed-ranks test. Rank sum test Kruskal-Wallis test to assess the relationship between two variables. Two-dimensional regression and correlation analysis. A scatterplot. Strength of the association correlation - correlation coefficient estimation, test of significance for the correlation coefficient, parameter estimation of linear regression function, a test of significance for the regression coefficient (slope of the regression line), the confidence interval for the regression coefficient.	2
Proj5	Multivariate analysis of correlation and regression. Estimation of the multiple regression function. The significance test for multiple regression coefficients. Estimation of the coefficient of determination and multiple correlation. Curvilinear regression. Logistic regression. Maximum likelihood estimation. Interpretation of the results of logistic regression.	2

Proj6	Univariate analysis of variance (ANOVA). Table of analysis of variance in one variable for the jednoczynnikowego. Analysis of the dynamics. Time series without periodicity and duration. Prediction methods. Development trend - a trend.	2
Proj7	Event History Analysis. Distribution function, the density function, survival function, hazard function. The life table. Kaplan-Meier curves. Cox proportional hazards model. Uncertainty evaluation of the overall result of the measurement. Disclosure of systematic errors. Disclosure of errors (gross errors). Uncertainty evaluation of the overall impact resulting from the effects of random and systematic. Methods of sampling. Drawing layered, collaborative, systematic. Non-random sample and load error.	2
		Total hours: 15

TEACHING TOOLS USED

N1. informative lecture
N2. case study
N3. calculation exercises
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_K01	small exam, evaluation of computing project
F2	PEK_U02,PEK_K02	small exam, evaluation of computing project
F3	PEK_U03,PEK_K03	evaluation of computational design, project evaluation
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Bobrowski D: Probability in technical applications. Warsaw 1986, WNT [2] R. Smith: Statistics for physicists. Warsaw 2002, PWN [3] Ostasiewicz W. (ed.): Statistical methods for data analysis. Wroclaw 1999, Publisher of Economics in Wroclaw [4] Zeliaś A., Pawelek, B., S. Wanat: Statistical Methods. The tasks and tests. Warsaw 2002, PWE

SECONDARY LITERATURE
[1] I. Bak, Markowicz I., Mojsiewicz M., K. Wawrzyniak: Statistics in tasks. Part I and II. Warsaw 2001. Publisher of Science and Technology [2] Cieciura M., Zacharski J.: Probabilistic methods in practical terms. Warsaw 2007, VIZJA PRESS & IT Sp. z oo [3] Dobosz M.: The computer-assisted statistical analysis of test results. Warsaw 2001, Academic Publishing House EXIT. [4] Frątczak E. Gach-Ciepiela Laws, Babiker H. event history analysis. Elements of the theory, some examples of applications. 2005 Warsaw School of Economics in Warsaw. [5] Puppet L: Fundamentals of engineering studies. Warsaw 2002, PWN. [6] Maliński M.: Computer-assisted mathematical statistics. Gliwice 2000, published by Silesian University of Technology [7] W. rods: Methods of data analysis examples. 2004 Częstochowa, Częstochowa University of Technology [8] Turzeniecka D.: Evaluation of uncertainties due to measurements. 1997 Poznan, Poznan University of Technology Publisher

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W01	C1, C2, C3	Lec1, Lec2	N1
PEK_W02	K1MBM_W01	C1, C2, C3	Lec3, Lec4, Lec5	N1
PEK_W03	K1MBM_W01	C1, C2, C3	Lec6, Lec7	N1,N5
PEK_U01	K1MBM_U04	C1, C2, C3	Pr1, Pr2	N2, N3, N4
PEK_U02	K1MBM_U04	C1, C2, C3	Pr3, Pr4, Pr5	N2, N3, N4
PEK_U03	K1MBM_U01, K1MBM_U05	C1, C2, C3	Pr6, Pr7	N2, N3, N4, N5
PEK_K01	K1MBM_K05	C4	Pr7	N5
PEK_K02	K1MBM_K04	C4	Pr7	N5
PEK_K03	K1MBM_K05	C4	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: **Termodynamika techniczna**
Name in English: **Technical thermodynamics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031008 (MMM031308)**
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	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 problems covered by Physics education program
2. Ability to independently perform laboratory exercises, supported by elementary manual efficiency
3. Awareness of the need for group work and the ability to implement it

SUBJECT OBJECTIVES

C1. Understanding of the principles of gas transformation and the possibilities of their use in technology basing on the laws of thermodynamics
C2. Knowledge and understanding of the engines air standard cycles and ability to evaluate its efficiency
C3. Introduction to the thermal air standard cycles in internal combustion engines and reciprocating compressors

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Recognizes and describes the laws of thermodynamics and thermodynamic processes
PEK_W02 - Characterises and explains the air standard cycles and is able to evaluate their efficiency
PEK_W03 - Identifies and describes the procedures of the air standard cycles realization in combustion engines and reciprocating compressors

II. Relating to skills:
PEK_U01 - Is able to calculate the level of imperfection of the adiabatic and isothermal process as an example of polytropic process
PEK_U02 - Calculates the values of the critical gas flow rate and the volumetric efficiency of the reciprocating compressor
PEK_U03 - Calculates and verifies coefficients of heat transfer through a flat plate as well as conductive coefficient for forced and natural convection

III. Relating to social competences:
PEK_K01 - Understand the necessity and is aware of possibilities of continuous education, particularly increasing their knowledge of technical thermodynamics (studies II and III degree)
PEK_K02 - Is aware of the importance, responsibility and the effects of engineer work of Mechanical Engineering faculty in terms of responsibility for the environment, resulting from the proper use of the knowledge of technical thermodynamics
PEK_K03 - Recognizes the need to improve professional, personal and social competences

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic definitions: mass, the amount of substance, pressure, temperature, volume	2
Lec2	I Law of Thermodynamics - work, heat, internal energy, power, open/ closed thermodynamic system,	2
Lec3	I Law of Thermodynamics for open thermodynamic systems - enthalpy, volume and technical work	2
Lec4	Thermodynamic processes, calculation of heat and work of the processes	2
Lec5	Cycles, entropy, efficiency of cycles	2
Lec6	Carnot Cycle, Second Law of Thermodynamics, reversible and irreversible, processes, entropy, the relation of entropy with the Second Law of Thermodynamics	2
Lec7	The flow of gas through nozzles, the energy balance for open movable systems, dynamic stream performance	2
Lec8	Basic air standard cycles for engine, efficiencies and comparison	2
Lec9	Combustion, the calorific value of the fuel, combustion control charts	2
Lec10	Internal and external combustion piston and gas turbine engines	2
Lec11	Stirling engine air standard cycle and its practical realisation	2
Lec12	Reciprocating and rotodynamic compressors; energy balance, indicator diagram and compressor operation	2
Lec13	Basic laws of heat transfer by convection, radiation and conduction	2

Lec14	Compressible fluid flow	2
Lec15	Diaphragm, convective heat exchangers	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Determination of the heat capacity coefficients for air	2
Lab2	Practical realization of adiabatic process	2
Lab3	Examination of the adiabatic flow through a Bendemann nozzle	2
Lab4	Determination of volumetric efficiency of the reciprocating compressor	2
Lab5	The study of isothermal process	2
Lab6	Determination of heat transfer coefficients for forced and natural convection	2
Lab7	Examination of the process of heat transfer through a flat barrier with: a) theoccurrence of convection and radiation, b) applying a debilitating radiation screen	2
Lab8	Isobaric heating using heat regeneration	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

F1	PEK_U01,PEK_K01	quiz, a report from the laboratory
F2	PEK_U02,PEK_K02	quiz, a report from the laboratory
F3	PEK_U03,PEK_K03	quiz, a report from the laboratory
P = (F1+F2+F3)/3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Callen, Herbert B. Thermodynamics and an Introduction to Thermostatistics. Wiley, 1985.

SECONDARY LITERATURE
Prigogine, Ilya. "Introduction to thermodynamics of irreversible processes." New York: Interscience, 1967, 3rd ed. (1967).

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W06	C1	Lec1 Lec2 Lec3 Lec4	N1. N2.
PEK_W02	K1MBM_W06	C2	Lec5 Lec6 Lec7 Lec8	N1. N2.
PEK_W03	K1MBM_W06	C3	Lec9 Lec10 Lec11 Lec12Lec13 Lec14 Lec15	N1. N2.
PEK_U01	K1MBM_U10	C1	Lab 2 Lab 5	N3. N4. N5.
PEK_U02	K1MBM_U10	C2	Lab 1 Lab 4	N3. N4. N5.
PEK_U03	K1MBM_U10	C3	Lab 3 Lab 6 Lab 7 Lab 8	N3. N4. N5.
PEK_K01	K1MBM_K01	C1 C2 C3	Lab 8	N. 1
PEK_K02	K1MBM_K02	C1 C2 C3	Lab 8	N.1 N3.
PEK_K03	K1MBM_K06	C1 C2 C3	Lab 8	N3. N4.

SUBJECT SUPERVISOR
dr inż. Aleksander Górniak email: aleksander.gorniak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Informatyka podstawy programowania (Matlab)**
Name in English: **Computer science – basics of programming (Matlab)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031013 (MMM031313)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about structure of a computer and its components, as well as on operating systems and principles of algorithm structure.
2. Knowledge of mathematics, covering basic problems of algebra and analysis.
3. Ability to use basic IT tools of CAE class.

SUBJECT OBJECTIVES

C1. Getting acquainted with high-level programming in Matlab, intended for engineering and scientific calculations.
C2. Getting acquainted with integration of calculations, visualisation (2D and 3D graphics) and programming in Matlab environment.
C3. Getting acquainted with principles of modelling technical systems using the Simulink module.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Ability to formulate a proceeding algorithm for mathematic calculations in the fields of algebra and analysis, covering, among others, matrix, differential and integral calculi, as well as problems related to solving systems of algebraic equations.
PEK_U02 - Ability to utilize possibilities of 2D and 3D graphics to visualize data and calculation results.
PEK_U03 - Ability to build a simple model of an object and to start simulation in the Matlab/Simulink system.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to acquire knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	General characteristics of Matlab system (graphic interface, environment maintaining, organization of work, system syntax) – exemplary applications.	2
Proj2	Operations on files and folders, saving and executing basic mathematical operations (evaluating function values).	2
Proj3	Vector and matrix calculi (basic matrix and table operations, identifying elements, generating vectors and matrices).	2
Proj4	Two-dimensional graphics in Matlab system – graphics generating functions, description of charts, window management.	2
Proj5	Three-dimensional graphics in Matlab system – graphics generating functions, description of charts, window management, animation 3D.	2
Proj6	Basics of programming in Matlab system (operators; conditional, iteration and switch statements).	2
Proj7	Basics of programming in Matlab system (compound statements; scripts and functions, creating M-files).	2
Proj8	Numerical methods: interpolation and approximation of functions.	2
Proj9	Function analysis (limits, derivatives, extrema).	2
Proj10	Solving equations and systems of equations – methods of solving.	2
Proj11	Numerical integration – characteristics of integration methods.	2
Proj12	Simulink – introduction to modelling technical objects (terminology, principles of building models and starting-up simulations).	2
Proj13	Building a simulation model based on the Simulink module library – analysis of influence of initial conditions and simulation parameters on calculation results.	2
Proj14	Building a model for a selected technical object – analysis of influence of initial conditions and simulation parameters on calculation results.	2
Proj15	Crediting the project.	2

	Total hours: 30

TEACHING TOOLS USED

N1. Auxiliary materials in form of instructions and multimedia presentations helpful at executing individual subjects.
N2. Tasks for checking knowledge within individual subjects.
N3. Self study - preparation for project class.
N4. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Assessment of preparation for executing subsequent project subjects, checking gained knowledge on the ground of test tasks.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Prepared instructions and aids to individual subjects (unpublished).
Mrozek B., Mrozek Z.: Matlab and Simulink. Editorial Office Helion Warsaw, 2004 (in Polish).
Brzózka J., Dorobczyński L.: Matlab. Environment of scientific-technical calculations. Editorial Office Helion PWN, 2005 (in Polish).
Zalewski A., Cegieła R.: Matlab – Numerical calculations and their application. Editorial Office Nakom. Poznan, 1998 (in Polish).
Reichel W., Stachurski M.: Matlab for students – exercises, problems, solutions. Editorial Office WITKOM. Warsaw, 2009 (in Polish).

SECONDARY LITERATURE
Pratap R.: Matlab 7 for scientists and engineers. Editorial Office MIKOM, 2007 (in Polish).
Regel W.: Symbolic and numerical calculations in Matlab program. Editorial Office MIKOM, 2004 (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer science – basics of programming (Matlab)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K1MBM_U05, K1MBM_U18	C1 - C3	Pr1 - Pr14	N1 - N4
PEK_K01 - PEK_K03	K1MBM_K04	C1 - C3	Pr1 - Pr14	N3, N4

SUBJECT SUPERVISOR

dr inż. Piotr Górski tel.: 37-81 email: piotr.gorski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo II**
Name in English: **Materials Science II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031017 (MMM031317)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	90		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Positive credit of Materials Science I lecture course
2. Positive credit of Materials Science I laboratory practice

SUBJECT OBJECTIVES

C1. Knowledge of division rules, classification and notatation for non-alloyed steels, alloyed steels , casts and their application
C2. Knowledge of heat treatment and termo-chemical teratment basement and their influence on steel properties
C3. Knowledge of types and non-iron metals properties

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know the rules of division, classification and notatation for non-alloyed steels, alloyed steels, casts and their application
PEK_W02 - Know the basement of termo and termo-chemical treatments and their influence on steel properties
PEK_W03 - Know the types and properties of non-iron metal alloys

II. Relating to skills:
PEK_U01 - Be able to divide, classification and notation of non-alloyed steels, alloyed steels , casts and their application
PEK_U02 - Be able to determine the types of heat and termo-chemical treatment application and theit influence on steel properties
PEK_U03 - Be able to determine the types and properties of non-iron metal alloys

III. Relating to social competences:
PEK_K01 - Information retrieval and their critical analyse
PEK_K02 - Observance of custom and rules binding at academic environment

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Cast irons. Grafitisation. Modification of cast irons	2
Lec2	Types of graphite and metall matrix of cast irons. Classification and natation rules of cast irons.	2
Lec3	Phase transformation in steels during heating	2
Lec4	Phase transformation in steels during cooling	2
Lec5	Basic types of annealing. Hardening and tempering of steel	2
Lec6	TTT diagrams. Hardenability. Supersaturation and ageing	2
Lec7	Surface treatment of steel, surface hardening, carburizing and nitriding	2
Lec8	Influence of alloying elements on the steel phase transformation	2
Lec9	General classification and notation rules for non-alloed steels	2
Lec10	Structures, properties and notation rules for alloed steels	2
Lec11	Alloyed structural steels. Weldability	2
Lec12	Alloyed tool steels.	2
Lec13	Steels with special properties: corrosion resistant steels, creep and heat resistant steels, maraging steels and wear resistant steels	2
Lec14	Copper and copper alloys	2
Lec15	Aluminium and light metal alloys	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Microstructures of steels and cast steels on the basement of Fe-Fe3C system	2
Lab2	Cast irons microstructures and properties	2

Lab3	Influence of the heat tratment on the steels microstructure and properties	2
Lab4	Mmicrostructures and properties of the tool steels	2
Lab5	Microstructures of stells with special properties	2
Lab6	Microstructures and properties of aluminium and copper alloys	2
Lab7	Summary and supplerment of laboratory practice	2
Lab8	Credit of laboratory practice	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03, PEK_K01 - PEK_K02	Introduction test, oral answers, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. M.F.Ashby, D.R. Jones - Engineerig Materials

SECONDARY LITERATURE
M. F. Ashby- Materials Selection in Mechanical Design, vol 1 and 2

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W02	K1MBM_W12	C1-C2	Lec 1 - lec 13	N1-N4
PEK_W03	K1MBM_W12	C3	Lec 14 - Lec 15	N1-N4
PEK_U01-PEK_U03	K1MBM_U16	C1-C3	Lab 1 - Lab 6	N3-N5
PEK_K01-PEK_K02	K1MBM_K09	C1-C3	Lab 1 - Lab 8	N2, N3, N5

SUBJECT SUPERVISOR

dr inż. Krzysztof Widanka tel.: 320-37-00 email: krzysztof.widanka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika II**
Name in English: **Mechanics II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031018 (MMM031318)**
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. mathematical analysis (differentiation, integration), linear algebra, trigonometry
2. differential equations (ordinary, linear) in the variables separation methods and the characteristic equation areas
3. mechanics in range of statics and kinematics

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

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

Lec9	Multi-mass systems. Constraints, degrees of freedom. The use of second Newton's laws in multi-mass constrained material systems.	2
Lec10	The principle of the center of mass motion and the principle of momentum in multi-mass systems.	2
Lec11	Total angular momentum and angular momentum principle in the multi-mass systems. Introduction to the dynamics of a rigid body. The equation of the dynamics of a rigid body rotation.	2
Lec12	Using the principle of angular momentum and the equation of rotational dynamics in determining the frequency of free vibration of complex systems. Equivalent mass and stiffness.	2
Lec13	Determination of the dynamic response in a rotating motion. The method of reduction of inertial forces.	2
Lec14	Angular momentum in the plane motion of a rigid body and dynamics of plane motion. The kinetic energy of rigid body in a general motion. The König's theorem.	2
Lec15	Determination of the differential equations of motion and natural frequency of the dynamical conservative systems based on the energy conservation law.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Practical problems of kinematics of particle, rotational motion and plane motion of rigid body.	2
Cl2	Practical problems of kinematics of relative motion of particle.	2
Cl3	Solving examples of tasks of Kinematics of rigid body rotation about a fixed point.	2
Cl4	Solving examples of tasks with dynamic free massl particle using The Newton's second law (rectilinear and curvilinear motion)	2
Cl5	The Newton's second law (applicable in the dynamics of the constrained massl particle).	2
Cl6	Test 1: Kinematics of massl particle and rigid body. The Newton's second law application in the derivation of the equations of motion of massl particle.	2
Cl7	Examples of tasks from free vibrations of simple mechanical systems with one degree of freedom (determination of free vibration frequencies and the motion equations)	2
Cl8	Examples of tasks from forced vibration of simple mechanical systems with one degree of freedom.	2
Cl9	Examples of the tasks of the dynamics of particle (momentum principle, the principle of conservation of energy)	2
Cl10	Examples of the tasks of the dynamics and rotational motion of the rigid body using momentum principle, angular momentum principle and mass center movement rule.	2
Cl11	Dynamic force responses in the supports of rotated body.	2
Cl12	Equations of motion for rigid body in plane movement.	2
Cl13	The kinetic energy of a rigid body in a general motion. The König's theorem. Determination of the differential equations of motion of the dynamical conservative systems based on the energy conservation law.	2
Cl14	Test 2: Dynamics of the particles system and rigid body, vibrations of mechanical systems with one degree of freedom.	2

Cl15	Passing talks, last chance tests.	2
		Total hours: 30

TEACHING TOOLS USED
N1. Traditional lecture with the use of transparencies and slides. N2. Calculation exercises. N3. Tutorials. N4. Self study - self studies and preparation for examination.

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01,PEK_U02,PEK_U03	test 1, oral answers
F2	PEK_K01,PEK_K02, PEK_K03,	test 2, oral answers
P = (F1+F2):2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 1, Statics, John Wiley & Sons, Inc., New York, 1998
2. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 2, Dynamics, John Wiley & Sons, Inc., New York, 1998

SECONDARY LITERATURE

1. Mary Lunn, A First Course in Mechanics, Oxford Science Publications, Oxford 1991
2. Philip Dyke, Roger Whiteworth, Guide to Mechanics, MacMillan Press, London 1992
3. Herbert Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W07	C1	Lec1 to Lec15	N1, N3, N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_U05, K1MBM_U08	C2	Cl1 to Cl15	N2, N3, N4
PEK_K01, PEK_K02, PEK_K03	K1MBM_K01, K1MBM_K03, K1MBM_K04	C3	Cl1 to Cl15	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Grzegorz Lesiuk tel.: 713203919 email: grzegorz.lesiuk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-odlewnictwo**
Name in English: **Manufactures techniques - casting**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031020 (MMM031320)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge about the metallurgical process of metal ores and receiving ferrous alloys and non-ferrous metals; Has a basic knowledge about the types of engineering materials - their properties, applications and principles of their selection; Has a basic knowledge about the structure of metals and alloys as well as the principles of their classification and labeling;
2. Can determine the characteristics of the materials microstructure, identify occurring in material phases; Also is able to differentiate: the microstructure of ferrous alloys (in terms of carbon content), non-ferrous alloys and the effect of the heat treatment;
3. Can read and interpret the figures and diagrams used in the technical documentation;

SUBJECT OBJECTIVES

C1. The acquisition of general knowledge about the basic techniques of foundry manufacturing methods;
C2. Acquiring the selection skills and a critical analysis of chosen casting technology and basic parameters of that process;
C3. Acquisition and consolidation of social skills like the ability of working in a group to solve the problems effectively; The acquisition of sense of responsibility and respect for traditions existing in academia and society;

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has a basic knowledge of the manual and machine manufacturing technologies of foundry molds and cores
PEK_W02 - Has a knowledge of the basic methods of melting and treatment of metallurgical alloys.
PEK_W03 - Has a basic knowledge about designing the casting products and the processes for their production with principles of technology of their selection dependent on the type of casting and the type of alloy.

II. Relating to skills:
PEK_U01 - Can analyze and design the process of production casting equipment to a simple product.
PEK_U02 - Can choose the right technology for casting and define the basic parameters of that process.
PEK_U03 - Can choose the right method of treatment of the casting alloy and define its basic parameters.

III. Relating to social competences:
PEK_K01 - Can search for information and critically analyze them, rationally explain them and justify the own point of view using the knowledge of foundry branch.
PEK_K02 - Recognizes the importance of team cooperation on ways to choose a strategy to optimally solve assigned to a group problems.
PEK_K03 - Understands the need to respect the traditions and rules in academia and society.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational issues. Discussion about the specific shape of the statethe from liquid metal, fundamental concepts and algorithms for casting production.	2
Lec2	Principles for design and construction of casting equipment.	3
Lec3	Materials and equipment used for the preparation of the molding and core sands and the methods of their manufacturing and testing their properties.	3
Lec4	Methods for manual manufacturing of foundry molds and cores.	2
Lec5	Automatic manufacturing of foundry molds and cores.	3
Lec6	Production of molds and cores from selfsetting molding sands.	3
Lec7	Production of molds and cores from thermosetting molding sands.	2
Lec8	Manufacturing the castings using a precise technique of lost models.	2
Lec9	Knocking out and the cleaning of castings.	1
Lec10	Manufacturing the castings in metal molds.	3
Lec11	Melting casting alloys.	3
Lec12	Obróbka metalurgiczna stopów odlewniczych i cieplna odlewów. Sprawdzian wiadomości.	3
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Organizational issues. Research the materials and molding sands.	2
Lab2	Construction of casting models and core boxes.	2

Lab3	Manual production of foundry molds and cores.	2
Lab4	Automatic production of foundry molds and cores.	2
Lab5	Production of molds and cores from self-and thermosetting molding sands.	2
Lab6	Manufacturing the castings in metal molds.	2
Lab7	Testing the properties of casting alloys. Completion of the course.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	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	short exam
F2	PEK_U01 - PEK_U03,PEK_K01-PEK_K03	oral exam
F3	PEK_U01 - PEK_U03,PEK_K01-PEK_K03	laboratory reports
P = średnia z wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Perzyk M. i inni; Odlewnictwo WNT Warszawa 2000; 2. Tabor A. Odlewnictwo wyd. „Akapit” Kraków 1996; 3. Murza-Mucha P., Techniki wytwarzania – Odlewnictwo. PWN, Warszawa 1978;4. Granat K. Laboratorium z odlewnictwa, skrypt PWr, Wrocław 2007; 5. Jaworski R. Ćwiczenia laboratoryjne z Budowy Maszyn, cz. I Odlewnictwo, skrypt PWr, Wrocław 1981;6. Perzyk M. i inni: Materiały do projektowania procesów odlewniczych, skr. P. Warsz. Warszawa 1981;

SECONDARY LITERATURE

1. Lewandowski J. L.; Tworzywa na formy odlewnicze, wyd.: „Akapit” Kraków 1997;2. Błaszkowski K. Technologia formy i rdzenia, Warszawa 1990;3. Poradnik inżyniera – Odlewnictwo WNT Warszawa 1986;

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Manufactures techniques - casting

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W21	C1, C2	lec1, lec3-10	N1-N5
PEK_W02	K1MBM_W21	C1, C2	lec11,12	N1-N5
PEK_W03	K1MBM_W21	C2	lec2	N1, N2, N4
PEK_U01, PEK_U02	K1MBM_U27	C1	La1-La6	N2-N5
PEK_U03	K1MBM_U27	C2	La7	N2-N5
PEK_K01, PEK_K03	K1MBM_K01, K1MBM_K06	C3	La1-La7	N2-N5
PEK_K02	K1MBM_K04	C3	La7	N2-N5

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Teoria mechanizmów i manipulatorów**
Name in English: **Theory of Mechanisms and Manipulators**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031023 (MMM031323)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematical analysis, matrix algebra
2. Knowledge of fundamental laws in statics, kinematics and dynamics
3. Skill in fuction analysis, derivatives, basic matrix and vector operations

SUBJECT OBJECTIVES

C1. Acquire knowledge in topology, kinematics and dynamics of mechanisms and manipulators
C2. Acquire and understanding of basic mechanisms and manipulators
C3. Getting skills in determining kinematic and dynamic parameters

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Understands theoretical fundamentals of mechanism and robot topology
PEK_W02 - Has the knowledge of kinematic and dynamic analysis methods
PEK_W03 - Is able to commentate results of analysis, evaluate their correctness

II. Relating to skills:
PEK_U01 - Is able to evaluate topological carrectness of kinematic systems
PEK_U02 - Is able to determine kinematic and dynamic properties
PEK_U03 - Is able to create models of simple planar mechanisms and manipulators

III. Relating to social competences:
PEK_K01 - Has a conviction of responsibility for the work done

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Topology of mechanisms, movable properties, redundant constraints	3
Lec2	Kinematics of mechanisms - graphic-analytical methods	3
Lec3	Analytical methods in kinematics (vectors, projections, time derivatives)	2
Lec4	Planetary gear trains	2
Lec5	Manipulators' properties. Planar serial and parallel systems	2
Lec6	Kinematics of planar manipulators, jacobian	2
Lec7	Matrix description of spatial systems	2
Lec8	Denavit-Hartenberg notation	2
Lec9	Introduction to mechanisms' dynamics	2
Lec10	Kinetostatic analysis	3
Lec11	Friction in joints, efficiency	3
Lec12	Dynamic motion analysis	2
Lec13	Fluctuation o machine motion, flyweels	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction to modelling mechanisms in SAM (Simulation and Analysis of Mechanisms) – presentation of examplesi	2
Proj2	Mechanisms' topology: rules of drawing digrams, topology analysis - joint classification, mobility (test, project)	2
Proj3	Rules of creating models in SAM system, creating simple models, model motion simulation, presentation of analysis results	2
Proj4	Dimensional modelling of mechanisms, drivers' definition, massis, external loads	2
Proj5	Kinematic analysis - position analysis (project)	2

Proj6	Kinematic analysis - velocity and acceleration determination - vector methods (test, project)	2
Proj7	Kinematic analysis - velocity and acceleration determination using SAM (project)	2
Proj8	Kinematic analysis using analytical methods: loop equation, vectors, projections, time derivatives (project)	2
Proj9	Planar manipulators - kinematic analysis using matrix notation	2
Proj10	Modelling manipulators in SAM: forward and inverse tasks (project)	2
Proj11	Anaysis of planetary transmissions, angular velocity ratio determination (test, project)	2
Proj12	Modelling of planetary transmissions and gear linkage mechanisms using SAM (project)	2
Proj13	Joint force and external equilibrium determination (test, project)	2
Proj14	Determination of joint forces including friction (test, project)	2
Proj15	Dynamic force analysis using SAM	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

F2	PEK_U01, PEK_U02, PEK_U03 PEK_K01	test
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Gronowicz A.: Fundamentals of kinematic systems analysis (in Polish). Oficyna Wydawnicza PWr., Wrocław 2003; Morecki A., Knapczyk J., Kędzior K.: Theory of mechanisms and manipulators (in Polish). WNT 2002; Miller S.: Theory of machines and mechanisms. Analysis of mechanical systems (in Polish). Oficyna Wydawnicza PWr. Wrocław 1996; Gronowicz A. i inni: Theory of machines and mechanisms. Set of analysis and synthesis problems (in Polish). Oficyna Wydawnicza PWr. Wrocław 2002

SECONDARY LITERATURE

Olędzki A.: Fundamentals of machines and mechanisms theory (in Polish). WNT 1987; Morecki A., Oderfeld J.: Theory of machines and mechanisms (in Polish). PWN 1987; Waldron K., Kinzel G.: Kinematics, Dynamics and Design of Machinery. John Wiley &Sons, Inc. 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Theory of Mechanisms and Manipulators
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W17	C1, C2, C3	Lec1-Lec13	N1 - N5
PEK_U01, PEK_U02, PEK_U03	K1MBM_U11	C2, C3	Proj1-Proj15	N2, N3, N4
PEK_K01	K1MBM_K04	C3	Proj1-Proj15	N3

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy automatyki**
Name in English: **Fundamentals of Automatic Control**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031024 (MMM031324)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of the 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
Lec15	Test. Credit.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Static characteristics of automatic objects.	2
Lab2	Dynamic characteristics of automatic objects.	2
Lab3	Frequency characteristics of automatic objects.	2

Lab4	Examination of automatic control systems.	2
Lab5	Simulation tests of automatic objects in Matlab-Simulink system.	2
Lab6	On-off control.	2
Lab7	Programming languages of PLC controllers.	2
Lab8	Mathematical fundamentals of digital automation systems.	2
Lab9	Elements and contactor-relay systems.	2
Lab10	Logic combinational systems.	2
Lab11	Synthesis of logic sequential systems.	2
Lab12	Modeling and programming of sequential processes.	2
Lab13	Modeling and programming of concurrent processes.	2
Lab14	Modeling and programming of complex processes.	2
Lab15	Industrial communication networks.	2
		Total hours: 30

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	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_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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W01, K1MBM_W16	C1-C3	Lec1-Lec15	N1
PEK_U01 - PEK_U03 PEK_K01 - PEK_K02	K1MBM_K05, K1MBM_U05	C4-C6	Lab1-Lab15	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: **Techniki wytwarzania-przeróbka plastyczna**
Name in English: **Manufacturing techniques-plastic working.**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031025 (MMM031325)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has knowledge of basic mechanical properties of engineering materials.
2. Have a basic knowledge of physics and mathematics.
3. Have skills in measurement methods, techniques for measuring and evaluating the results of the measurement.

SUBJECT OBJECTIVES

C1. Understanding the different manufacturing technologies by processing plastic products. Method used to investigate the effect of shaping the properties of the manufactured products.
C2. Understanding the phenomena limiting plastic forming processes.
C3. Knowledge of modern technologies for shaping plastic.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the basic technologies and material plastic forming process parameters.
PEK_W02 - Able to properly define the problem in the field of plastic forming and properly be characterized.
PEK_W03 - Can choose the right technology plastic forming and defining the basic parameters of the process.

II. Relating to skills:
PEK_U01 - Can search for information on plastic forming and execute their critical analysis.
PEK_U02 - Can use the theoretical knowledge gained in forming the lecture and apply it in practice.
PEK_U03 - Able to perform selected laboratory tests and correct to assess their performance.

III. Relating to social competences:
PEK_K01 - Can think and act in a creative way.
PEK_K02 - Acquires the ability to work as a team.
PEK_K03 - Understands the impact of engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	History of plastic processing.	1
Lec2	Effect of strain on the structure and properties of the material.	2
Lec3	Effect of plastic forming process on the properties of the product.	3
Lec4	Sheet metal forming processes. Analysis of cutting and bending processes.	3
Lec5	Course of process of formation of articles about non - the developable surface.	3
Lec6	Processes of forming lumps. Analysis of the process of rolling plates and profiles.	3
Lec7	The conduct and analysis of the extrusion process..	3
Lec8	The course and forging process analysis.	2
Lec9	Manufacture of metal in the drawing process.	2
Lec10	Manufacture of metal in the metal powder metallurgy.	2
Lec11	Metal Forming Tools.	2
Lec12	Overview of modern technologies for shaping plastic.	3
Lec13	Final test	1
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Cold deformation and annealing of metals.	2
Lab2	Cupping test sheets.	2
Lab3	Rolled metal sheets and profiles.	2
Lab4	Squeezing metallurgical and machine parts.	2
Lab5	Manufacture of metal in the process of drawing.	2
Lab6	Expression - cut, bending and pressing.	3

Lab7	Free forging and matrix.	2
		Total hours: 15

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

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

The Gronostajski J., Plastic processing of metals, Wroclaw 1974Morawiecki M., Sadok L., Wosiek the E., Theoretical bases of technological processes of plastic alteration, Wyd. Silesia, Katowice 1981 http://www.metalplast.pwr.wroc.pl/instrukcje.html

SECONDARY LITERATURE

The Romanowski P., Guide of plastic processing on hold, the Publishing house Scientifically - Technical, Warsaw 1976. the Erbel the S., Kuczyński the K., Marciniak the Z., plastic Processing of, PWN, Warsaw 1981.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing techniques-plastic working.
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01÷ PEK_W03	K1MBM_W21	C1÷ C3	Lec1÷ Lec7	N1
PEK_U01÷PEK_U03	K1MBM_U29	C1÷ C3	Lab1÷ Lab7	N2, N3, N4
PEK_K02÷ PEK_K03	K1MBM_K04	C1÷ C3	Lab1÷ Lab7	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Andrzej Dolny tel.: 21-74 email: andrzej.dolny@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Techniki wytwarzania-spawalnictwo**
Name in English: **Manufacturing techniques - welding**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031026 (MMM031326)**
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. 1.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 its right choice.
2. 2.Has a detailed knowledge about structures of steel and cast iron, rules of its classification and description, has a basic knowledge about thermal and thermo-mechanical treatment, knowledge about alloyed steels and non-ferrous metals and its alloys, has the theoretical knowledge about electric circuits.
3. 3.Can analyze macrostructures of materials, technological imperfections, can estimate features of microstructure of metals, can identify phases using the balance curves, can distinguish microstructures according to amount of carbon in steel, influence of thermal treatment, can analyze electric circuits, understands technical drawings, can prepare technical documentation

SUBJECT OBJECTIVES

C1. Getting of basic knowledge about joining of metals with use of welding methods.
C2. Getting of skills of the right choice of joining and basic parameters of the process.
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 - Knows types of joints, welding positions, description of joints, reasons of cracking of joints
PEK_W02 - Knows basic methods of welding and parameters of the process
PEK_W03 - Has the knowledge concerning metallurgy of welding processes, brazing/soldering, pressure joining and thermal cutting

II. Relating to skills:
PEK_U01 - Can define basic parameters of welding, describe basic properties of welding equipment and make a right choice of consumables
PEK_U02 - Can define basic parameters of brazing/soldering and resistance welding, describe basic properties of welding equipment and make a right choice of consumables
PEK_U03 - Can define basic parameters of thermal cutting, analyze influence of cutting on properties of the cutting surface and precision of following of the shape

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	Organization of the lecture, Safety in welding, Types of welds and joints, welding positions	2
Lec2	Basics of metallurgy of welding processes	2
Lec3	Fuel gas welding of steel, cast iron and non-ferrous metals	2
Lec4	Basic information about arc welding	2
Lec5	Shielded manual metal arc welding	2
Lec6	Gas shielded tungsten arc welding	2
Lec7	Gas shielded metal arc welding GMAW	2
Lec8	Submerged arc welding and electroslag welding	2
Lec9	Welding with use of concentrated energy sources	2

Lec10	Brazing and soldering. Braze welding	2
Lec11	Thermal oxygen, plasma and laser cutting. Water cutting	2
Lec12	Resistance pressure joining, Friction welding	2
Lec13	Hardfacing and thermal spraying	2
Lec14	Stresses and deformations in welding. Thermal treatment of welded joints	2
Lec15	Acceptance tests of welded structure. Quality systems in welding	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Organization of the lab. Safety in welding. Fuel gas welding of steel	2
Lab2	Brazing and soldering of steel, copper and aluminum	2
Lab3	Resistance pressure joining Friction welding	2
Lab4	Shielded manual metal arc welding	2
Lab5	Gas shielded tungsten and metal arc welding	2
Lab6	Stresses and deformations in welding. Submerged arc welding	2
Lab7	Thermal oxygen and plasma cutting. Robotic welding	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Ambroziak, A. (ed.). Manufacturing techniques. Welding. Laboratory. Wrocław University of Technology, 2011, http://Www.Dbc.Wroc.Pl/

SECONDARY LITERATURE

1. Pilarczyk, J. (eds.): Advisory Engineer. Welding. Vol I and II, WNT Warszawa, 2003, 2005
2. Klimpel A: Welding, Resistance Welding and Cutting Metals., WNT, Warsaw, 1999

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Manufacturing techniques - welding
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W21	C1, C3	Le1 - Le15	N1, N5
PEK_U01 - PEK_U03	K1MBM_U28	C1, C2, C3	Lab1 - Lab7	N2, N3, N4
PEK_K01 - PEK_K03	K1MBM_K04	C3	Lab1 - Lab7	N2 - N5

SUBJECT SUPERVISOR

dr inż. Piotr Białucki tel.: 42-71 email: piotr.bialucki@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Tworzywa sztuczne**
Name in English: **Polymers**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031027 (MMM031327)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The Student has got a basic knowledge in the field of materials science and chemistry.

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge of construction, preparation, modification and properties of polymeric materials.
C2. Acquisition of basic knowledge about the technology used for plastics processing.
C3. Getting skill about selection of polymeric materials in certain applications.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows the basic groups of polymers, their structure, properties.
PEK_W02 - The student knows the technology used for the processing of polymeric materials,
PEK_W03 - The student knows the basic applications of polymeric materials.

II. Relating to skills:
PEK_U01 - Is able to identify polymeric materials.
PEK_U02 - Can indicate the processing technology for producing a selected product from the plastic material,
PEK_U03 - Place the selected polymeric materials for specific applications.

III. Relating to social competences:
PEK_K01 - Searches of information and its critical analysis,
PEK_K02 - Team cooperation on improving methods for the selection of a strategy to optimally solve problems assigned to the group
PEK_K03 - Compliance with the customs and rules of the academic community.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basics, nomenclature. Classification and distribution of polymeric materials.	2
Lec2	Preparation of polymers and plastics. Polymerization processes and the production of plastic materials	2
Lec3	Structure of the polymers and the resulting properties.	2
Lec4	Models mechanical behavior of polymers.	2
Lec5	Rheology and behavior of materials during processing.	2
Lec6	Transformation of plastics, the impact of environmental conditions on the behavior of polymeric materials.	2
Lec7	The basic group of polymeric materials and their specific properties.	2
Lec8	Methods for modification of polymeric materials and their impact on the property.	2
Lec9	Preparation of polymer composites.	2
Lec10	Overview of polymeric construction materials - Properties and application of thermoplastic materials.	2
Lec11	Overview of polymeric construction materials - Properties and application of chemically-and thermosetting plastics and elastomers.	2
Lec12	Primary processing technologies plastics - injection molding	2
Lec13	Technologies primary processing of polymeric materials - extrusion	2
Lec14	Technologies secondary processing of polymeric materials - thermoforming	2
Lec15	Manufacturing technologies of chemicallysetted polymers	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Polymeric materials and methods for their identification	2

Lab2	Technologies of plastics parts joning	2
Lab3	Primary processing technology - injecting molding	2
Lab4	Secondary processing technologies - Vacuum thermoforming and blow molding	2
Lab5	Friction and wear test of polymeric materials	2
Lab6	Research sagging body wall - analytical methods and experimental	2
Lab7	Thermosetting plastics processing technologies - casting and pressing	2
Lab8	Tools for processing of plastics	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. laboratory experiment
N4. report preparation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	quiz,
F2	PEK_U02	quiz, oral answer
F3	PEK_U03	quiz, oral answer
F4	PEK_K01, PEK_K02, PEK_K03	oral answer, report
P = (F1+F2+F3+F4)/4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Robert Sikora, Przetwórstwo tworzyw wielkocząsteczkowych, Warszawa : "Żak", 1993;Wojciech Kucharczyk, Wojciech Żurowski, Przetwórstwo tworzyw sztucznych dla mechaników, Radom : Politechnika Radomska. Wydawnictwo, cop. 2005; Izabella Hyla, Tworzywa sztuczne : własności, przetwórstwo, zastosowanie, Gliwice : Wydawnictwo Politechniki Śląskiej, 2000.

SECONDARY LITERATURE
Piotr Jasiulek, Łączenie tworzyw sztucznych metodami spawania zgrzewania, klejenia i laminowania, Krosno, Wydaw. i Handel Książkami "KaBe", 2004;

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03,	K1MBM_W13	C1	Lec1-Lec15	N1, N2-N3
PEK_U01-PEK_U03	K1MBM_U29	C2	Lab1-Lab8	N2-N4
PEK_K01-PEK_K03	K1MBM_K09	C3	Lab1-Lab8	N2-N4

SUBJECT SUPERVISOR

dr inż. Roman Wróblewski tel.: 320-21-70 email: r.m.wroblewski@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): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031029**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student 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 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.	1
Lec2	Basic symbols of hydraulic and pneumatics components.	1
Lec3	Hydraulic fluids - their properties.	2
Lec4	Contaminations - sources, reasons and results - filtration.	1
Lec5	Positive displacement pumps - systematics, characteristics, efficiencies.	2
Lec6	Valves - systematics, types, functions.	4
Lec7	Hydraulic and volumetrics losses in displacement machines and in the system.	2
Lec8	Efficiency: hydraulic, volumetric and overall.	2
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Introduction, laboratory range presentation, check form, requirements.	2
Lab2	Experimental determination properties of working fluid - bulk modulus.	2
Lab3	Experimental determination resistance character in hydraulic pipes - linear resistance.	2
Lab4	Local resistences in hydraulic systems. Orifice as a local resistance - cavitation effect.	2
Lab5	Experimental determination pump characteristic.	2

Lab6	Static characteritics of conventional directional control valve.	2
Lab7	Description of transient states in hydraulic systems - experimental determination of basic dynamic factors.	2
Lab8	Check.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K03	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 .
Kollek W.: Gear pumps (in polish). Zakład Narodowy im. Ossolińskich, Wrocław 1996.
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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W08	C1	Lec1,Lec2, Lec3	N1,N2
PEK_W02	K1MBM_W08	C2	Lec4,Lec5, Lec6	N1,N2
PEK_W03	K1MBM_W08, K1MBM_W20	C3	Lec7,Lec8	N1,N2
PEK_U01	K1MBM_U09	C1,C2	Lab1,Lab2, Lab4,Lab5, Lab6	N3,N4,N5
PEK_U02	K1MBM_U09, K1MBM_U24	C3	Lab3,Lab4, Lab7	N3,N4,N5
PEK_U03	K1MBM_U24, K1MBM_U25	C1,C3	Lab8,Lab2	N3,N4,N5
PEK_K01- PEK_K03	K1MBM_K09	C1-C3	Lab1-Lab7	N1-N5

SUBJECT SUPERVISOR

dr hab. inż. Michał Stosiak tel.: 71 320-45-99 email: Michal.Stosiak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metoda elementów skończonych**
Name in English: **Finite Element Method**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031030 (MMM031330)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of strength materials. Analysis of beam, plate and shell structures. Fundamentals of engineering materials.
2. Matrix algebra
3. Skills in basic CAD tolls. Skills for solving basic engineering elements with use of classical elastic theory.

SUBJECT OBJECTIVES

C1. Learn the basics of the finite element method theory
C2. Learn how to prepare proper model for FEM calculations
C3. Learn to model and perform simulations of the effort of the load carrying structures with use of numerical methods

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Have knowledge in the fundamentals of finite element method
PEK_W02 - Have the knowledge to prepare proper geometrical and discrete model to solve FEM task.
PEK_W03 - Is able to use FEM in practical application of calculation of engineering structures. Can formulate and solve problems of the ultimate strength of load carrying structures.

II. Relating to skills:
PEK_U01 - Skills in software for the FEA
PEK_U02 - Have the knowledge to prepare proper geometrical and discrete model to solve the task in the range of elastic deformation.
PEK_U03 - Is able to perform FEA in the field of liner and nonlinear statics, dynamics, vibrations and linear buckling.

III. Relating to social competences:
PEK_K01 - Learn the responsibility for his work.
PEK_K02 - Creative thinking and acting
PEK_K03 - Learn team work due to the necessity of information flow during project realisation

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Development of the numerical methods in the theory of constitutive equations.	1
Lec2	Introduction and basic assumptions of FEM	1
Lec3	Approximation functions, classifications of finite elements, convergence conditions	2
Lec4	Construction of stiffness matrix of the fundamental finite elements (plate, shield, beam, solid)	2
Lec5	Characteristics of the fundamental finite elements 1D, 2D, 3D and presentation of the basic relations	4
Lec6	Definition of the material model used in simulations of static, dynamic problems with use of FEM.	1
Lec7	Mehtodics of discrete model creation	1
Lec8	Numerical simulations with use of FEM in statics, dynamics and thermal problems	3
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction. Presentation of the software	2
Proj2	Discrete model creation principles. Assumptions and simplifications of the model	3
Proj3	Solid models discretization. Analysis of the parameters (type of the element, mesh density) and its influence on the results.	4
Proj4	Designing and modeling of the thin walled beam and shell structures	4
Proj5	Boundary conditions: DOF and load applicaiton	2

Proj6	Principles of the creation of the complex models of load carrying structures.	4
Proj7	Principles of design and modeling of structural nodes and the load transfer	3
Proj8	Results analysis. Effort criterion.	2
Proj9	Modal analysis, buckling and thermal load	3
Proj10	Individual modeling of selected structural node	3
		Total hours: 30

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. problem exercises
N3. project presentation
N4. individual work and preparation to the exam

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01-PEK_K03	mark on the basis of the simulation project part
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusiński E., Metoda elementów skończonych. System COSMOS/M, WKiŁ Warszawa 1994
Rusinski E., Czmochowski J., Smolnicki T.: Zaawansowana metoda elementów skończonych w konstrukcjach nośnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Zienkiewicz O.C.: Metoda elementów skończonych, Arkady 1972

SECONDARY LITERATURE

Rusiński E.: Zasady projektowania konstrukcji nośnych pojazdów samochodowych. Oficyna Wyd. PWr Wrocław 2002
Rakowski G., Kacprzyk Z.: Metoda elementów skończonych w mechanice konstrukcji, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005
Szmelter J., Dacko M., Dobrociński S., Wieczorek M.: Metoda elementów skończonych w statyce konstrukcji, Arkady 1979
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski K., Wittbrodt E.: Metoda elementów skończonych w dynamice konstrukcji, Arkady, Warszawa 1984
Waszczyszyn Z., Cichoń Cz., Radwańska M.: Metoda elementów skończonych w stateczności konstrukcji, Arkady, Warszawa 1990
Kleiber M.: Wprowadzenie do metody elementów skończonych, PWN, Warszawa-Poznań 1989

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W19	C1	Lec 1-15	N4
PEK_W02	K1MBM_W19	C2	Lec 6, 7	N2, N4
PEK_W03	K1MBM_W18, K1MBM_W19	C3	Lec 8	N4
PEK_U01, PEK_K01	K1MBM_K02, K1MBM_U22	C1	Pr 1,2	N2
PEK_U02, PEK_K02	K1MBM_K02, K1MBM_U22	C2	Pr 3-7	N1, N2
PEK_U03, PEK_K03	K1MBM_K02, K1MBM_U18, K1MBM_U19	C3	Pr 8-10	N1, N3

SUBJECT SUPERVISOR

Prof. dr hab. inż. Eugeniusz Rusiński tel.: 71 320-42-85 email: Eugeniusz.Rusinski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Układy napędowe pojazdów**
Name in English: **Driving Systems of Vehicles**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031032 (MMM031332)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. positive marks of mechanics, mathematical analysis and construction of foundations.
2. basic knowledge of working various systems or machines devices.
3. Basic ability to work in groups.

SUBJECT OBJECTIVES

C1. The aim of the course is to broaden the knowledge of the construction vehicle propulsion systems and their components. The student gets acquainted with the methods of developing and preparing the characteristics of individual components of propulsion systems, traction characteristics and primary energy sources.
C2. The aim of the course is to acquire practical knowledge of the methods of calculation and selection of individual drive components and determine how to prevent undesirable phenomena such as the circulating power, etc. He knows the need for further professional development.
C3. The aim of the course is the acquisition of practical skills experiment planning, conducting it and interpreting the results. The student is aware of the impact of selected environmental solutions and is able to use the correct terminology. Student is responsible for own work and group work.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - primary energy sources can be selected and the characteristics are known; can and described the power flow through the various elements of the powertrain, hydrostatic, hydrodynamic and mechanical, powertrain components are selected on the basis of calculations and characteristics.
PEK_W02 - can point out the use of power systems and improve them to suit your needs based on the development of technology;
PEK_W03 - is able to describe and explain the principles of operation of the various components of propulsion systems, indicate the potential for adverse effects and identify methods for their elimination.

II. Relating to skills:
PEK_U01 - can also using foreign literature to interpret the results obtained in the laboratory experiments and the use of catalogs;
PEK_U02 - is able to analyze and develop the results in order to obtain the characteristics or parameters measured in the propulsion system of vehicles and machinery at different settings of the control system;
PEK_U03 - is able to offer own ideas and own propulsion control systems performing similar functions.

III. Relating to social competences:
PEK_K01 - is capable and understands the need for continuous updating of skills and acquire new kwowledge;
PEK_K02 - is responsible for the decisions both in terms of environmental and mechanical engineering activities;
PEK_K03 - is able to work in a team and solve the tasks assigned to the various positions and is responsible for the group to achieve its intended purpose.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Systematic drive systems (systems single source, multi-source, serial, parallel, hybrid) - application examples. The basic functions performed by the powertrain (transmission, transformation, distribution, accumulation and energy recuperation) - Case studies.	2
Lec2	The characteristics of conventional primary and secondary sources of energy - control principle. Non-conventional sources of energy (eg, fuel, etc.) - examples of applications and development trends.	2
Lec3	Strenuous-intensity characteristics of power consumers - examples of typical load in the form of linear, area, cycle, spectrum charges etc.	2
Lec4	Propulsion systems of the "rigid" and "flexible" kinematic coupling. The issue of non-compliance kinematic and power circulating in the propulsion system - basic physical, technical implications, sposobyeliminacji-examples.	2
Lec5	Basic structure of the propulsion system selection and selection problem of primary energy sources: a) typical mechanical drive system b) typical drive system converter.	2
Lec6	Basic structure of the propulsion system selection and selection problem of primary energy sources: c) a typical hydrostatic system. Drive systems with stepper motors and servo-electric principle.	2
Lec7	Issues of transients in the propulsion system under the elastic ties, starting characteristics of conventional and programmable - minimizing the negative effects of dynamic.	3
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Experimental studies hydrostatic drive earth working vehicle.	2
Lab2	Experimental studies on hybrid caterpillar driving system.	2
Lab3	Experimental determination of the characteristics of the selected receiver of energy and the choice of the optimum driveline capstans.	2
Lab4	Comparison of the boot process of asynchronous motor in the driving system	2
Lab5	Study of the effect of elastic stiffness in a driving system on its dynamic toughness.	2
Lab6	Determination of the characteristics of the external combustion engine ignition.	2
Lab7	The study of motion parameters of the propulsion system of an internal combustion engine and "flexible" kinematic coupling.	2
Lab8	Experimental research of wheel loader extended arm working system.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_K01-PEK_K03	short test, the report of the exercises, oral answer
P = pozytywne oceny z wszystkich ćwiczeń laboratoryjnych		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Szumanowski A. , tytuł: Układy napędowe z akumulacja energii, PWN, rok: 19902. Pieczonka K. , tytuł: Maszyny urabiające, Politechnika Wrocławska, rok: 19883. Szydelski Z. , tytuł: Napęd i sterowanie hydrauliczne, WKŁ, rok: 19994. Kaczmarek T., tytuł: Napęd elektryczny robotów, Wydawnictwo Politechniki Poznańskiej, rok: 19965. Wróbel T. , tytuł: Silniki krokowe, Wydawnictwo Naukowo-Techniczne, rok: 19936. Kosmol J., tytuł: Serwonapędy obrabiarek sterowanych numerycznie, Wydawnictwo Naukowo-Techniczne,rok: 1998

SECONDARY LITERATURE

1. Dębicki M., tytuł: Teoria samochodu, WNT , rok: 19692. Szumanowski A. , tytuł: Czas energii, WKiŁ, rok: 19883. Mitschke M. , tytuł: Dynamika samochodu. Napęd i hamowanie., WKiŁ, rok: 19874. Michałowski K. Ocioszyński J., tytuł: Pojazdy samochodowe o napędzie elektrycznym i hybrydowym, WKiŁ, rok: 1989

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Driving Systems of Vehicles
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W20	C1, C2, C3	Lec1-Lec7	N1, N3
PEK_W02	K1MBM_W25	C1, C2, C3	Lec3-Lec7	N1, N3
PEK_W03	K1MBM_W17	C1, C2, C3	Lec1-Lec7	N1, N3
PEK_U01	K1MBM_U01	C3	Lab1-Lab7	N2
PEK_U02	K1MBM_U24, K1MBM_U39	C3	Lab1-Lab7	N2
PEK_U03	K1MBM_U25	C3	Lab1-Lab7	N2
PEK_K01	K1MBM_K07	C1, C2	Lab1-Lab7	N3
PEK_K02	K1MBM_K02	C1, C2	Lab1-Lab7	N3
PEK_K03	K1MBM_K04	C3	Lab1-Lab7	N2

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Metrologia wielkości geometrycznych**
Name in English: **Metrology of geometrical quantites**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031033 (MMM031333)**
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 has a basic knowledge of mathematics and physics at secondary school level
2. Student has the ability to read drawings and diagrams contained in the technical documentation.
3. Student has basic knowledge in the design of machine elements. It has a basic knowledge of manufacturing techniques of machine parts.

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

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

Lec2	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	Dimensions, tolerance of linear dimensions nad fits.	3
Lec5	GPS - geometrical tolerance according to ISO 1101. Geometrical deviations mesurements.	3
Lec6	Description of geometric structure of surfaces - roughness and waviness, and their measurement.	2
Lec7	Tolerance and machine parts measurement.	3
Lec8	Tolerating and measurements of machines parts manufactured in the process of: casting, plastic forming, welding, plastics processing.	3
Lec9	Classification of the measuring equipment, the metrological characteristics and methods of assessment.	2
Lec10	Mehods and means of mechanization and automation of measurements.	2
Lec11	Analysis of dimension. Fundamentals of statistical control of dimensions.	2
Lec12	Fundamentals of coordinate measurement techniques.	2
		Total hours: 28
Form of classes – Laboratory		Number of hours
Lab1	Organizational matters. General principles for the use of measuring equipment.	2
Lab2	Errors of measurement and assasement methods of measurement uncerteinaty.	2
Lab3	Measurements of linear dimensions.	2
Lab4	Measurements of angular dimensions.	2
Lab5	Direct and indirect measurements of cones.	2
Lab6	Identification and measurement of threads.	2
Lab7	Project of a tests.	2
Lab8	Assessment of the geometrical structure of the surface.	2
Lab9	Identification and measurement of cylindrical gears.	2
Lab10	Measurements of selected shape deviations.	2
Lab11	Measurements of selected displacement.	2
Lab12	Cams measurement.	2
Lab13	Measurements of machine parts with pneumatic measurement equipment.	2
Lab14	Verification of measuring instruments	2
Lab15	Coordinate masurements of machine parts.	2
		Total hours: 30

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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03;	K1MBM_W15	C1; C2; C3; C4; C5; C6	Wy1-Wy13	N1; N5
PEK_U01; PEK_U02; PEK_U03;	K1MBM_U12, K1MBM_U40	C1; C2; C3; C4; C5; C6	La1 - La15	N2; N3; N4; N5
PEK_K01; PEK_K02; PEK_K03;	K1MBM_K04, K1MBM_K05, K1MBM_K06	C1; C2; C3; C4; C5; C6	La1 - La15	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: **Techniki wytwarzania-obróbka ubytkowa**
Name in English: **Production Technics - Machining**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031034 (MMM031334).**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	45		30		
Number of hours of total student workload (CNPS)	60		60		
Form of crediting	Examination		Crediting with grade		
Group of courses					
Number of ECTS points	2		2		
including number of ECTS points for practical (P) classes			2		
including number of ECTS points for direct teacher-student contact (BK) classes	1.2		1.4		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		3
Lec2		3
Lec3		3
Lec4		3
Lec5		3
Lec6		3
Lec7		3
Lec8		3
Lec9		3
Lec10		3
Lec11		3
Lec12		3
Lec13		3
Lec14		3
Lec15		3
		Total hours: 45
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		2
Lab8		2
Lab9		2
Lab10		2
Lab11		2
Lab12		2
Lab13		2
Lab14		2
Lab15		2
		Total hours: 30

TEACHING TOOLS USED

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Production Technics - Machining
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01; PEK_W02; PEK_W03	K1MBM_W22	C1; C2; C3		N1
PEK_U01; PEK_U02; PEK_U03	K1MBM_U26, K1MBM_U31	C1; C2; C3		N2; N3

PEK_K01; PEK_K02; PEK_K03	K1MBM_K04, K1MBM_K07	C1; C2; C3		N2; N3

SUBJECT SUPERVISOR
Prof. dr hab. inż. Piotr Cichosz tel.: 21-57 email: piotr.cichosz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszyny technologiczne CNC i roboty**
Name in English: **Technological CNC machines and robots**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031036 (MM031336)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about design & manufacturing process, structure and operation of machine components and assemblies, as well as principles of their selection and designing.
2. Well-grounded knowledge about basic manufacturing techniques and role of technological machines.
3. Ability to design a manufacturing process in the field of chipless forming and machining.

SUBJECT OBJECTIVES

C1. Getting acquainted with engineering of basic CNC manufacturing machines and robots, in particular with their control, drive and measurement systems.
C2. Getting acquainted with programming principles of CNC machines according to ISO standard and with principles of building and implementing driver software, as well as with methods supporting a programmer's work.
C3. Getting acquainted with principles and possibilities of using automated single- and multimachine systems for executing specific machining tasks.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of engineering and operation principles of modern CNC manufacturing machines, in particular principles of their operation control.
PEK_W02 - Knowledge of selection principles of CNC manufacturing machines intended for specific machining tasks.
PEK_W03 - Knowledge of programming principles of CNC machines.

II. Relating to skills:
PEK_U01 - Ability to evaluate CNC manufacturing machines with respect to their suitability for specific machining tasks.
PEK_U02 - Ability to elaborate a program structure for basic CNC machines, as well as to use standard subprograms and cycles.
PEK_U03 - Ability to select and preset machining parameters, select tools and verify correctness of the developed programs.

III. Relating to social competences:
PEK_K01 - Ability to search-out and use professional literature recommended for the course and to gain knowledge independently.
PEK_K02 - Ability to make use of modern IT tools.
PEK_K03 - Understanding of the necessity of systematic and individual work on mastering the course content.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	General characteristics of manufacturing machines and their classification. Geometrical, kinematic and dynamic structures of the machines. Technical and operational parameters. Basic requirements.	2
Lec2	Parts, mechanisms and components of CNC manufacturing machines: bodies, spindle and guiding assemblies, tooling and workpiece systems.	2
Lec3	Main drive and feeding systems of modern manufacturing machines (basic requirements, exemplary solutions). Measurement, diagnostics and supervision systems.	4
Lec4	Basics of automatic control of manufacturing machines. Classification of control systems (NC, CNC, DNC, AC and PLC systems).	2
Lec5	Introduction to programming numerically controlled machines – geometrical basics of CNC control, coordinate systems, driver structure, interpolation. Ways of computer-aided programming – machining simulators.	2
Lec6	Review of groups of CNC machines: lathes, milling machines, grinding machines (technical & usable features and purpose of the machines).	2
Lec7	Review of groups of CNC machines: machining centres, autonomous machining stations (technical & usable features and purpose of the machines).	2
Lec8	CNC machines for electrochemical and laser machining (technical & usable features and purpose of the machines).	2
Lec9	Industrial robots and manipulators (structure, classification and application fields). Structure and purpose of coordinate measuring machines.	2

Lec10	Multimachine, robotized manufacturing systems, production centres and lines (organizational structures and application fields). Computer-integrated manufacturing systems (CIM).	2
Lec11	Machines and devices for additive manufacturing and reverse engineering techniques – exemplary applications.	2
Lec12	Trends in development of CNC manufacturing machines (machines for HSC and HPC machining, hexapods, intelligent and hybrid machine tools).	2
Lec13	Credit colloquium.	2
		Total hours: 28
Form of classes – Laboratory		Number of hours
Lab1	The use of the manipulator in processes of thermal spraying.	2
Lab2	The use of robots in sheet and spot welding processes.	2
Lab3	Control of machines in sheet metal forming processes.	2
Lab4	The use of Coordinate Measuring Machine (CMM).	2
Lab5	Automation of technological processes using PLC controllers (FESTO system).	2
Lab6	Machines to implement additive technology (Rapid Prototyping).	2
Lab7	Reverse Engineering equipment.	2
Lab8	Crediting the course.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Selection of a machine tool, preparation of a workpiece, selection of tools and machining parameters.	2
Proj2	Determination of characteristic points of a contour and location of a workpiece in the machine-tool workspace.	2
Proj3	Elaboration of a driver software to control the manufacturing process on a CNC machine – linear and circular interpolation.	2
Proj4	Elaboration of a driver software to control the manufacturing process on a CNC machine – establishing corrective functions; programming movements with correction of tool dimensions.	2
Proj5	Elaboration of a driver software to control the manufacturing process on a CNC machine – subprograms technique, incremental programming, programming movements in a loop.	2
Proj6	Elaboration of a driver software to control the manufacturing process on a CNC machine – use of machining cycles at programming.	2
Proj7	Elaboration of a driver software to control the manufacturing process on a CNC machine – completion of the project and its verification.	2
Proj8	Summary of the work – presentation of the project and its assessment.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. own work – preparation for crediting the lecture
N3. self study - preparation for project class and laboratory
N4. presentation of the project, crediting the lab subjects
N5. consultancies

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

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	Class admission test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Assessment of the project preparation
F2	PEK_U01 - PEK_U03	Defence of the project
P = 0.5(F1+F2)		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Honczarenko J.: Flexible automation of manufacture. Machine tools and machining systems. WNT Warsaw, 2000 (in Polish)
Kosmol J.: Automation of machine tools and machining. WNT Warsaw, 2000 (in Polish)
Honczarenko J.: Numerically controlled machine tools. WNT Warsaw, 2009 (in Polish)
Programming of CNC machine tools. Editorial Office REA. Warsaw, 1999 (in Polish)
Nikiel G.: Programming of CNC machine tools on the example of control system Sinumerik 810D/840D. ATH Bielsko-Biała, 2004 (available in internet) (in Polish)
Habrat W.: Operation and programming of CNC machine tools. Operator's handbook. KaBe, Krosno, 2007 (in Polish)
Kosmol J., Słupik H.: Programming of numerically controlled machine tools. Silesian University of Technology, Gliwice, 2001 (in Polish).

SECONDARY LITERATURE
Engineer's handbook. Machining. Vol. 1, 2, 3. WNT Warsaw, 1992 – 1994 (in Polish)
Instruction manual of Sinumerik control system programming (available in internet) (in Polish)
Dudik K., Górski E.: Lathe operator's handbook. WNT Warsaw, 2000 (in Polish)
Dudik K., Górski E.: Milling machine operator's handbook. WNT Warsaw, 2003 (in Polish)
Catalogues of tools used at CNC machine tools (in Polish).

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technological CNC machines and robots
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W35	C1 - C3	Wy1 - Wy13	N1, N2, N5
PEK_U01 - PEK_U03	K1MBM_U17	C1 - C3	Pr1 - Pr8; Lab1 -Lab8	N3, N4
PEK_K01 - PEK_K03	K1MBM_K04	C1 - C3	Pr1 - Pr8; Lab1 -Lab8	N2 - N5

SUBJECT SUPERVISOR

dr inż. Marcin Madeja tel.: 3204185 email: marcin.madeja@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy eksploatacji i remontów maszyn**
Name in English: **Fundamentals of machine exploitation and repair**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031039**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has basic knowledge of chemistry, physics, engineering drawing, material science and machine component construction; knows the principles of matching typical machine components; understands the necessity of lubrication and wear preventing measures in machine operation; knows the basic technological processes for typical machine parts; understands the necessity of protecting the natural resources and reducing the amount of wastes; is aware of the consequences of polluting the environment with production wastes.
2. The student has knowledge concerning the hazards arising from industrial activity and machine operation; knows the international conventions and the Polish laws applying to environmental protection, and the environmental aspects of constructing, using and upgrading machines; is aware of the importance of and understands the nontechnical aspects and consequences of engineer and production manager activity, including its impact on the environment, and the consequent responsibility for the decisions made.

SUBJECT OBJECTIVES

C1. The student is to acquire basic knowledge about machine operation processes; to understand the systemic approach to operation and to the description and assessment of the operation process; to learn to describe the technical condition and reliability of an object.
C2. The student is to learrn models of the reliability of simple repairable und unrepairable objects and of the reliability of complex objects.
C3. The student is to acquire skills of planning stocks of spare parts and consumable materials; to learn the principles of implementing repair management, the methods of regenerating worn out machine parts, modernizing machines, waste acquisition and recycling; to learn the principles of preventing and diagnosing in the operation of machines and the environmental principles of their operation.
C4. The student is to learn how to process rating indices and operational test simulation results; to acquire basic knowledge relating to diagnosing and assessing the condition of machines through the measurement and analysis of such machine operating parameters as energy consumption, machine component heating, vibration and noise levels and machine unit positioning accuracy; to learn to determine the technical condition of a machine, the degree of its wear and the range of repairs.
C5. The student is to acquire the skill of selecting a machine repair system and organizing repairs.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student understands the systemic approach to the operation process, knows how to describe this process and the technical condition of an object and knows the principles of assessing its reliability.
PEK_W02 - The student has knowledge relating to the assessment of the technical condition of an object, the cost-effectiveness of a machine repair, the way of preparing and carrying out the repair; understands the impact of the machine and the processes being conducted on the human being and the environment; knows the principles of eco-friendly machine operation.
PEK_W03 - The student knows the methods of assessing machine condition;can assess the need for, viability and range of a machine repair.

II. Relating to skills:
PEK_U01 - The student can assess the condition of simple and complex technical objects and their reliability
PEK_U02 - The student can assess the need for repair and its essential extent, select a method of regenerating oarts, manage the stock of consumable materials and spare parts
PEK_U03 - The student can minimize the adverse effects of a machine and the process being run on the oersonnel and the environment

III. Relating to social competences:
PEK_K01 - The student knows how to search for information on machine repairs and to critically evaluate this information.
PEK_K02 - The student can objectively evaluate diagnostic parameters and collaborate in a team to select the optimum method of bringing a machine back to its original operating condition.
PEK_K03 - The student can objectively evaluate arguments, substantiate her/his ideas, using machine operation knowledge.

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1	Basic machine operation terms.	1
Lec2	The praxeological and systemic approach to operation.	2
Lec3	The description and assessment of the operation process.	2
Lec4	The description of the technical condition of an object.	2
Lec5	The notion of reliability.	2
Lec6	The reliability of simple reapairable and unrepairable objects.	2
Lec7	The reliability of complex objects.	2
Lec8	The planning of spare parts and consumable materials inventories.	2
Lec9	The technicallyjustified methods of regenerating machine parts.	2
Lec10	Repair management, repair systems, machine modernization.	3
Lec11	Prevention and diagnostics in machine use.	3
Lec12	Waste acqisition, recycling and neutralization.	1
Lec13	Environmental aspects of constructing, operating and repairing machines.	2
Lec14	The rational lubrication of machines, lubrication tecgniques, minimal lubrication.	2
Lec15	The treatment and neutralization of lubricants, cooling agents and techological fluids.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	The basic operational states of a technical object, operating process rating indices.	1
Lab2	The analisysis of the condition of a technical object (a car, an engineering machine) on the basis of its fuel and energy consumption.	2
Lab3	The analysis of the undamageability of a selected technical object. Basic reliability indices.	2
Lab4	The analysis of the repairability of a selected technical object. The determination of repair time and weak links.	2
Lab5	The power losses and efficiency of complex drive system, the assessment of the condition of a drive.	2
Lab6	The assessment of the enery consumption and condition of bearings.	2
Lab7	The acoustic diagnosis of the technical condition of machine assembiles, the testing ofthe dynamic properties of machines.	2
Lab8	The operating properties of and the determination of the charakteristic of a drive system with a ball screw.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - preparation for laboratory class
N3. laboratory experiment
N4. 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_W03	written examination
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U02 ÷ PEK_U03, PEK_K01 ÷ PEK_K03	short tests
F2	PEK_U02 ÷ PEK_U03, PEK_K01 ÷ PEK_K03	reports from laboratory classes
P = średnia wszystkich ocen		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Konspekty przekazane przez prowadzącego,
2. Ziemba S: Problemy rozwoju nauki o eksploatacji maszyn i urządzeń technicznych, PWN W-wa 1983,
3. Olearczyk E: Zarys teorii użytkowania urządzeń technicznych, WNT W-wa,
4. Gołąbek A: Elementy teorii eksploatacji - skrypt PWr,
5. Podniało A: Paliwa, oleje i smary w ekologicznej eksploatacji, WNT W-wa 202

SECONDARY LITERATURE

Miesięcznik: Inżynieria i Utrzymanie Ruchu Zakładów Przemysłowych

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Fundamentals of machine exploitation and repair
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

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

PEK_W01	K1MBM_W25, K1MBM_W26	C1, C2	Wy1 ÷ Wy7	N1, N2, N4, N5
PEK_W02	K1MBM_W05, K1MBM_W11, K1MBM_W22	C3	Wy8 ÷ Wy 15	N1, N2, N4, N5
PEK_W03	K1MBM_W15, K1MBM_W26, K1MBM_W27	C4, C5	Wy1 ÷ Wy15	N1, N2, N3, N4, N5
PEK_U01, PEK_K01	K1MBM_K02, K1MBM_K05, K1MBM_K11, K1MBM_U12	C2, C4, C5	La1 ÷ La8	N2, N3, N4
PEK_U02, PEK_K01-PEK_K03	K1MBM_K05, K1MBM_K10, K1MBM_U12, K1MBM_U32, K1MBM_U37	C3, C4, C5	La1 ÷ La8	N2, N3, N4, N5
PEK_U03	K1MBM_U26	C1, C3	La1 ÷ La8	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Andrzej Roszkowski tel.: (71) 320 2781 email: andrzej.roszkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Maszynoznawstwo**
Name in English: **Machines science**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031040**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student has knowledge about physical and chemical processes at the level of high school.
2. A student has the elementary ability to associate the principles of operation of selected machines and vehicles with the known laws of physics and chemistry.
3. A student is able to use knowledge to analyze the methods of operation of simple mechanical systems.

SUBJECT OBJECTIVES

C1. Understanding the general principles of the operation of machines and devices and their role in the modern world.
C2. Acquisition of knowledge and skills of material and functional analysis of the machine's structure. Determining the relationship between the engine, work tool system components and drive system. Getting acquainted with the EU machinery directive and its requirements.
C3. Acquisition of basic skills to determine the prerequisites that are the basis of the machine construction process.
C4. Mastering the basic skills of using scientific knowledge in the process of construction and operation of machines.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - A student should understand the role of machines and devices in modern technology. A student should know the basic principles of operation and construction of working machines and vehicles as well as engines as sources of mechanical energy.
PEK_W02 - As a result of the course the student should be aware of the division of machines in terms of the function and construction, while at the same time being able to identify individual components of machines and machine systems.

II. Relating to skills:
PEK_U01 - As a result of the implementation of the seminar the student should have the ability to analyze the selected machine. The scope of the analysis includes:
- description of the operation and purpose of the machine,
- principle of operation - laws of physics, chemistry, biology on which its essence is based,
- description of the material structure including characteristic systems and nodes,
- specification of a measure of efficiency (eg. m3/ h) or efficiency (energy efficiency) characteristic for a given type of machinery.

PEK_U02 - As a result of the course a student should be able to acquire information from the literature, have the ability to self-education, make simple calculations to determine the basic parameters of the machine and its assemblies.

III. Relating to social competences:
PEK_K01 - Awareness of the role of machines and mechanical devices in the modern world. The ability to identify the role of machines in production processes, transport and everyday life.
PEK_K02 - Understanding the potential of the work of specialists teams from many different fields in the processes of designing, producing and decommissioning machinery and equipment.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The concept of technique and technical system. Transformation matrix of matter. The role of technology in the development of civilization.	2
Lec2	Machine definitions: classic, functional and EU. Analogies of systems with various physical forms: mechanical, electrical, hydraulic, pneumatic, thermal, etc.	2
Lec3	Classification of machines. Examples of machinery and machine systems.	2
Lec4	Construction, principle of operation and basic parameters of motors/engines used in machine drives.	2
Lec5	The concept of the drive system. Functions implemented by drive systems of machines and devices and their structure. Examples of load characteristics.	2
Lec6	Typical elements used in the construction of machines.	2
Lec7	Fundamentals of machine control systems, automatic control systems, the concept of mechatronics. Basic definitions and structure of mechatronic systems.	2
Lec8	Written final test.	1
		Total hours: 15

Form of classes – Seminar		Number of hours
Sem1	Presentation of the rules for the implementation of seminar exercises. Presentation of a list of proposed topics - machines or groups of machines to choose from. Allocating topics. The division of students into seminar groups.	2
Sem2	Presentation of topics by students.	12
Sem3	Discussing the results of the seminar. Final evaluation.	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. student's own work - studies and preparation for the examination
N3. multimedia presentation
N4. preparation of the report

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Written 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_U02	Presence and activity in the classes, the method of preparing the presentation
F2	PEK_U01	Presentation and discussion, presentation report
P = F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
[1] Biały W.: Maszynoznawstwo. WNT, Warszawa 2003.
[2] Chwiej M. Maszynoznawstwo ogólne. PWN, Warszawa 1983 (IV wyd.).
[3] Wołek M.: Maszynoznawstwo ogólne. PWN, Warszawa 1978.
[4] Orlik Z.: Maszynoznawstwo. WSziP, Warszawa 1989.
[5] Gnutek Z., Kordylewski W.: Maszynoznawstwo energetyczne. Wyd. Politechniki Wrocławskiej, Wrocław 2003.
[6] Mille A., Kijewski J., Pawlik K., Szolc T.: Maszynoznawstwo. WSziP, Warszawa 2003.
[7] Olszewska M. (red.): Podstawy mechatroniki. Wyd. REA. Warszawa 2006.
[8] Schmid D. (red.): Mechatronika. Wyd. REA. Warszawa 2002.

SECONDARY LITERATURE
[1]Hryniewicz A.: Energia. Wyzwanie XXI wieku. Wyd. Uniwersytetu Jagielońskiego, Kraków 2002.
[2]Krick E.U.: Wprowadzenie do techniki i projektowania technicznego. WNT, Warszawa 1975.
[3]Szumanowski A.: Czas energii. WKiŁ, Warszawa 1988.
[4]Charles Panati: Niezwykłe dzieje zwykłych rzeczy. Książka i Wiedza, Warszawa 2004.
[5]Encyklopedia Techniki. MUZA SA.
[6] Pritschow G.: Techika sterowania obrabiarkami i robotami przemysłowymi. Oficyna Wyd. Politechniki Wrocławskiej 1993.
[7] Ochoa G., Corey M.: Kalendarium nauki i techniki. Wyd. Zysk i S-ka, Poznań.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W17, K1MBM_W18	C1	Lec1 - Lec7	N1, N2
PEK_W02	K1MBM_W18	C1	Lec1 - Lec7	N1, N2
PEK_U01	K1MBM_U01	C2, C3	Sem1-Sem2	N3, N4
PEK_U02	K1MBM_U07	C2, C3	Sem1-Sem2	N3, N4
PEK_K01	K1MBM_K02	C4	Sem1-Sem2	N1, N3
PEK_K02	K1MBM_K07	C4	Sem1-Sem2	N1, N3

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika płynów**
Name in English: **Fluid Mechanics**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031042 (MMM031362)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a structured knowledge of mathematics, including algebra and analysis.
2. Student has a structured knowledge of physics, mechanics.
3. Student has a structured knowledge of basis of machine design.

SUBJECT OBJECTIVES

C1. Understanding the basic laws of mechanics in relation to flows of liquids and gases
C2. Gaining ability to use basic laws of fluid mechanics in the construction and design of the machines
C3. Gaining ability to use basic laws of fluid mechanics in the machinery operation

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to define basic laws of fluid mechanics.
PEK_W02 - Student is able to explain the principles of machines operation and the phenomena utilized in their construction.
PEK_W03 - Student is able to Indicate the relationship between the fundamental laws of fluid mechanics and principles of operation of machines equipment.

II. Relating to skills:
PEK_U01 - Student is able to analyse the process of the phenomena associated with the flows in the machines operation.
PEK_U02 - Structured knowledge of machine design theory.
PEK_U03 - Student is able to combine law of fluid mechanics with the problems of machine design and operation.

III. Relating to social competences:
PEK_K01 - Student understands the legal aspects and effects of engineering activities.
PEK_K02 - Student understands and is aware of the non-technical aspects and impacts of engineering activities in machine design.
PEK_K03 - Student is aware of the necessity of individual and group activities that go beyond the engineering operation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of liquids and gases, forces and stresses in fluids,basic concepts of field theory.	2
Lec2	Newtonian and non-Newtonian fluids, fluid motion analysis method, streamlines , potential and rotational flow.	2
Lec3	The basic equations of fluid mechanics, the continuity equation, the conservation of momentum equation for the ideal and real fluids (Euler equation and Navier-Stokes equations).	2
Lec4	Hydrostatic equations, communicating vessels, the pressure forces of the liquid on the walls.	2
Lec5	Buoyancy and stability of floating bodies.	2
Lec6	Euler equation integrals - Bernoulli's equation, examples of applications: measurements of velocity, the flow of liquid through the holes.	2
Lec7	The equations of momentum and moment of momentum equation, hydrodynamic reaction, principles of turbo-machinery, pumps and turbines.	2
Lec8	Real fluids, laminar and turbulent flow, the Bernoulli's equation for real fluids.	1
Lec9	The flow similitude, the dimensionless numbers in fluid Dynamics, examples of applications.	2
Lec10	Examples of solutions of N-S equations , flows in the axially-symmetric pipes , major losses and their calculation, the effect of roughness.	2
Lec11	Hydrodynamic theory of lubrication in bearings, flows through the narrow gaps.	2
Lec12	Flow in pipes, pipelines characteristics, the unsteady phenomena - water hammer.	2

Lec13	The theory of the boundary layer, laminar and turbulent layer, the phenomenon of flow separation.	1
Lec14	Flow around bodies, drag forces, aerofoil theory, the hydrodynamic characteristics of profiles. Methods of calculation of forces on aerofoil.	2
Lec15	Numerical methods in fluid mechanics, examples of use in the analysis of flows.	2
Lec16	Final Test	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	The solution of the basic fluid properties problems.	1
Cl2	Exercises illustrating the application of the Euler equation and Pascal's law.	2
Cl3	Calculation of pressure forces on the walls.	2
Cl4	Application of the Bernoulli's equation and the continuity equation for calculating ideal fluid flow.	2
Cl5	Calculation of buoyancy and stability of floating bodies.	2
Cl6	Application of the conservation of momentum equation and moment of momentum equation to calculate the hydrodynamic forces.	2
Cl7	Calculation of the pressure loss in closed in pipelines. Determination of pipeline characteristics.	2
Cl8	Final Test	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	Test
P = 0.5*F1+0.5*FC		

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	Test
P = F1=FC		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Prosnak W.J.,: Mechanika płynów. Tom I. PWN, Warszawa 1970.Bukowski J., Kijkowski P.; Kurs mechaniki płynów, PWN, 1980.Orzechowski Z., Prywer J., Zarzycki R.: Mechanika płynów w inżynierii środowiska. PWN, Warszawa 1998.Jeżowiecka-Kabsch K., Szewczyk H.: Mechanika płynów. Oficyna Wydawnicza PWr, Wrocław 2001.

SECONDARY LITERATURE

Burka S.E., Nałęcz T.J.: Mechanika płynów w przykładach. PWN, Warszawa 1994.Zieliński A.: Wybrane zagadnienia z mechaniki płynów. Oficyna Wydawnicza PWr, Wrocław 2011.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W06	C1	Lec1-Lec15	N1
PEK_W02	K1MBM_W08	C2, C3	Lec5, Lec5, Lec12, Lec15	N1, N2
PEK_W03	K1MBM_W02	C2, C3	Lec1-Lec1	N1, N2
PEK_U01	K1MBM_U09	C2, C3	Cl1-Cl7	N3
PEK_U02	K1MBM_U06	C2, C3	Cl2,Cl6, Cl7	N3
PEK_U03	K1MBM_U05	C2, C3	Cl2, Cl4-Cl7	N3
PEK_K01, PEK_K02, PEK_K03	K1MBM_K08	C1-C3	Cl1-Cl7	N3

SUBJECT SUPERVISOR

dr inż. Krzysztof Patralski tel.: 2667 email: krzysztof.patralski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji maszyn I**
Name in English: **Fundamentals of Machine Design I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031043 (MMM031364)**
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)	90		30	60	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	3		1	2	
including number of ECTS points for practical (P) classes			1	2	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		0.7	1.4	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic understanding of the types of engineering materials, their structure, properties and properties, processing, applications and selection rules. 2 It has a basic knowledge of mechanics, strength of materials and manufacturing techniques. 3 He has knowledge of the methods of mapping geometric formations on the plane and the principles of saving design of machine elements and the performance of their schemes.
2. Skills: 1 Able to read and interpret drawings and diagrams used in the technical ability to perform the technical documentation. 2 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 3 It can be used in the process of constructing knowledge gained on subjects: Metallurgy, Mechanics, Strength of materials, Engineering Graphics.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2. Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the process of design and engineering.
C2. Gaining knowledge of the construction, operation and use of the major machine components (connections) and the rules for their selection and construction.
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is to construct a simple device with screw drive (for example, a screw press, bearing puller, scissor lift, car jack, etc.) while using the knowledge of the connections, used in mechanical engineering (screw, bolt, dowel, keyways, spline, serrated, snap-fitting, welded and spring).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He has knowledge in the design, principles of design, design features, and knows the algorithm design and construction.
PEK_W02 - It has a basic knowledge of connections in the construction of machines, their design and strength calculations and applications.
PEK_W03 - He has knowledge of the factors affecting the fatigue strength of machine elements and how they are taken into account in the design calculations.

II. Relating to skills:
PEK_U01 - Able to independently formulate and solve simple technical tasks.
PEK_U02 - He can choose and calculate the basic connection used in mechanical engineering.
PEK_U03 - He can choose the optimal (in light of the criteria used) machine parts and know their limitations.

III. Relating to social competences:
PEK_K01 - Can search information and carry out their critical analysis.
PEK_K02 - Able to work independently and in a team.
PEK_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Defined notions of technical product and design. Design features, principles of design. Rationale for the existence of a product.	2
Lec2	Design and construction - differences. Description of the process of design - examples.	2
Lec3	Algorithmical and heuristic methods of generating of conceptions (method of elementary questions, morphology boards and boxes, biological analogy, brainstorming, 635 method, Delphic method).	2
Lec4	Criteria of conception rating. Methods of selection of the best conception: method of balancing positive and negative features, weighting of criteria method, etc.. Examples.	2
Lec5	Stress, fatigue, fatigue strength and method of its determination. Smith's and Haighe's graphes.	2

Lec6	Stress raisers and possible impacts on strength calculations. Processes resulting in the increased fatigue life of machine elements. β - fatigue stress concentration factor.	2
Lec7	Methods for increasing the fatigue strength. Allowable stress k - means for their appointment. Factor of safety and actual safety factor.	2
Lec8	The actual safety factor in the case of complex stress state. Stages of strength calculations for machine elements loaded forces variables. Calculation example (the roller gear).	2
Lec9	Joints in mechanical engineering, classification and characteristics. Bolted connections, thread specifications. Determination of the forces and moments on the thread.	2
Lec10	Efficiency and self-locking of a power screw. The minimum height of the nut in the screw.	2
Lec11	The notion of preload. Method for the calculation of bolted connections with preload. Calculations of thread forms.	2
Lec12	Shaft-hub connections: keys, splines, serrated joints. Dowel connections. Main features and calculation rules.	2
Lec13	Welded and pin connections. Specifications, principles of design and calculations.	2
Lec14	Pressed connections. Analytical bases of geometry selection, elements fit.	2
Lec15	Steel elastic connectors. Fundamentals of strength calculations of selected types of springs. Forming of cylindrical coil springs.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction. Health and Safety Training. Recognizing of standard machine elements.	1
Lab2	Determination of static stiffness, energy dissipated and acquired in elastic-damping elements.	2
Lab3	Determination of the frictional characteristics of the cross slide bearing.	2
Lab4	Determining of resistance to motion of angular bearing.	2
Lab5	Theoretical and practical identification of phenomenon of the resonance in shaft with one non-balanced mass.	2
Lab6	Research of the pressed connections.	2
Lab7	Investigation of belt transmission with V-belt – elastic slip and efficiency.	2
Lab8	Estimation of efficiency of power screw.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed device.	3
Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	5
Proj3	Calculations and analysis of designed elements (power screw, bearings, bolts, etc..).	12
Proj4	Performance of assembly drawing designed device and working drawings of elements selected by lecturer.	10
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. calculation exercises N3. tutorials N4. laboratory experiment 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	exam, quiz
P = F1		

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Podstawy konstrukcji maszyn; Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999. 2. Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT. 3. Beitz G.; Nauka konstruowania . Warszawa, WNT 1984. 4. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982. 5. Roloff / Matek, Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

SECONDARY LITERATURE

1. A. Dziama; Metodyka konstruowania maszyn, PWN, Warszawa, 1985. 2. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom I i II. Warszawa, WNT.1966. 3 .Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982. 4. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer-Verlag 1985. 5. Niezgodzinski M., Niezgodziński T.; Wzory, wykresy i tablice wytrzymałościowe Warszawa, PWN 2000.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W18	C1	Lec1 - Lec5	N1, N2, N3, N5
PEK_W02	K1MBM_W18	C2	Lec8 - Lec14	N1-N5
PEK_W03	K1MBM_W18	C2, C3	Lec6 - Lec7	N1, N2, N3, N5
PEK_U01 - PEK_U03	K1MBM_U14, K1MBM_U18, K1MBM_U21	C1 - C3	Proj1- Proj4, Lab1 - Lab8	N2-N5
PEK_K01- PEK_K03	K1MBM_K10	C1 - C3	Proj1- Proj4, Lab2 - Lab8	N2-N5

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy konstrukcji maszyn II**
Name in English: **Fundamentals of Machine Design II**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031045 (MMM031366)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge: 1 It has a basic knowledge of metallurgy, construction materials, mechanics, strength of materials and manufacturing techniques, engineering graphics. 2 It has a basic knowledge of Fundamentals od Machine Design I (process design and engineering, connections used in mechanical engineering) and perform the technical documentation using AutoCAD.
2. Skills: 1 It has self-learning ability, and is able to retrieve information from various sources, to make their interpretation, and to draw conclusions and formulate and justify opinions. 2 It can be used in the process of constructing knowledge gained on subjects: metallurgy, mechanics, strength of materials, Engineering Graphics, Fundamentals of Machine Design I.
3. Competencies: 1 He can think and act in an entrepreneurial manner. 2 Is aware of the seriousness and impact of activities in mechanical engineering, and understands the need for professional activities (both individually and collectively).

SUBJECT OBJECTIVES

C1. Acquisition of basic knowledge about the design of machine shafts (structural calculations, the selection of geometric features, resonance, mounting elements on the shaft) and the holder shafts - bearings (bearings characteristics, selection criteria, rules for bearing and fit).
C2. Gaining knowledge of the construction, operation, selection, design calculations and operation of the couplings and conveyor units and changing the rotation (mechanical transmission belts, chains and gears).
C3. Gain practical skills to make a simple construction task through a typical solution to the problem, the content of which is the optimal design of the drive unit driven machine (eg conveyor, ball mill, crusher, rotary kiln, etc.) The process of constructing a computer-aided both in the selection of design features (using the computer programs for the calculation of constructed elements) as well as at the stage of their graphical application (AutoCAD).

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - He knows the algorithm design calculations machine shafts and shafts supporting elements.
PEK_W02 - It has an extended knowledge in the construction of clutches, their applications and the selection and calculation.
PEK_W03 - It has a basic knowledge of construction, operation, principles of selection and design calculations of the conveyor units and changing the rotation (mechanical gears: belt, chain and gear).

II. Relating to skills:
PEK_U01 - Able to independently formulate and solve simple technical tasks.
PEK_U02 - He can choose and calculate the shafts, bearings, couplings, mechanical.
PEK_U03 - It can construct an optimal (in light of the criteria used) drive any machine work.

III. Relating to social competences:
PEK_K01 - Can search information and carry out their critical analysis.
PEK_K02 - Able to work independently and in a team.
PEK_K03 - Objectively evaluate the task, conceptual design, and they can justify the chosen solution and the method of its implementation.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Syllabus and requirements. Shafts and axes – characteristics. Theoretical bases selection of constructional features of shafts. Fundamentals of shafts and axes forming. Methods for the axial location of machine elements on a shaft.	2
Lec2	Design calculations of the shafts (preliminary, checkout). The phenomenon of resonance. Calculations of shafting for resonance in bending mode.	2
Lec3	Main features of rolling and sliding friction. Classification of bearings, main features of rolling contact and sliding bearings. Procedure and criteria for the selection of roller contact bearings.	2
Lec4	Bearing arrangement. Fits, lubrication and sealing in application for roller bearings.	2

Lec5	Classification of coupling and clutches. Main features of couplings. Selection and calculation rules.	2
Lec6	Main features of clutches. Engagement process, Work and friction losses, heat balance, service life. Equivalent friction radius.	2
Lec7	Belt transmissions, classification, general characteristic and selection criteria. Friction coupling of the belt with the wheel. Elastic slip, actual transmission ratio, load transfer coefficient.	2
Lec8	Force distribution, tensioning devices in belt. Required tension force and ways of regulation.	2
Lec9	Efficiency of belt transmission and belt durability. Characteristics material for belts. The design of pulleys (material, main dimensions). Design calculations of V-belt transmissions.	2
Lec10	Chain transmissions – characteristic and calculation.	2
Lec11	Gear transmissions. Classification and main features. Fundamental rule of engagement. Cycloid and involute profiles.	2
Lec12	Basic rack tooth profile. Standardization of involute wheels. Basic notions. Geometry of spur gears. Generation methods.	2
Lec13	Boundary tooth number, mesh correction, addendum modification.	2
Lec14	Tooth loading model for bending and contact pressure. Service factor. Distribution of forces in spur and helical gearing.	2
Lec15	ISO recommended methods for the calculation of gear transmission, a summary.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Preparation of design specifications for the designed drive system (operation principles, location data, quantitative data, operation conditions).	2
Proj2	Possible solutions of the problem, a draft drawing (without details) of one selected solution (acceptance criteria included).	4
Proj3	Assumption of acceptance criteria for each of the sub-assemblies of the unit. Selection of the best solution using a dedicated software.	12
Proj4	Implementation stage of the design process: assembly and selected working drawings. Drafting technique - CAD.	12
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. calculation exercises
N3. tutorials
N4. self study - preparation for project 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	exam, quiz
P = F1		

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.Podstawy konstrukcji maszyn. Praca zbiorowa pod red. Z. Osińskiego. Warszawa, PWN 1999. 2.Dietrych J. i inni; Podstawy konstrukcji maszyn. Tom II i III, Warszawa, WNT. 3. Dziama A. i inni; Przekładnie zębate. Warszawa, PWN 1995. 4. Dietrych M. i inni; Podstawy konstrukcji maszyn. Tom III i IV. W-a, WNT 1996. 5. Ćwiczenia z podstaw konstrukcji maszyn. Poradnik. Praca zbiorowa pod red. Z. Lawrowskiego, skrypt PWr., Wrocław , 1982. 6. Krawiec S.; Obliczenia konstrukcyjne przekładni pasowych i zębatych wspomagane mikrokomputerem, skrypt PWr.,Wrocław, 1992. 7. Capanidis D, Krawiec S. Wieleba W.; Materiały pomocnicze do ćwiczeń projektowych z PKM wspomaganych komputerowo, IKEM PWr., 1993. 8. Roloff/Matek; Maschinenelemente - Normung, Berechnung, Gestaltung, Wiesbaden, Vieweg 1994.

SECONDARY LITERATURE

1.Jaśkiewicz Z., Wąsiewski A.; Przekładnie walcowe. Warszawa, WKŁ 1992. 2. Niemann G., Winter H.; Maschinenelemente. Band II. Berlin, Springer- Verlag 1985. 3. Niemann G., Winter H.; Maschinenelemente. Band III. Berlin, Springer- Verlag 1983. 4. Skarbiński M., Skarbiński J.; Technologiczność konstrukcji maszyn. Warszawa, WNT 1982.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W18	C1	Lec1-Lec4	N1, N3, N5
PEK_W02	K1MBM_W18, K1MBM_W25	C2	Lec5, Lec6	N1, N3, N5
PEK_W03	K1MBM_W18, K1MBM_W19, K1MBM_W25	C2	Lec7-Lec15	N1, N3, N5
PEK_U01 - PEK_U03	K1MBM_U02, K1MBM_U07, K1MBM_U21, K1MBM_U34	C3	Proj1-Proj4	N2-N5
PEK_K01 - PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K05, K1MBM_K11	C1-C3	Proj1-Proj4	N2-N5

SUBJECT SUPERVISOR

dr inż. Tadeusz Leśniewski tel.: 71 320-40-31 email: Tadeusz.Lesniewski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Podstawy metrologii**
Name in English: **Principles of metrology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031047**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has a basic knowledge of mathematics and physics at secondary school level.

SUBJECT OBJECTIVES

C1. Understanding the essence of measurement to recognize true state and relations between physical quantities
C2. Gaining knowledge of basic metrological concepts, unit system SI, rules of making measurements of physical quantities and basic properties of measurements sensors and apparatus.
C3. Gaining knowledge about signal processing, measurements systems, rules and properties of measurement process.
C4. Gaining basic knowledge about measurement interferences factors.
C5. Gaining basic knowledge about experiment planning and results elaboration and uncertainty analysis.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has basic knowledge of metrology, understands essence of measurements and knows measurements methods
PEK_W02 - Knows basic properties of measurements apparatus and measurements systems.
PEK_W03 - Has basic knowledge of accuracy and measurement uncertainty.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - Search for information and its critical analysis
PEK_K02 - Objective evaluation of arguments, the rational explanation of his own point of view using the knowledge of fundamentals of metrology.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Basic concepts of metrology.	1
Lec2	Quantities and units of measurement. Integrated measurement units. SI units, measurement standards, a hierarchical system of measurement standards.	2
Lec3	Measurement method, types and classification. Examples.	2
Lec4	Analog and digital measurement instruments: types, components, I/O elements, A/C converters, microprocessor role; metrological properties; influence of interferences.	4
Lec5	Measurement uncertainty and results elaboration: sources of uncertainty; division and rules of estimation, calculation of A-type uncertainty.	2
Lec6	Calculation of B-type standard uncertainty and enhanced uncertainty with proper trust level. Methods for results elaboration and presentation.	2
Lec7	Test	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1.M. Lisowski: Podstawy metrologii. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2011.
2.J. Ciepłucha: Podstawy metrologii. Wyd. II. Wydawnictwo Politechniki Łódzkiej. Łódź 2008
3.J. Arendarski: Niepewność pomiarów. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.

SECONDARY LITERATURE

1.J. Piotrowski: Podstawy miernictwa. WNT, Warszawa 2002.
2.J. Jaworski, R. Morawski, J. Olędzki: Wstęp do metrologii i techniki eksperymentu. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1992.
3.J. Piotrowski, K. Kostyro: Wzorcowanie aparatury pomiarowej. WNT, Warszawa 2000.
4.T. Skubis: Postawy metrologicznej interpretacji wyników pomiarów. Wydawnictwo Politechniki Śląskiej. Gliwice 2004.
5.S. Białas: Metrologia techniczna z podstawami tolerowania wielkości geometrycznych dla mechaników. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2006.
6.P.H. Sydenham: Podręcznik metrologii. Tom II. WKiŁ, Warszawa 1990.
7.Międzynarodowy słownik podstawowych i ogólnych terminów metrologii. Wyd. Główny Urząd Miar, Warszawa 1996.
8.Wyrażanie niepewności pomiaru – przewodnik. Wyd. Główny Urząd Miar, Warszawa 1996.
9.Wyrażanie niepewności pomiaru przy wzorcowaniu. Dokument EA-4/02, Europejska Współpraca w Dziedzinie Akredytacji. Wyd. Główny Urząd Miar, Warszawa 1999.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W15	C1, C2	Lec2, Lec3	N1, N2, N3
PEK_W02	K1MBM_W15	C3, C4	Lec4, Lec5	N1, N2, N3
PEK_W03	K1MBM_W15	C5	Lec6, Lec7	N1, N2, N3

PEK_K01- PEK_K02	K1MBM_K04	C1-C5	Lec1- Lec7	N1-N3

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Chemia**
Name in English: **Chemistry**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031048 (MMM031345)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. high school level

SUBJECT OBJECTIVES

C1. Introduction with chemistry sections usable over study of related courses (meterial scicnce, metallurgy, polymers)
C2. Introduction with basic chemical knowledge enabling of chemical rules and physicochemical properties of technical materials particularly metals, alloys and polymers

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student should have basic chemical knowledge associated with structure of matter, states of matter.
PEK_W02 - The student should have basic inorganic knowledge associated with the structure of metals, alloys, electron conductivity as well as basic organic knowledge associated with fuels and polymers
PEK_W03 - The student should have basic knowledge associated wit physicochemical characterization techniques of construction materials.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The structure of matter, elements, periodic table, compounds	4
Lec2	Chemical bonds, molecules	2
Lec3	The states of matter	2
Lec4	Metals and alloys, solid state band theory.	2
Lec5	Electrochemistry, corrosion	2
Lec6	Basic crystallography, unit cell, symmetry elements, crystallographic defect	4
Lec7	Ceramic materials	2
Lec8	Selected topics of organic chemistry	4
Lec9	Polymers chemistry	2
Lec10	Selected methods of solid materials characterizations	4
Lec11	Qualifying class –test	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Chemical Principles, Atkins Peter William, Jones Loretta, Palgrave Macmillan

SECONDARY LITERATURE
Chemistry, Michell J. Sienlo and Robert A. Plane, both of Cornell University, Ithaca, New York.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 , PEK_W02, PEK_W03	K1MBM_W03, K1MBM_W06, K1MBM_W11, K1MBM_W13	C1,C2,C3	Lec1-Lec10	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr hab. Marek Jasiorski tel.: 320-32-21 email: marek.jasiorski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ekologia**
Name in English: **Ecology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031049**
Group of courses: **no**

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

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 theknowledge of the international conventions and Polish environmental regulations.
PEK_W03 - Can characterize modern solution for environmental protection.

II. Relating to skills:

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	Introduction. Basic concepts and definitions of ecology and environmental protection.	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
F2	PEK_K01	
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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 ÷ PEK_W03	K1MBM_W32	C1 - C3	lec1 ÷ lek6	N1, N2
PEK_K01	K1MBM_K08	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: **Grafika inżynierska - zapis konstrukcji**
Name in English: **Engineering Graphics - Engineering Drawing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031050 (MMM031347)**
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				X	
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				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of descriptive geometry.
2. Basic drawing skills and use of computer equipment.
3. The skill to use the Internet digital resources

SUBJECT OBJECTIVES

C1. The acquisition of knowledge and skills in axonometric projection and rectangular in mapping the elements of space on the plane and the rules for engineering drawing with the use of views, sections, and lays in the engineering drawings.
C2. The acquisition of knowledge and skills in the dimensioning and tolerancing of dimensions of machine parts, as well as the identification of their surface features and shape and position tolerances.
C3. The acquisition of knowledge and skills in the field of graphic representation of connections of machines and rules for standardization in constructions drawings, as well as elements drawings (manufacturing drawings) and complex systems (assembly drawings) and the principles of schematization.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - The student knows and is able to explain the rules of constructions drawings and creating the technical documentation of elements and mechanical components.
PEK_W02 - The student knows how to call the basic parameters characterizing the geometric features of a product and propose how to save these information.
PEK_W03 - The student knows the principles of graphic representation of joint of machine elements and drawing the standard machine elements.

II. Relating to skills:
PEK_U01 - Student is able to make in a handwritten way and using computer drawing software (CAD) the construction drawing and schematization of technical systems.
PEK_U02 - The student knows how to read the technical documentation of machine components, complex technical systems and schematic drawing.
PEK_U03 - The student can identify and draw the basic standardized joints of machine parts.

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Rules of technical drawings. Standardization in technical documentation. The fundamentals for creation of freehand drawings and using computer-aided design system (CAD).	2
Lec2	Orthogonal and axonometric projections. Drawing composition.	2
Lec3	Types of views in the technical drawing. Details presentation.	2
Lec4	The application of sections, revolved and removed sections.	2
Lec5	Dimensioning. The rules of dimensioning of machine elements.	2
Lec6	Tolerances and deviations in dimensioning. Methods of tolerancing dimensions and fits in drawings	2
Lec7	Test-1 (projection, views, sections).	2
Lec8	Presentation of surface roughness. Form or position tolerances and complex tolerances.	2
Lec9	Drawing of the basic machine joints - separable joints.	2
Lec10	Drawing of the basic machine joints - inseparable joints.	2
Lec11	Drawing of the standardized machine elements.	2
Lec12	Types of drawings in the technical documentation. Detail drawings, assembly drawings, general arrangement drawings	2
Lec13	Schematic drawings.	2
Lec14	Final test	2
Lec15	Discussion of the test results and the course summary.	2
		Total hours: 30

Form of classes – Project		Number of hours
Proj1	Introduction. Basic principles of drawing using computer technology. Simple drawings using a computer program (CAD): organization of a graphic editor, basic drawing functions (line, circle, arc, etc.)	2
Proj2	Basic techniques of freehand drawing - line, arc, circle, ellipse. Drawings of simple machine elements.	2
Proj3	Views of machine elements based on axonometric drawings. Technical sketch - freehand made. Drawing composition. Computer drawing (editing and modification functions of drawings)	2
Proj4	Views of more complex machine elements. Computer drawing (editing and modification functions - continuation)	2
Proj5	Sections of simple machine elements. Drawing of symmetrical elements (half view and half section).	2
Proj6	Drawing of rotary machine elements (shafts, sleeves). Sections, revolved and removed sections.	2
Proj7	Detail drawings. Dimensioning rules. Tolerances. Surface roughness description.	2
Proj8	Drawing of welded joints and glued joints. Drawing of a frame, body or support element containing parts, that are connected by welding or gluing.	2
Proj9	Thread fits in drawings. Drawing of machine assembly containing a thread fits.	2
Proj10	Final test	2
Proj11	Design exercise - topic overview. The draft sketch of machine assembly as the content of the exercise.	2
Proj12	Design exercise. The general arrangement drawing of the machine assembly.	2
Proj13	Design exercise. Detail drawings of the machine assembly.	2
Proj14	Design exercise. The detail drawings of the machine assembly. Schematic drawing.	2
Proj15	Evaluation of the design exercise. Course grade.	2
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with the use of multimedia techniques.
N2. Self study - preparation for project class.
N3. Discussion about design problems during lectures and laboratory exercises.
N4. Individual solving the drawing exercises with the tutor.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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 = 0,4*F1+0,6*F2		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01	Assessment of the self-dissolved homeworks
F2	PEK_U01- PEK_U03, PEK_K01	Assessment of the design exercise
F3	PEK_U01- PEK_U03	Final test
P = 0.2*F1+0.3*F2+0.5*F3		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Dobrzański T., Rysunek techniczny maszynowy. WNT, Warszawa 2017.
2. Rydzanicz I., Zapis konstrukcji. Podstawy. Oficyna Wyd. PWr, Wrocław 2000.
3. Rydzanicz I., Zapis konstrukcji. Zadania. WNT, Warszawa 2009.
4. Giesecke F.E. et al., Engineering Graphics. Pearson Education Inc. 2004.

SECONDARY LITERATURE

1. Suseł M., Makowski K.. Grafika inżynierska z zastosowaniem programu AutoCAD, Oficyna Wydawnicza PWr, 2005
2. Kasprzycki A., Sochacki W. Wybrane zagadnienia projektowania i eksploatacji maszyn i urządzeń.[Dokument elektroniczny], s. 7-47.
3. Bethune J.D. Engineering Design and Graphics with AutoDesk Inventor(R) 8. Upper Saddle River : Pearson Prentice Hall, 2005.
4 .Websites for AutoCAD learning eg.
https://autocad-beginners.blogspot.com/2018/01/content-of-autocad-tutorials.html
https://strefainzyniera.pl/index.php/artykul/498/oprogramowanie-cadca
http://www.cad.pl/kursy/ (for older AutoCAD version)

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W14	C1, C3	Lec1-Lec5, Lec12-Lec13, Lec15	N1
PEK_W02	K1MBM_W14	C2	Lec6, Lec8	N1, N3
PEK_W03	K1MBM_W14	C3	Lec9-Lec11	N1, N3
PEK_U01	K1MBM_U14, K1MBM_U18	C1, C2, C3	Proj1-Proj7	N2, N3, N4
PEK_U02	K1MBM_U14	C2, C3	Proj11-Proj14	N2, N3, N4
PEK_U03	K1MBM_U14	C3	Proj8-Proj9	N4
PEK_K01	K1MBM_K09	C2, C3	Proj1-Proj7, Proj11-Proj14	N2, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Materiałoznawstwo I**
Name in English: **Materials Science I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031051 (MMM031348)**
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	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 of physic at the high school level
2. Basic of chemistry at the high school level

SUBJECT OBJECTIVES

C1. Knowledge of interaction between structure, manufacturing and properties the basic groups of engineering materials
C2. Knowledge of basic rules of selection materials applied for constructional elements in machines building
C3. Knowledge of basic crystallography and cristalline structures properties
C4. Knowledge of structures and properties of iron-cementite system alloys
C5. Knowledge basic properties of unalloyed steels

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Know basic types and properties of materials
PEK_W02 - Know influence of basic manufacturing technoilogies on the basic materials properties
PEK_W03 - Know basic types and properties iron alloys structures

II. Relating to skills:
PEK_U01 - Able to assess the type of materials applied for engineering design
PEK_U02 - Can determine the structures of materials applied for engineering design
PEK_U03 - Can determine the basic properties of materials applied for engineering design

III. Relating to social competences:
PEK_K01 - Information retrieval and their critical analyse
PEK_K02 - Observance of custom and rules binding at academic environment

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classificationof engineerig materials. Relations between manufactiring processes, structures and properties of materials	2
Lec2	Mechanical and physical properties of materials and methods of their determination. The rules of materials selection at machine building	2
Lec3	Polymer materials - classification, structures, properties	2
Lec4	Ceramic and glass materials - classification, structures, properties	2
Lec5	Composite materials - classification, manufacturing methods, properties	2
Lec6	Metals reinforcement methods. Classification and method of metals formation	2
Lec7	Elements of crystallography. Build of real crystals. Defects of crystalline structures	2
Lec8	Equilibrium and criterion of equilibrium. Internal energy. Entropy, Free energy	2
Lec9	Phase transformation, Crystallisation. Allotropic and magnetic transformation	2
Lec10	Plastical deformation and recrystallisation	2
Lec11	Alloys. Build and types of alloys. Intermetallic phases	2
Lec12	Characteristic of phases presented in alloys of metals	2
Lec13	Pfase equilibrium diagrams of binary systems. Phase rule.	2
Lec14	Analyse basic types of phase equilibrium diagrams	2
Lec15	Iron-cementite equilibrium diagram. Analysis of diagram	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction. The aim and methods materials investigation. Construction and maintenaceof metallographic microscope	2
Lab2	Macroscopic investigations, analyse of fracture surfaces, macrostructures of materials and technological origin defects	2

Lab3	Macroscopic and microscopic investigation of composite materials	2
Lab4	Analyse of equilibrium binary system diagrams	2
Lab5	Investigation of microstructures of mono and multiphase alloys at etched and non-etched state	2
Lab6	Analyse of iron-cementite phase equilibrium diagram	2
Lab7	Analyse microstructures of iron-cementite diagram	2
Lab8	Summary and credit of laboratory practice	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	Exam, 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_U03, PEK_K01 - PEK_K02	Introduction test, oral answers, report
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. M.F.Ashby, D.R. Jones - Engineerig Materials

SECONDARY LITERATURE

M. F. Ashby- Materials Selection in Mechanical Design

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W10, K1MBM_W11	C1 - C5	Lec 1 - lec 15	N1 - N4
PEK_U01 - PEK_U03	K1MBM_U01, K1MBM_U02, K1MBM_U06	C1- C2	lab 1 - lab 8	N3 - N5
PEK_K01 - PEK_K02	K1MBM_K09	C1 - C5	lab 1 - lab 8	N2 , N3, N5

SUBJECT SUPERVISOR

dr inż. Krzysztof Widanka tel.: 320-37-00 email: krzysztof.widanka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Mechanika I**
Name in English: **Mechanics I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031052 (MMM031349)**
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. Mathematics I (differenting, integrating)
2. Algebra, Linear algebra, (Matrix, Determinants)
3. Euklides geometry & Trigonometry

SUBJECT OBJECTIVES

C1. Solving technical problems on the basis of mechanics rules
C2. Making statical strength analysis of machines elements.
C3. Acquisition and consolidation of social skills including emotional intelligence relying ability to work in a group of students with
a view to effective problem solving. Responsibility, honesty and fairness in behaviour; observance of customs in academic community and society

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - He is able to define basic quantities in Mechanics (Force and momentum). He knows conditions of static equilibrium of forces system.

PEK_W02 - He knows the Centroid of Area, the center of Gravity of a Mass, Moments of inertia, Product of inertia, Parallel–axis theorem, Rotation transformation of Moments of inertia, Iinertia Tensor, inertia ellipsoid, the principal axes.

PEK_W03 - He is able to define key concepts in Kinematics, motion of particle, trajectory, one–dimensional model. Velocity and acceleration in natural coordinates. Rigid body, The Degrees of Freedom, Classification of motions, Velocity and acceleration in general motion.

II. Relating to skills:

PEK_U01 - He can solve typical engineering structures (Trusses, Beams & Frames) under statical loading. Conditions of static equilibrium of forces system. Plane forces system reduction.

PEK_U02 - He can calculate the Centroid of Area, the center of Gravity of a Mass, Moments of inertia, Product of inertia, He can use Parallel–axis theorem, Rotation transformation of Moments of inertia, Iinertia Tensor, inertia ellipsoid, the principal axes.

PEK_U03 - He can calculate the velocity and acceleration in plane motion of a rigid body and in the relative motion of a point. He can derive the equations of motion of a free and constrained material point for time-varying dynamic loads using the Newton's second principle.

III. Relating to social competences:

PEK_K01 - He can search information and is able to review it critically.

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

PEK_K03 - He can observe customs and rules of academic community

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Curriculum. Requirements. Literature.Theory of vectors algebra	2
Lec2	Force and momentum. Principal vector and principal momentum of forces system. Statics. Conditions of static equilibrium of forces system. The change of momentum point.	2
Lec3	Concurrent forces system.Trusses. Method of Joints.	2
Lec4	Plane forces system. Reactions in the statically determinate systems (Beams, Trusses, Frames).	2
Lec5	Conditions of static equilibrium of forces system. Plane forces system reduction.	2
Lec6	Internal forces in Beams (analytical methods, diagrams).	2
Lec7	Internal forces in Frames (analytical methods, diagrams).	2
Lec8	Centroid of Area. The center of Gravity of a Mass.	2
Lec9	Moments of inertia. Product of inertia. Parallel–axis theorem. Rotation transformation of Moments of inertia,	2
Lec10	Iinertia tensor, inertia ellipsoid. The principal axes.	2

Lec11	Kinematics, motion of particle, trajectory, one–dimensional model. Velocity, acceleration. Velocity and acceleration in natural coordinates.	2
Lec12	Rigid body, The Degrees of Freedom, Classification of motions, Velocity and acceleration in general motion.	2
Lec13	Plane motion and rotation over permanent axis. Planar motion of rigid body, velocity, center of circulation.	2
Lec14	Centroids, acceleration in a planar motion of rigid body.	2
Lec15	Relative motion. Kinematics in a general motion of rigid body. The Coriolis' acceleration.	2
		Total hours: 30
Form of classes – Classes		Number of hours
Cl1	Vectors algebra	2
Cl2	Trusses. Method of Joints. Analytical methods of trusses solving.	2
Cl3	Reactions in the statically determinate plane systems. Analytical methods.	2
Cl4	Reactions in the statically determinate space systems. Analytical methods.	1
Cl5	Analytical methods of trusses solving. The Ritter's methods.	1
Cl6	Test 1: Vectors, Trusses	1
Cl7	Internal forces in beams (analytical methods, diagrams).	1
Cl8	Internal forces in beams (analytical methods, diagrams). Beams with Joints.	2
Cl9	Internal forces in Frames (analytical methods, diagrams).	2
Cl10	Test 1: Internal forces in plane structures	1
Cl11	Centroid of Area. The center of Gravity of discrete Multi-mass structures.	1
Cl12	Centroid of Area. The center of Gravity of continue-mass structures.	2
Cl13	Moments of inertia & inertia products. Parallel–axis theorem.	2
Cl14	Rotation transformation of Moments of inertia, inertia tensor, inertia ellipsoid. Principal axes.	2
Cl15	Test 3: The center of Gravity of a Mass. Moments of inertia.	1
Cl16	Kinematics of particle in orthogonal coordinates.	2
Cl17	Kinematics of rigid body. Plane motion and rotation over permanent axis.	2
Cl18	Velocity in a plane motion.	2
Cl19	Test 4: Kinematics (task by yourself choose.)	1
		Total hours: 30

TEACHING TOOLS USED

N1. Traditional lecture with the use of transparencies and slides
N2. Calculation exercises
N3. Four small tests instead of two big make students more regular in the study
N4. Tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	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_K01	test 1 & 2 or/& oral answers
F2	PEK_U02,PEK_K02	test 3 or/& oral answers
F3	PEK_U03,PEK_K03	test 4 or/& oral answers
P = 2 jeśli ocena F1=2. Jeśli nie to P=(2F1+F2+F3):4		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 1, Statics, John Wiley & Sons, Inc., New York, 1998
2. J.L. Meriam, L.G. Kraige, Engineering Mechanics, volume 2, Dynamics, John Wiley & Sons, Inc., New York, 1998

SECONDARY LITERATURE
1. Mary Lunn, A First Course in Mechanics, Oxford Science Publications, Oxford 1991
2. Philip Dyke, Roger Whiteworth, Guide to Mechanics, MacMillan Press, London 1992
3. Herbert Goldstein, Classical Mechanics, Addison-Wesley Publishing Company, London

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W07	C1	Lec 1 to Lec 15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_U05, K1MBM_U07	C2,	Classis 1 to 19	N2, N3
PEK_K01, PEK_K02, PEK_K03	K1MBM_K03, K1MBM_K04	C3	Classis 1 to 19	N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Daniel Lewandowski tel.: 320-28-99 email: daniel.lewandowski@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): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031053 (MMM031372)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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. Knowledge and skills in the field of 3D modeling of the machines parts and assemblies
C2. Knowledge and skills in range of machinery and equipment research and analysis on the virtual models (virtual prototyping)
C3. Knowledge and 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 machine parts
PEK_U02 - Students should be able to build 3D models of the machines 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: preparing to create an assembly- parts assembling, bonds and relationships in the assembly	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	The project of assembly: analysis of the functional correctness of the assembly (parameters analysis, kinematic analysis, analysis of collision) rectify design faults, loads analysis	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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PPEK_U01, PEK_U02	K1MBM_U21	C1, C2	Pr1 - Pr12	N1, N2, N3, N4

, PEK_U03	K1MBM_U21	C3	Pr13, Pr14	N3, N4
PEK_K01	K1MBM_K04	C2	Pr8, Pr11	N2

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: **Wytrzymałość materiałów I**
Name in English: **STRENGTH OF MATERIALS I**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031054 (MMM031373)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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 and compression.	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 members.	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	Strength design of straight members in tension and compression. Effect of temperature.	2
Cl2	Statically indeterminate cases in stretching/compressing.	2
Cl3	Plane stress. Mohr’s circle.	2
Cl4	Engineering strain measurement.	2
Cl5	Shafts in torsion – strength and stiffness.	2
Cl6	Thin-walled members in torsion – strength and stiffness.	2
Cl7	Written test.	2
Cl8	Bending. Stress field.	2
Cl9	General case of bending.	2
Cl10	Displacements in beams. Deflection line of a beam.	2
Cl11	Unsymmetrical bending. Shearing centre.	2
Cl12	Buckling of compressed members.	2
Cl13	Applications of failure criteria hypotheses.	2
Cl14	Castigliano and Menabre-Castigliano theorem.	2
Cl15	Written test.	2
		Total hours: 30

TEACHING TOOLS USED

N1. lectures supported with audiovisual aids when necessary.
N2. calculating classes
N3. homework
N4. self study and preparation for the exam.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS 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
(Basic reading)

SECONDARY LITERATURE
(Additional reading)

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W09	C1	L1 - L15	N1, N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_U19	C2	C1 - C15	N2, N3
PEK_K01, PEK_K02, PEK_K03	K1MBM_K01, K1MBM_K03	C3	C1 - C15	N2 do 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: **Równania różniczkowe zwyczajne**
Name in English: **Ordinary differential equations**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031055 (MMM031378)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student 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	Second-order linear homogeneous differential equations. Wronskian. Second-order linear homogeneous differential equations with constant coefficients.	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	Final 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	Final test (in case of evaluation on base of short tests, 2 hours are necessary to perform them during semester).	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture
N2. calculation exercises
N3. tutorials
N4. work on preparing for tests

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 - PEK_W03	final test
P = 2/3*F1(wykład/lecture) + 1/3*F1(ćwiczenia/classes), gdzie obie oceny F1>2,0 (both marks F1 > 2.0)		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Classes)

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

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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K01-PEK_K03	K1MBM_K03, K1MBM_K04	C3	Cl1 - Cl7	N3, N4
PEK_U01_PEK_U03,	K1MBM_U08	C2	Cl1 - Cl7	N2, N4
PEK_W01, PEK_W02, PEK_W03	K1MBM_W01	C1	Lec1 - Lec7	N1, N3

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: **Zarządzanie w produkcji**
Name in English: **Management in production**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031057**
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)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

C1. Knowing the specifics of management of the production and manufacturing processes
C2. Knowledge of methods and techniques for managing different types of manufacturing processes
C3. The acquisition of skills in planning, organizing and controlling of production processes

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Distinguishes and characterizes by different types of production systems.
PEK_W02 - Can define the concepts of production and technological processes.
PEK_W03 - Has knowledge of the methods and techniques of production systems management.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Characteristics of manufacturing organizations	1
Lec2	Characteristics of production systems	1
Lec3	Manufacturing system, its organization and components	1
Lec4	Classification of production processes	1
Lec5	Types and forms of production	1
Lec6	Methods of manufacturing control systems (pull, push and squeeze)	2
Lec7	Methods of organization of production systems	2
Lec8	Characteristics of bottlenecks in manufacturing processes	2
Lec9	Methods of manufacturing inventory management	2
Lec10	Principles of planning and scheduling	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. Chlebus E.: "Techniki komputerowe CAx w inżynierii produkcji", Wydawnictwa Naukowo-Techniczne, Warszawa 2000,
2. Durlik I.: "nżynieria zarządzania : Cz. 1 i Cz.2", Wydawnictwo Placet, Warszawa 2007,
3. Liwowski B.: "Podstawowe zagadnienia zarządzania produkcją", Oficyna Ekonomiczna, Kraków 2006

SECONDARY LITERATURE
1. Rogowski A..: "Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie", Wydawnictwa Fachowe CeDeWu, Warszawa 2010, 2. Burchart-Korol D.: "Zarządzanie produkcją i usługami", Wydawnictwo Politechniki Śląskiej, Gliwice 2007

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W24	C1, C2, C3	Lec1 - Lec10	N1

SUBJECT SUPERVISOR

dr inż. Jarosław Chrobot tel.: 20-66 email: jaroslaw.chrobot@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ergonomia i BHP**
Name in English: **Ergonomics and safety**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031058 (MMM031346)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. has basic knowledge from range of characteristic and properties of hazardous physical agents (electric energy, mechanical vibrations, lighting, electromagnetic field, dusts), chemical and biological agents.
2. has systematical knowledge from range of mathematics, physics, chemistry and informatics.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of labor law, as well as work accidents and occupational diseases
C2. Acquirement of basic knowledge from areas of ergonomics and labor biomechanics
C3. Acquirement of basic knowledge from analysis and protection before dangerous, harmful and strenuous factors in work environment

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - It knows basic regulations and standards of work safety
PEK_W02 - It has basic knowledge from ergonomics area and it is conscious for capability of its practical application in designing and manufacturing of products
PEK_W03 - It knows basic threats at work stands and methods of protection before them.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Labor protection, work safety regulations and principles	2
Lec2	Accidents at work and occupational diseases, estimate of professional risk on work positions	2
Lec3	Ergonomics as interdisciplinary science	2
Lec4	Labor biomechanics - science about threats for employee health discovering, being result of executable work	2
Lec5	Dangerous and harmful agents in work environment - mechanical agents and electric power	2
Lec6	Dangerous and harmful agents in work environment - noise, vibrations and lighting	2
Lec7	Dangerous and harmful agents in work environment - chemical and biological agents	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

F1	PEK_W01 - PEK_W03	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

CIOP - Science about work - safety, sanitation, ergonomics, CIOP, Warsaw 2000 , B. Rączkowski - Industrial Safety in practice - BHP, ODDK, Gdansk 2012

SECONDARY LITERATURE

D. Idczak - Ergonomics as forming of work conditions, L. Skuza - Accidents at work from A to Z

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W27	C1	Lec1, Lec2	N1, N2, N3, N4
PEK_W02	K1MBM_W30	C2	Lec3	N1, N2, N3, N4
PEK_W03	K1MBM_W26	C3	Lec4, Lec5, Lec6, Lec7	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Jacek Iwko tel.: 42-54 email: jacek.iwko@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): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031059 (MMM031382)**
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 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 rotating disks, pipes and thick-walled tanks,
PEK_W02 - the theory of thin-walled axisymmetric shells loaded with pressure,
PEK_W03 - the basics of fatigue of material and fatigue of simple construction elements,

II. Relating to skills:
PEK_U01 - Student has practical skills in: 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 - 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	Eccentric compression of slender members.	2
Lec2	Bending of a curved member.	2
Lec3	Models of material damage.	2
Lec4	Single- and multi-layer thick-walled cylinders.	2
Lec5	Rotating disks.	2
Lec6	Differential equation of thin plate.	2
Lec7	Symmetrically loaded circular plates. Rectangular plates.	2
Lec8	Axially symmetric shells.	2
Lec9	Impact loads in members.	2
Lec10	Time and temperature dependent loads – fatigue, creep, relaxation.	2
Lec11	Material fatigue – basic calculations.	2
Lec12	Finite Element Method (FEM) – introduction, shape functions.	2
Lec13	FEM – member and shell elements.	2
Lec14	Examples of applications of FEM.	2
Lec15	Written test	2
		Total hours: 30

Form of classes – Laboratory		Number of hours
Lab1	Introduction.	3
Lab2	Tensile test in metals and plastics.	2
Lab3	Strain gauge analysis.	2

Lab4	Determination of fatigue limit.	2
Lab5	Combined loading in members (torsion + bending).	2
Lab6	Buckling of slender members. Compression test.	2
Lab7	Symmetric and unsymmetric bending. Summary of laboratories and examination.	2
		Total hours: 15

TEACHING TOOLS USED

N1. Lectures supported with audiovisual aids when necessary.
N2. Self study and exam preparation.
N3. Laboratory experiment
N4. Report preparation
N5. Individual preparation for laboratories.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
(basic reading)

SECONDARY LITERATURE
(additional reading)

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 do PEK_W03	K1MBM_W09	C1, C2	L1 - L15	N1, N2
PEK_U01 do PEK_U03	K1MBM_U20	C1, C2	La1 - La7	N3 -N5
PEK_K01 do PEK_K03	K1MBM_K01, K1MBM_K03	C3	La1 - La7	N2- 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: **Podstawy tribologii**
Name in English: **Fundamentals of Tribology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031102 (MMM031352)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

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

Lec5	Susceptibility, stiffness and configuration elements as factors that increase the wear resistance.	2
Lec6	Grease as a construction material. Objectives lubrication. The way of obtaining o fluid friction. Distribution of lubricants. Lubricating oils and their properties.	2
Lec7	Greases, their distribution and characteristics.Their characteristics.	2
Lec8	Final test.	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Determining of properties of slide bearing materials.	2
Lab2	Determining of coefficient of static friction.	2
Lab3	Research of lubricity of greases using a four ball tester.	2
Lab4	Determination of the behavior of friction materials for brakes and clutches.	2
Lab5	Analysis of the impact bushing stiffness for load distribution in the sliding bearing.	2
Lab6	Analysis of the impact on the structure of the material on abrasive wear (Tester T-07).	2
Lab7	Research of the frictions into screw gear.	2
Lab8	Study materials for the seizure.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

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

SECONDARY LITERATURE

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W11, K1MBM_W18, K1MBM_W26	C1	Lec1, Lec2, Lec3	N1, N2, N5
PEK_W02	K1MBM_W18, K1MBM_W25	C1	Lec6, Lec7	N1, N2, N5
PEK_W03	K1MBM_W21, K1MBM_W22, K1MBM_W26	C1	Lec4, Lec5	N1, N2, N5
PEK_U01 - PEK_U03	K1MBM_U01, K1MBM_U04, K1MBM_U06, K1MBM_U15, K1MBM_U20	C2, C3	Lab1 - Lab8	N3, N4, N5
PEK_K01- PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K04	C3	Lab1-Lab7	N2, N3, N4

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Silniki spalinowe**
Name in English: **Combustion engines**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031105 (MMM031355)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. knowledge of the principles of thermodynamics and thermodynamic transformations
2. ability to perform laboratory exercises independently, supported by elemental manual skills
3. awareness of the need for group work and ability to implement it

SUBJECT OBJECTIVES

C1. based on the laws of thermodynamics knowledge and understanding of the combustion and power generation combustion engines
C2. knowledge of the structure of the internal combustion engine systems such as the camshaft, crankshaft, the power exchange working fluid, cooling, lubrication
C3. understanding of the use of specific manufacturing technology of components for internal combustion engines

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

PEK_W01 - has knowledge of thermodynamics to the extent that the calculation of the thermodynamic cycle of the traction combustion engine

PEK_W02 - acquires basic knowledge in the field of classification, activities, circuits, and performance characteristics of combustion engines

PEK_W03 - knows the rules of selection of an internal combustion engine for the drive of motor vehicles and work machines

II. Relating to skills:

PEK_U01 - is able to perform tests of selected systems of the internal combustion engine

PEK_U02 - it analyzes the results of conducted research conducted during laboratory classes

PEK_U03 - calculates and correctly interprets the results of laboratory tests

III. Relating to social competences:

PEK_K01 - understands the need and knows the possibilities of continuous learning, especially by raising their knowledge of internal combustion engines driving vehicles (second and third degree courses, postgraduate studies, courses).

PEK_K02 - is aware of the importance, responsibility and consequences of the engineering and mechanical engineering business as regards the responsibility for the environmental condition resulting from the proper operation of internal combustion engines that are a significant threat to the environment

PEK_K03 - appreciates the need to improve professional, personal and social competences

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Classification and principles of internal combustion engines.	2
Lec2	Thermodynamic cycles, efficiency, energy balance	2
Lec3	Fuel for internal combustion engines	2
Lec4	Combustion processes in spark ignition and diesel engines	2
Lec5	Replacement of the working medium	2
Lec6	Fuel systems for spark ignition and diesel engines	2
Lec7	Characteristics of combustion engines	2
Lec8	Selection of engine for torque receiver	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Construction of the crank-piston system	2
Lab2	Wheel of timing phases	2
Lab3	Classical fuel system for compression ignition engines	2
Lab4	Common Rail fuel system for diesel engine	2
Lab5	Spark Ignition Engine fuel System; single point injection (SPI)	2
Lab6	Spark Ignition Engine fuel System; multi point injection (MPI)	2
Lab7	Hybrid drive of a two-wheel vehicle	2

Lab8	An unconventional vehicle with a fuel cell	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_KM_W04, K1MBM_W06	C1	Lec1 Lec2	N1.
PEK_W02	K1MBM_KM_W04	C2 C3	Lec3 Lec4 Lec5	N1.
PEK_W03	K1MBM_KM_W04	C3	Lec7 Lec8	N1.
PEK_U01	K1MBM_KM_U03, K1MBM_KM_U05, K1MBM_KM_U06	C1 C2	Lab1 Lab2	N2. N3. N4.
PEK_U02	K1MBM_KM_U03, K1MBM_KM_U05	C2 C3	Lab3 Lab4 Lab5	N2. N3. N4.
PEK_U03	K1MBM_KM_U03, K1MBM_KM_U05	C2 C3	Lab6 Lab7	N2. N3. N4.
PEK_K01 - PEK_K03	K1MBM_K01, K1MBM_K02, K1MBM_K07	C1	Lab1-lab7	N3.

SUBJECT SUPERVISOR

dr inż. Marcin Tkaczyk tel.: 71 347-79-18 email: Marcin.Tkaczyk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Ustroje nośne**
Name in English: **Load-carrying structures**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031107 (MMM031357)**
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. Strength of materials fundamentals; trusses , beams, plates and shells analysis. Fundamentals of materials science.
2. Fundamentals of Finite Element Method
3. Ability to perform numerical strength analysis of basic elements in the elastic range behavior.

SUBJECT OBJECTIVES

C1. Recommendations for trusses, thin and thick plates elements design
C2. Presentation of problem related to proper design of connections and structural nodes under static and alternating loads
C3. Ability to design basic load carryings structures with use of the CAD/CAE software

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge in the field of design of load carrying structure under alternating loads, prone to fatigue (trusses, frames, thin shell, solid elements)
PEK_W02 - Knowledge in the field of designing of structural nodes and connections of load carrying structures
PEK_W03 - Knowledge in the field of designing on the basis of standards (cranes, steel structures) with respect to the stiffness and durability criterion

II. Relating to skills:
PEK_U01 - Ability to develop numerical model of basic structural elements for strength, buckling and vibrations analysis
PEK_U02 - Ability to define proper kinetic, kinematic boundaries to the structure
PEK_U03 - Ability to proper results intepretation

III. Relating to social competences:
PEK_K01 - Acquire skills in the responsibility of performed tasks
PEK_K02 - Acquire skills of creative engineering
PEK_K03 - Acquire skills of team work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Survey of the machines load carrying structures	1
Lec2	Failures and disasters analysis of load carrying structures	2
Lec3	Load carrying structures modeling	2
Lec4	Recommendations for connecting structure elements under alternating loads	2
Lec5	Recommendations for design of thin shell elements. Local and global stability approach.	2
Lec6	Recommendations for structural nodes design	2
Lec7	Calculation methods in load carrying structures design – permissible stresses method, limiting stresses method	2
Lec8	Fatigue phenomenon of load carrying structures	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Description and scope of the project classes. Introduction to the software.	2
Proj2	Designing, modeling of volume/solid elements structures	2
Proj3	Boundary conditions: support definition; symmetry, kinetic and kinematic load, strength analysis	2
Proj4	Optimization of the solid elements structures (mass minimization)	2
Proj5	Designing and modeling of thin shell elements (I profiles, box profiles)	2
Proj6	Designing and modeling of thin shell elements (mass minimization)	4
Proj7	Designing and modeling of truss elements (3D truss)	2
Proj8	Designing and modeling of structural nodes (rigid, elastic and revolute joints)	4

Proj9	Designing and modeling of 3D beam structures of machines and vehicles	4
Proj10	Design optimization of the 3D beam structure	2
Proj11	Definition and combination of fundamental loads for cranes	2
Proj12	Natural frequencies and linear buckling analysis of load carrying structures	2
		Total hours: 30

TEACHING TOOLS USED

N1. Individual work – project development
N2. Design tasks assignments
N3. Multimedia presentation
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	Colloquium and possible orally improvement
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusinski E., Czmochowski J., Smolnicki T.: The advanced finite element method in the construction of load-bearing (in polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rusiński E.: Finite Element Method. COSMOS/M (in Polish) System, WKiŁ, Warszawa 1994
Rusiński E.: Computer analysis of frames and bodies of vehicles and work machines (in Polish), WKiŁ, Warszawa 1990
Rusiński E.: Principles of design of bearing structures of vehicles (in Polish). Oficyna Wyd. PWr Wrocław 2002

SECONDARY LITERATURE

Augustyn J., Śledziewski E.: Technology of steel welded constructions (in Polish), Arkady, Warszawa 1981
Augustyn J.: Welded and spot-welded joints (in Polish), Arkady, Warszawa 1987
Dudczak A.: Excavators. Theory and design (in Polish), PWN, Warszawa 2000
Ferenc K., Ferenc J.: Welded constructions. Designing connections. (in Polish) WNT, Warszawa 2000
Pieczonka K.: Engineering of work machines. Part I. The basics of mining, driving, lifting and turning (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007
Żmuda J.: Basic design of metal structures (in Polish), Arkady, Warszawa 1997
EN 1993-1 Eurokod 3 Design of steel structures

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Load-carrying structures
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_KM_W01, K1MBM_KM_W02, K1MBM_W19	C1	Lec1 – Lec3	N2, N3
PEK_W02	K1MBM_KM_W02	C2	Lec4 - Lec6	N2, N3
PEK_W03	K1MBM_W09	C3	Lec7, Lec8	N2, N3
PEK_U01	K1MBM_KM_U01, K1MBM_KM_U02, K1MBM_U19, K1MBM_U22	C1 - C3	Proj1 – Proj10	N1, N4
PEK_U02	K1MBM_KM_U01, K1MBM_KM_U02, K1MBM_U19, K1MBM_U22	C2	Proj1 – Proj10	N1, N4
PEK_U03	K1MBM_KM_U01, K1MBM_KM_U02, K1MBM_U19, K1MBM_U22	C3	Proj11 – Proj12	N1, N4
PEK_K01-PEK_K03	K1MBM_K04, K1MBM_K05	C1-C3	Proj1 – Proj12	N1, N4

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English: **Thesis seminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031110 (MMM031341).**
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. Fundamentals of engineering knowledge in the field of construction machinery, technology and materials science
2. Able to obtain technical information from different sources (literature, the Internet, databases), also in foreign languages
3. Can speak in the scientific and technical field, can formulate and justify his position, participate in the discussion, prepare and present the presentation

SUBJECT OBJECTIVES

C1. Acquisition of knowledge in the field of preparation of the technical diploma thesis
C2. Acquiring the ability to formulate its own position, presentation of their work
C3. Ability to conduct discussions on engineering issues

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - He can define the purpose and scope and innovative aspects of engineering work
PEK_U02 - Acquiring the ability to speak (correct formulation) in the field of engineering topics
PEK_U03 - Broadening the ability to conduct discussions related to solving engineering problems

III. Relating to social competences:
PEK_K01 - Acquires the ability to take responsibility for the work done
PEK_K02 - Think and act in a creative way
PEK_K03 - Acquires the skill of teamwork

PROGRAMME CONTENT		
Form of classes – Seminar		Number of hours
Sem1	Presentation of the program, the purpose and scope of classes and the schedule of the speeches of the diplomats	1
Sem2	Presentation of own topics of engineering work (substantive discussion)	14
		Total hours: 15

TEACHING TOOLS USED

N1. problem discussion
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01,PEK_K02, PEK_K03	Rating for active participation in problem discussions and for presentation of work
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Baranowski B., Methods of creative engineering problem solving (in Polish), Wyd. Wielkopolska Korporacja Techniczna NOT, Poznań 1999
Basics of machine construction (in Polish) pod red. Marka Dietricha, T. 1÷3,WNT Warszawa 2006
Kurmaz L. W., Kurmaz O. L., Basics of construction of nodes and machine parts. Construction manual (in Polish), Wyd. PŚw, Kielce 2011
Gronowicz A., Miller S.: The mechanisms (in Polish). Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1997
Ferenc K., Ferenc J.Ł Welded constructions (in Polish), WNT, Warszawa 2000
Rusiński E.: Principles of design of load bearing structures of motor vehicles (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002

SECONDARY LITERATURE
Piątkiewicz A., Sobolski R., Hoisting equipment (in Polish), WNT, Warszawa 1977
Pieczonka K.: Engineering of work machines. Vol. 1. The basics of mining, driving, lifting and turning (in Polish), Oficyna Wyd. PWr, Wrocław 2007
Construction machinery, Characteristics and application (in Polish), praca zbiorowa pod kier. prof. I. Bracha, Arkady, Warszawa 1974
ISO 8686-1:1999 Cranes. Principles of calculating and associating loads. General provisions
EN 1993-1-1:2006. Eurokod 3: Design of steel structures

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K1MBM_U33	C1,C2	Sem1-Sem7	N1, N2
PEK_K01-PEK_K03	K1MBM_K01, K1MBM_K02, K1MBM_K05	C3	Sem2 - Sem7	N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Budowa pojazdów samochodowych**
Name in English: **Vehicle Enineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031111 (MMM031368)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge of machine design
2. The ability to associate and use knowledge

SUBJECT OBJECTIVES

C1. Knowing the main units and systems of motor vehicles
C2. Understanding the basic principles of the selection of types of teams and systems in motor vehicle
C3. Knowledge and understanding of the workings of teams and systems in motor vehicle

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has a basic knowledge of the construction and operation of major components or vehicle general automotive parts and mechanisms of a motor vehicle
PEK_W02 - It has a basic knowledge of the names of individual components and systems vehicle.
PEK_W03 - Versed in the current state and recent trends in vehicle development car

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Basic information about the ingredients of the road transport system	2
Lec2	Classification of vehicles. Approval. elements identification	2
Lec3	Fundamentals of traffic engineering. resistance to motion	2
Lec4	The choice of power source. Power on wheels and engine characteristics	2
Lec5	Construction of automotive powertrain vehicles	3
Lec6	Construction chassis vehicles. Bearing and suspension system	3
Lec7	Wheels. tires	2
Lec8	The construction of the steering	2
Lec9	Construction of the brake system	2
Lec10	Automation of systems of a motor vehicle	2
Lec11	The criteria for assessing the safety car	2
Lec12	Compatible vehicles	1
Lec13	Outdoor Lighting Vehicle	2
Lec14	CAN / BUS	1
Lec15	Features built-ins of vehicles with special	2
		Total hours: 30

TEACHING TOOLS USED

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Reimpell J., Betzler J.: Chassis cars. Basic construction. Optics Warsaw 2001

PAWrzecioniarz, W.Ambroszko, A.Górniak - Energy Efficient Design of powetrain and body, Wrocław University of Technology, 2011

SECONDARY LITERATURE

L. Prochowski: Mechanical Movement. Publisher of Science and Technology, Warsaw, 2005.

M. Zając: Transmission systems for trucks and buses. WKiŁ Warsaw 2003

Automobile Engineering Handbook. publishing REA

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01- PEK_W03	K1MBM_KM_W04, K1MBM_W18	C1-C3	WY1-WY15	N1- N3

SUBJECT SUPERVISOR

dr inż. Wojciech Ambroszko tel.: 71 347-79-18 email: wojciech.ambroszko@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Inżynieria pojazdów przemysłowych**
Name in English: **Offroad Vehicles Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031112 (MMM031369)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	15	
Number of hours of total student workload (CNPS)	90		60	30	
Form of crediting	Examination				
Group of courses					
Number of ECTS points	3		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has knowledge in the field of construction vehicle drive systems
2. Can work with a group and individually solve complex tasks
3. Advance knowledge in mechanics, mathematical analysis and basics of machine design vehicle drive systems

SUBJECT OBJECTIVES

C1. The aim of the course is to extend knowledge of the structure and working methods of engineering vehicles, in detail: wheeled and tracked. The range also includes the calculation of the force resistance while moving, turning with comparison of different chassis systems
C2. The aim of the course is to gain practical knowledge on the calculation of supporting elements typical wheeled and tracked chassis . Classes also expand knowledge in the use of various vehicle chassis systems; The aim of the course is to gain knowledge in the field of cooperation tool with the soil to determine the suitability of tools for various works .
C3. The aim of the course is to gain ability of working in the group, analyzing the results .

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student can calculate the various components of suspension systems both wheeled and tracked vehicles.
PEK_W02 - Student is able to identify the right tool for the task to be performed.
PEK_W03 - Student knows the basis for cooperation tool with the ground and is familiar with the methods , allowing to obtain a full load.

II. Relating to skills:
PEK_U01 - Student can use also foreign literature, and base on experiance analyzes and interprets the results.
PEK_U02 - Student is able to analyze and compile the results in order to obtain characteristics or measured performance drive systems for vehicles and machines with different settings of the control system.
PEK_U03 - Student can propose their own ideas for chassis systems.

III. Relating to social competences:
PEK_K01 - able to and understands the need for continuous retraining and acquiring new information.
PEK_K02 - It is responsible for the decisions made both in terms of environmental protection.
as well as mechanical engineering activities
PEK_K03 - able to work in a group and solve the tasks assigned to the various positions and is responsible for the Group to achieve the intended purpose.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Means of transport in nature. Overview of methods of moving animals and vehicles with examples. The theory of rubber wheel movement on different surfaces. Characteristics and examples of calculations resistance movement.	2
Lec2	Selected examples of industrial vehicles (articulated in the mines aggregates , chassis propelled telescopic cranes, jib chassis container cars , forklifts).	2
Lec3	Typical suspension systems of wheeled vehicles , construction examples and calculations of selected support elements. Engineering mechanisms of selected industrial vehicle (chassis steering system mechanisms wheeled vehicles with one and several torsion axles).	3
Lec4	The theory of tracked vehicle. Steering resistance, driving, pulling power, determination unit pressure and determining the pulling forces. Mechanisms track tensioning systems - examples of calculations.	3
Lec5	Suspension systems of tracked vehicles. Examples of solutions and calculations of selected components. Steel, elastomer and other tracks . Construction, suspension of road wheels and / or body operating advantages and disadvantages.	3
Lec6	The basic theory of walking vehicles. Examples of their use. The construction principle and examples of solutions and calculations hovercraft.	2
Lec7	Comparison of different methods of transport : wheeled vehicles, tracked, walking, hovercraft and screw vehicles.	2

Lec8	Sensors and transducers used in working machines. The problems associated with their use, reliability and buildings not influencing the kinematics of rigging, steering mechanisms etc.	4
Lec9	Automation of working machines. Methods of mining land in order to achieve a high degree of filling tools, path following mechanisms tools to increase the efficiency of the drive system.	4
Lec10	Overview of operating systems and hardware used in wheeled loaders. Determining path and movement of the tool. Determination of kinematic motion. Calculate the power requirements of a typical boom. Selection of the powertrain. Overview of operating systems and hardware used excavators.	3
Lec11	Calculate the power requirements of a typical boom. Selection of the powertrain. Examples of machinery and handling equipment - cranes, cranes with their construction and examples of design solutions.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Working tool and overturning stability normative standard testing of industrial vehicle.	2
Lab2	Overhead crane lifting system dynamic impact forces examining.	2
Lab3	Rock excavating process examining by different shape tools.	2
Lab4	Experimental determination of tractive forces generated by tracked undercarriage on different grounds 1/2.	2
Lab5	Experimental determination of tractive forces generated by tracked undercarriage on different grounds 2/2.	2
Lab6	Examining of friction coefficient between elastomeric truck and steel rope.	2
Lab7	Traction parameters estimation of vehicle moving on steel rope.	2
Lab8	Truck vehicle moving resistance force estimation.	2
Lab9	Wheeled vehicle moving resistance force estimation.	2
Lab10	Analysis load the track elastomeric teeth working with contoured feedback.	2
Lab11	Cornering resistant forces experimental examination of truck vehicle.	2
Lab12	Cornering resistant forces experimental examination of wheeled vehicle.	2
Lab13	Moving parameters examining of vehicle equipped with multidirectional wheels type: Mecanum.	2
Lab14	Traction parameters estimation of: vehicle using magnetic adhesion, screw drive vehicle and hoovercraft.	2
Lab15	Examination of gravel loading process with a bucket loader.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	The aim of the project is to develop a drive system for a wheeled or tracked vehicle. The project includes calculating the pulling forces, driving torque resistance movement and preparation of drawings selected component. The project may also involve the selection of the geometry of the boom in order to maintain straight path movement of the tool and powertrain classic or hybrid. In this case, the determined resistance to motion during scooping muck and selects individual components .	15
		Total hours: 15

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. laboratory experiment N3. project presentation

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

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	Positive marks from raports and tests
P = pozytywne oceny z wszystkich ćwiczeń laboratoryjnych		

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	Project positive mark
P = pozytywnie oceniony projekt		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Inżynieria maszyn roboczych, K. Pieczonka, OW PWr, 2007
2. Theory of ground vehicles; J. Y. Wong, John Wiley & Sons, New York
3. Tyre and Vehicle Dynamics, H. B. Pacejka, Delft University of Technology
4. Vehicle Dynamisc, Theory and Applicaton, R. N. Jazar, Springer, 2008
5. Automotive Engineering Powertrain, Chassis System and Vehicle Body, A. Crolla, Elsevier, 2009
6. Fundamentals of Vehicle Dynamisc, T. D. Gillespie, Society of Automotive Engeeners,
7. Ciągniki, H. Dajniak, Wydawnictwa Komunikacji i Łączności, 2008
8. Kierowalność i stateczność samochodu, A. Litwinow, WKŁ, 1975
9. Teoria ruchu pojazdu gąsienicowego, Z. Burdziński, WKŁ, 1972

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
pek_W1	K1MBM_W34	C1, C2, C3	Le2-Le7,	N1, N2, N3
pek_W2	K1MBM_W01	C1, C2, C3	Le1-Le15,	N1, N2, N3
pek_W3	K1MBM_W20	C1, C2, C3	Le1-Le15,	N1, N2, N3
pek_U1	K1MBM_KM_U01, K1MBM_KM_U03	C3	La1-La15, Pr.	N1, N2, N3
pek_U2	K1MBM_KM_U04, K1MBM_KM_U06	C3	La1-La15, Pr.	N1, N2, N3
pek_U3	K1MBM_KM_U02	C3	La1-La15	N1, N2, N3
pek_K1	K1MBM_K01	C1, C2	La1-La15	N1, N2, N3
pek_K2	K1MBM_K10	C1, C2	La1-La15	N1, N2, N3
pek_K2	K1MBM_K04	C1, C2	La1-La15	N1, N2, N3

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Napęd hydrauliczny**
Name in English: **Hydraulic drive**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031113 (MMM031370)**
Group of courses: **no**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		30	15	
Number of hours of total student workload (CNPS)	90		60	30	
Form of crediting	Examination		Crediting with grade	Crediting with grade	
Group of courses					
Number of ECTS points	3		2	1	
including number of ECTS points for practical (P) classes			2	1	
including number of ECTS points for direct teacher-student contact (BK) classes	1.8		1.4	0.7	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. A student possesses the basic knowledge of fluid mechanics.
2. A student can solve differential equations of mathematical models of hydraulic components and systems.
3. A student possesses the basic knowledge of hydrostatic drive systems.

SUBJECT OBJECTIVES

C1. Acquaintance of students with the functions of hydraulic components in hydrostatic systems.
C2. Acquaintance of students with hydraulic drive systems.
C3. Acquaintance of students with the control and regulation methods of the selected parameters of hydraulic drive systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - As a result of the course a student has the knowledge to describe basic hydraulic systems.
PEK_W02 - As a result of the course a student has the knowledge to explain the principles of designing hydraulic drive systems.
PEK_W03 - As a result of the course a student has the knowledge to characterize the components of hydraulic systems controlling the relevant parameters, or regulating certain parameters.

II. Relating to skills:
PEK_U01 - As the result of the course a student can design a hydraulic system together with the control system - perform the appropriate technical calculations and on their basis select the elements of the hydraulic system with appropriate dimensions and properties.
PEK_U02 - As the result of the course a student can make measurements on hydraulic components and systems, and then discuss the results and draw the appropriate conclusions.
PEK_U03 - As the result of the course a student knows how to assemble, run the settings and analyze the correctness of the operation of hydraulic and electrohydraulic drive systems.

III. Relating to social competences:
PEK_K01 - A Student can cooperate in A group during assembly of hydraulic and electrohydraulic systems and creating a report on the exercise.
PEK_K02 - A student is able to properly plan measurements during a laboratory exercise and plan the implementation of the project.
PEK_K03 - A student correctly identifies and solves problems encountered during the assembly of hydraulic and electrohydraulic systems and the implementation of the project. He draws the appropriate conclusions from the exercise.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction, presentation of the content of the course, forms of evaluation and requirements, providing literature on the subject. Features of hydraulic systems.	3
Lec2	Hydrostatic transmission - principle of operation, basic parameters and dependencies.	2
Lec3	Regulation methods of the parameters of the hydraulic energy source.	2
Lec4	Calculation of the suction system of the hydraulic pump.	2
Lec5	Multi-pump systems and emergency hydraulic energy source.	2
Lec6	Synchronization of motion speed of hydraulic motors.	2
Lec7	Thermal balance of hydraulic systems.	2
Lec8	Hydrostatic transmission in drive systems.	2
Lec9	Hydrostatic drive systems of machine work tool systems.	2
Lec10	Hydrostatic braking systems, ABS system.	2
Lec11	Steering servomechanisms.	2
Lec12	Hydropneumatic suspension, vibration dampers.	2
Lec13	Sequential control of hydraulic motors.	2

Lec14	Examples of hydraulic drive design.	3
		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	Characteristics of the hydraulic power supply.	2
Lab3	Methods of controlling the speed of a hydraulic actuators in systems with a constant capacity pump - throttle control.	2
Lab4	Methods to reduce power losses in hydraulic systems.	2
Lab5	The use of piloted non-return valve in hydraulic systems of work machines.	2
Lab6	Hydraulic systems with flow regulator.	2
Lab7	Functions of hydraulic accumulator.	2
Lab8	Control of the hydraulic system with a proportional pressure relief valve.	2
Lab9	Testing of the Load-Sensing hydraulic system.	2
Lab10	Sequential control of hydraulic actuators.	2
Lab11	Comparative tests of control systems and speed regulation of a hydraulic actuator.	2
Lab12	Conventional volume control.	2
Lab13	Constant power hydraulic system.	2
Lab14	Experimental analysis of dynamic processes in hydraulic systems.	2
Lab15	Final assessment.	2
		Total hours: 30
Form of classes – Project		Number of hours
Proj1	Introduction to the project. Assigning design topics.	2
Proj2	Definition of the assumed system parameters. Generating the structure of the hydraulic system.	2
Proj3	Preparation of basic calculations.	2
Proj4	Selection of typical components.	2
Proj5	Determination of the parameters of the designed system. Comparative analysis with initial assumptions.	3
Proj6	Description of the system operation principles and specification of the selected components.	2
Proj7	Final assessment of the project.	2
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. laboratory experiment
N3. self study - preparation for project classes
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 verification of design and assembling of systems
F2	PEK_U02	report on laboratory exercises
F3	PEK_U03	student's activity grade
P = (2F1+F2+F3)/4		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)		
Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_K01-PEK_K03	project check
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 .
Szydelski Z.: Hydraulic drive and control (in polish), WKŁ, Warszawa 1999.
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
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_KM_W03, K1MBM_W14, K1MBM_W20	C2 C3	Lec1 Lec4 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13	N1
PEK_W02	K1MBM_KM_W03, K1MBM_W08, K1MBM_W14, K1MBM_W20	C1 C2	Lec1 Lec2 Lec5 Lec14 Lec15	N1 N3
PEK_W03	K1MBM_W16, K1MBM_W20	C1 C2 C3	Lec1 Lec3 Lec6 Lec7 Lec9 Lec11 Lec13	N1
PEK_U01	K1MBM_KM_U03, K1MBM_U23, K1MBM_U25	C1 C2 C3	Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7 Lab13	N1 N3
PEK_U02	K1MBM_U12, K1MBM_U24	C1 C2 C3	Lab4 Lab9 Lab10 Lab11 Lab12 Lab14	N2 N4
PEK_U03	K1MBM_U09, K1MBM_U23, K1MBM_U24	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab12 Lab13	N2 N4
PEK_K01	K1MBM_K04, K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14	N2 N4
PEK_K02	K1MBM_K04, K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N2 N3 N4
PEK_K03	K1MBM_K09	C1 C2 C3	Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8 Lab9 Lab10 Lab11 Lab12 Lab13 Lab14 Proj1 Proj2 Proj3 Proj4 Proj5 Proj6 Proj7	N2 N3 N4

SUBJECT SUPERVISOR

dr inż. Tomasz Siwulski tel.: 71 320-28-92 email: tomasz.siwulski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Biomechanika inżynierska**
Name in English: **Biomedical Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031120 (MMM031359).**
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)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1.8				

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture	Number of hours

Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		2
Lec8		2
Lec9		2
Lec10		2
Lec11		2
Lec12		2
Lec13		2
Lec14		2
Lec15		2
		Total hours: 30

TEACHING TOOLS USED

N1. informative lecture
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02	K1MBM_W11, K1MBM_W30	C1, C2		N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Celina Pezowicz tel.: 71 320-27-13 email: Celina.Pezowicz@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technika w medycynie**
Name in English: **Technique in Medicine**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031121**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mechanics and strength of materials.
2. Knowledge of the basics of mechanical design.
3. Knowledge of powertrains.

SUBJECT OBJECTIVES

C1. Discussion of the technical means supporting the human locomotion
C2. Overview of the design and operation of selected artificial organs.
C3. Discussion of the design and operation the equipment and systems that support treatments and surgery

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It has a basic knowledge about biomechanical aspects of the anatomy and functioning of the organs and systems of man.
PEK_W02 - Have the knowledge about the design and functional charactristics of selected devices supporting the body
functions of man and systems supporting the planning and execution of surgical operations.

II. Relating to skills:

III. Relating to social competences:
PEK_K01 - He is aware of the role of the engineer in efforts to improve the quality of life of contemporary society

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Technical progress and 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 osteoarticular system, basic knowledge about the structure of bone biomechanics of the osteoarticular system, bone tissue adaptation processes	2
Lec3	Muscular system as a source of human power: types of muscles, their structure, the types of muscle work, the mechanism of muscle contraction, muscle interaction with the sceletaly system.	2
Lec4	The nervous system - controlling the operation the living organism: the base of the structure of the nervous system, control algorithms of the human body movements, the spinal cord as the main information line, man of the waves generated by the brain.	2
Lec5	Supporting of locomotion disabled persons (DP): crutches and walking frames (design, calculations, applied technical solutions), wheelchairs (classification, examples of construction, types of drives, basic calculations of traction), trucks feature upright, standards for the design of means of transport for DP, directions of development of the structure supporting locomotion DP.	2
Lec6	Automobiles for DP, equipment for loading the wheelchair into the car, on the roof of the car, the device stair climber by DP equipment for vertical transport DP	2
Lec7	Lower limb prostheses, functions, classification, requirements for lower limb prosthesis, biomechanics of prosthesis, discuss design solutions of prosthesis (the knee, foot), mechatronic systems in prosthesis, bionic prosthesis, the possibility of using signals generated by the body to control the prosthesis (EMG EEG)	2
Lec8	Prostheses upper limbs; functions, classification, discussion prostheses design solutions, hand prosthesis (inds of grips) drive systems of multi- fingerlike prosthesis, bionic prostheses.	2

Lec9	Long bones systems stabilization - their development, external fixatorrs for the treatment of bone fractures and their elongation. Influence of stabilser structure on the biomechanics of the bone tissue regeneration.	2
Lec10	Technical means used in the rehabilitation of osteo-articular and muscular, equipment for active and passive rehabilitation of limbs, lifts and parapodia for patient, exoskeletons supporting locomotion DP and medical personnel, systems rehabilitative using biofeedback.	2
Lec11	Navigation systems for the operating room: purpose, classification, optical and magnetic navigation -operating principle, examples of mechanical components construction, examples of applications in clinical practice.	2
Lec12	Manipulators medical, their genesis and history, design solutions used in medical manipulators, tools for laparoscopic surgery, operations on distance, telemedicine	2
Lec13	Technical support for the cardiovascular system: artificial heart, the idea of building applied solutions, materials, controls system; pacemakers, extracorporeal circulatory systems, the technique of minimally invasive vascular angioplasty; vascular stents, stengrafts, design, operation, applied design solutions.	2
Lec14	Imaging in medicine, history, design and operation of CT scanners (types of structure, scope of application), magnetic resonance imaging, intravascular ultrasound, algorithms reconstruction of three-dimensional images of internal organs	2
Lec15	Biomaterials, definition, classification, requirements for biomaterials, an overview of metallic biomaterials, ceramics, polymers and natural	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	test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W25, K1MBM_W30	C1, C2		N1
PEK_W02	K1MBM_W25	C3		N1
PEK_K01	K1MBM_K01, K1MBM_K02, K1MBM_K06, K1MBM_K08	C1, C2, C3		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: **Projektowanie elementów z tworzyw sztucznych**
Name in English: **Polymers in Engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031124 (MMM031376)**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic knowledge about properties of polymeric materials
2. Basic knowledge about technology of manufacturing plastic elements
3. Basic knowledge about design of machine elements

SUBJECT OBJECTIVES

C1. Acquisitions of skills in applications of plastics for machine elements, taking into account assumptions about working conditions, manufacturing technology, production costs, etc.
C2. Knowledge of issues related to design principles of machine elements made from plastics
C3. Learn about issues related to recycling of plastic machine elements

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student has knowledge about characteristic properties of polymeric materials
PEK_W02 - Student knows principles of design and joining methods of plastic elements
PEK_W03 - Student knows methods and principles of plastic elements recycling

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Properties of polymeric materials used in machines. Characteristics of mechanical and operational properties of polymeric materials - effect of temperature and time.	2
Lec2	Overview of engineering polymers - properties and technical applications. Polymeric composite materials.	6
Lec3	Modeling of mechanical properties of polymeric materials. Application of models in calculations that take into account viscoelasticity of polymers.	2
Lec4	Design principles for plastic housings and bodies - technology, molding, methods of calculation. Plastic containers and tanks - overview of construction solutions, rules of molding.	2
Lec5	Ways to join plastic parts - detachable and inseparable joints. Design of joints, methods of strength calculation.	4
Lec6	Modeling and calculation of plastic machine elements using computer technique - FEM.	2
Lec7	Friction and wear of plastic machine parts. Plastic plain bearings - calculations and design solutions.	2
Lec8	Plastics gears - design, calculations.	2
Lec9	Polymer materials in bioengineering applications.	2
Lec10	Plastics parts of hydraulic equipment - materials selection, design.	2
Lec11	Recycling of plastics products.	2
Lec12	Pass grade.	2
		Total hours: 30

TEACHING TOOLS USED

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

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Erhard G.: Designing with Plastics. Hanser Gardner Publications, 2006
2. Tooley M.: Design Techniques: Plastics. Elsevier, 2010
3. Mastro P.F. Plastics Product Design. Wiley-Scrivener, 2016
4. Mills N.J.: Plastics. Burlington Butterworth-Heinemann,2005
5. Abstracts of lectures

SECONDARY LITERATURE

1. Tutorials and brochures of plastics manufacturers on the websites (links are given at the first lecture)

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W11	C1	Lec1-Lec3	N1
PEK_W02	K1MBM_W13, K1MBM_W18	C2	Lec4-Lec10	N1,N2
PEK_W03	K1MBM_W13	C3	Lec11	N1,N2

SUBJECT SUPERVISOR

Prof. dr hab. inż. Wojciech Wieleba tel.: +4871 320-27-74 email: wojciech.wieleba@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): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031152 (MMM031381).**
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)				360	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				12	
including number of ECTS points for practical (P) classes				12	
including number of ECTS points for direct teacher-student contact (BK) classes				12.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

TEACHING TOOLS USED

N1.
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	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K1MBM_U41, K1MBM_U42, K1MBM_U45	C1, C2, C3		N1
PEK_K01	K1MBM_K01, K1MBM_K02, K1MBM_K03, K1MBM_K04, K1MBM_K05, K1MBM_K06, K1MBM_K08, K1MBM_K09, K1MBM_K10	C1, C2, C3		N1, N2

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie spajania**
Name in English: **Joining technology**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031202**
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	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 knows the types of welds, welding positions, joints marking, causes of welded joints cracking
- The student knows the basic welding methods and parameters of the welding processes
- The student has knowledge of the fundamentals and applications of soldering, brazing, resistance welding and thermal cutting
2. - The student is able to select the right technology (method) of joining (bonding) and define basic parameters of the process;
- The student is able to select the right technology (method) of thermal cutting and define basic parameters of the process;
- The student is able to design a simple bonding process of the product

SUBJECT OBJECTIVES

C1. Acquisition of knowledge about the different types of welded structures
C2. Acquiring the ability to develop bonding technology
C3. Searching for information and its critical analysis

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Has knowledge of the performance of various welded structures
PEK_W02 - Knows welding, resistance welding, soldering, brazing and adhesive bonding technologies of different metals and alloys
PEK_W03 - Has knowledge of use of welding, resistance welding, soldering, brazing and adhesive bonding

II. Relating to skills:
PEK_U01 - Is able to select the right bonding technology
PEK_U02 - Is able to select the appropriate parameters of welding, soldering, brazing, resistance welding and adhesive bonding
PEK_U03 - Is able to design bonding process of different types of structures

III. Relating to social competences:
PEK_K01 - searching for information and its critical analysis
PEK_K02 - team cooperation on improving methods for the selection of a strategy to optimally solve assigned problems
PEK_K03 - objective evaluation of arguments, rational explanations and justifications of own point of view, using knowledge of welding technology

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to economics of welding processes	2
Lec2	Technological parameters of manual metal arc welding	2
Lec3	Technological parameters of TIG welding	2
Lec4	Technological parameters of submerged arc welding	2
Lec5	Technological parameters MAG/MIG welding	2
Lec6	Welding of unalloyed and low-alloy steel	2
Lec7	Welding of high-alloy steel	2
Lec8	Welding of copper and cast iron alloys	2
Lec9	Aluminum and its alloys welded constructions	2
Lec10	Welding of pressure vessels	2
Lec11	Advanced soldering and brazing technologies	2
Lec12	Selected aspects of resistance welding	2
Lec13	Structural adhesives, properties and applications	2
Lec14	Adhesive technology of engineering materials	2
Lec15	Laser welding	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Selection of MMA welding parameters	3
Lab2	Selection of MIG, MAG, TIG welding parameters	2

Lab3	Determination of pre-heating temperature of welded steels	2
Lab4	Selection of filler materials for welding high-alloy steels	2
Lab5	Influence of welding parameters on the process of resistance weld forming. Evaluation of resistance welded joints.	2
Lab6	Advanced soldering and brazing technologies	2
Lab7	Adhesive bonding of basic engineering materials	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01- PEK_W03; PEK_K03	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 PEK_K01 - PEK_K03	short test, laboratory report
P = Średnia z F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Klimpel A.: Spawanie, Zgrzewanie i Ciecie Metali., WNT, Warszawa, 1999
2. Tasak E.: Spawalność stali,Fotobit, Kraków,2002
3. Pilarczyk J., Pilarczyk J. : Spawanie i napawanie elektryczne metali, Wyd. Śląsk, Katowice 1996
4. Ferenc K.,Ferenc J.: Konstrukcje spawane. Projektowanie połączeń, WNT, Warszawa 2000

SECONDARY LITERATURE
Pilarczyk J. (red.): Poradnik Inżyniera. Spawalnictwo. T. I i II, WNT Warszawa, 2003, 2005
Normatywy spawalnicze
Normy

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_W21	C1-C3	lec1-13	N1 - N5
PEK_U01-PEK_U03	K1MBM_U28	C1-C3	La1-La7	N1 - N5
PEK_K01-PEK_K03	K1MBM_K02	C1-C3	lec1-13, la1-7	N1 - N5
PEK_W01-PEK_W03	K1MBM_TSW_W03	C1-C3	lec1-13	N1 - N5

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Narzędzia skrawające**
Name in English: **Cutting tools**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031204**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic knowledge of manufacturing in machining
2. He has skills in measurement methods, techniques for measuring and evaluating the results of measurement
3. Can obtain information from literature, databases and other sources, and to draw conclusions and formulate and justify opinions

SUBJECT OBJECTIVES

C1. Expanding knowledge of cutting tools, cutting edge geometry, tools materials and coatings used on the cutting edge.
C2. Knowing the rules of proper tool selection, due to working conditions, treatment efficiency and manufacturing costs.
C3. Gaining knowledge of wear and regeneration blunted cutting tools.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student is able to correctly classify cutting tools, know their structure and geometry in different frames of reference.
PEK_W02 - Student can choose the modern technological processes cutting tools due to the efficiency and cost of production.
PEK_W03 - The student is able to explain the physical and chemical phenomena occurring at the cutting edge during machining.

II. Relating to skills:
PEK_U01 - Students can choose the tool materials due to optimal cutting for various workpiece materials.
PEK_U02 - Student can determine what is the influence of cutting edge geometry on the effects of machining technology.
PEK_U03 - Students should be able to use the computer programs used for the selection of tools set machining conditions.

III. Relating to social competences:
PEK_K01 - Is aware of the importance of behavior in a professional way, well-defined and resolve dilemmas.
PEK_K02 - Recognize the effects of the impact of technology on the environment and related social responsibility of science and technology.
PEK_K03 - Is aware of the necessity of individual and group activities that go beyond the activities of engineering.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The role of tools and equipment in the production of machine parts	2
Lec2	Tool materials and their selection	2
Lec3	The geometry of the cutting edge. Reference systems and dimensioning of the blade. The role and importance of the angles of the blades in the cutting process.	2
Lec4	Components of tools - construction and their functions	2
Lec5	Characteristics and application of tools	2
Lec6	Cutters and cutter heads. Thread Tools and gears	2
Lec7	Modular and multifunction tool	2
Lec8	Colloquium	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Measurement and tool setting in flexible production system	2
Lab2	The measurement tool components.	2
Lab3	Turning with inserts WIPER type.	2
Lab4	Cutting tool geometry on technological effect of machining.	2
Lab5	Drilling with gundrills.	2
Lab6	Machinability determination for choosen tools.	2

Lab7	The choice of cutting tools with the use of computer programs	2
Lab8	Grading	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. self study - self studies and preparation for examination
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Autor: Piotr Cichosz, tytuł: Narzędzia skrawające, wydawnictwo: WNT , rok: 2006
Autor: Mieczysław Feld, tytuł: Uchwyty obróbkowe, wydawnictwo: WNT, rok: 2002

SECONDARY LITERATURE

Autor: Henryk Żebrowski, tytuł: Przyrządy i uchwyty obróbkowe, , wydawnictwo: Oficyna Wyd. PWr., rok: 1983

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_TSW_W01, K1MBM_W22	C1, C3	Lec1 - Lec8	N1 ,N4, N5
PEK_U01, PEK_U02, PEK_U03	K1MBM_TSW_U01, K1MBM_U26, K1MBM_U31	C1, C2, C3	La1 - La8	N2, N3, N5
PEK_K01, PEK_K02, PEK_K03	K1MBM_K02, K1MBM_K03, K1MBM_K07	C1	La5 - La7	N1, N5

SUBJECT SUPERVISOR

dr inż. Marek Kołodziej tel.: 41-81 email: marek.kolodziej@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologia i materiały stosowane w wytwarzaniu konstrukcji lekkich**
Name in English: **New technologies materials in manufacturing light constructions**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031207.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1		2
Lec2		2
Lec3		2
Lec4		2
Lec5		2
Lec6		2
Lec7		3
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1		2
Lab2		2
Lab3		2
Lab4		2
Lab5		2
Lab6		2
Lab7		3
		Total hours: 15
Form of classes – Project		Number of hours
Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		2
Proj6		2
Proj7		3
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides
N2. self study - self studies and preparation for examination
N3. self study - preparation for laboratory class
N4. 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_W02	
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U01, PEK_U01	
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_U01, PEK_U01	
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
New technologies materials in manufacturing light constructions
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_TSW_W02, K1MBM_TSW_W05	C1, C2, C3		N1
PEK_U01, PEK_U03, PEK_U03	K1MBM_TSW_U02, K1MBM_U14	C1, C2, C3		N2, N3, N5
PEK_K01	K1MBM_K02	C1, C2, C3		N1, N3, N4

SUBJECT SUPERVISOR

Prof. dr hab. inż. Zbigniew Gronostajski tel.: 21-73 email: zbigniew.gronostajski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Seminarium dyplomowe**
Name in English:
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031210.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		1
Sem2		14
		Total hours: 15

TEACHING TOOLS USED

N1. problem discussion
N2. multimedia presentation

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K1MBM_U33	C1		N1,N2
PEK_K01-PEK_K03	K1MBM_K01, K1MBM_K02, K1MBM_K05	C2,C3		N1,N2

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Utrzymanie ruchu maszyn i urządzeń wytwórczych**
Name in English: **Operation maintenance of manufacturing machines and devices**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031212**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge of scope and principles of selecting a maintenance strategy of manufacturing machines and devices.
PEK_W02 - Knowledge of basic TPM tools and indices.
PEK_W03 - Knowledge of basic features and possibilities of CMMS-class computer systems to support planning operation and repair tasks, stock management and managing the operation/repair personnel.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

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

TEACHING TOOLS USED

N1. Traditional lecture with use of transparencies and slides.
N2. Own work – preparation for crediting the lecture.
N3. Consultancies.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

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

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

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W18, K1MBM_W26	C1 - C3	Wy1 - Wy7	N1 - N3

SUBJECT SUPERVISOR

dr inż. Tomasz Kurzynowski tel.: 713202083 email: tomasz.kurzynowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowa symulacja procesów odlewania**
Name in English: **Casting process simulation**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031213.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of geometric modeling and CAD systems. Fundamentals of technology planing
2. Basic knowledge of manufacture and casting methods.
3. Ability to read and develop of technical drawing at the basic level.

SUBJECT OBJECTIVES

C1. Acquirement of basic knowledge from areas of casting process design based on computer-aided environment in 3D.
C2. Ability to design casting process of a simple element. Ability to modify mold and cast structure due to manufacturability structure.
C3. Gaining skills in searching and handling of information - effectively solve problems and discover the counter-measures.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knows the principles of constructing sand mods and casting; knows the principles of model discretization and its division into groups.
PEK_W02 - Knows mathematical models of flow and solidification metal in the mold process.
PEK_W03 - Knows the causes of defects in castings, their types and their elimination methods

II. Relating to skills:
PEK_U01 - Acquires the ability to design molds and casting in computer-aided environment in 3D.
PEK_U02 - Acquires the ability from areas of modification mold structure to eliminate defects in molds.
PEK_U03 - Acquires the essential ability to use Flow 3D program.

III. Relating to social competences:
PEK_K01 - Searching information and their critical analysis
PEK_K02 - Work in a team and relying on improving methods for the selection of a strategy to optimally solve the problems assigned to the group.
PEK_K03 - Respect the traditions and rules in academia and society

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Issues of organization. Introduction to simulation of casting processes.	1
Lec2	Overview of design principles casting moulds. The calculation of the gating systems.	2
Lec3	Overview of boundary conditions and characteristics of coefficients	2
Lec4	The Principles of geometric structure of casts and its discretization in Flow3D program.	2
Lec5	Modeling methods of flow liquid metal and the process of filling the mold in liquid metal. Mathematical models.	2
Lec6	Modeling of the liquid metal solidification process. Mathematical models.	2
Lec7	Methods of elimination heat nodes based on analysis and simulation results solidification process	2
Lec8	Casting defects and methods of their elimination. Modification of cast and mold structure. Credit colloquium.	2
		Total hours: 15

Form of classes – Project		Number of hours
Proj1	Issues of organization. Overview of structures of simulation programs. Hand out the projects.	1
Proj2	Construction of casting mold geometry in CAD environment and import to the Flow3D	2
Proj3	Definition of boundary conditions. Discretization of the mold model.	2
Proj4	Simulation, visualisation and analysis of the filling mold process in liquid metal.	2
Proj5	Simulation, visualisation and analysis of mold solidification process.	2

Proj6	Identification of thermal nodes, porosity, surface defects in castings. Analysis of the causes of defects in castings based on the simulation results.	2
Proj7	Modify the casting mold, the filler and the cast structure.	2
Proj8	Analysis of the results obtained after modification of mold structure. Pass projects	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03, PEK_K01-PEK_K03	answers
F2	PEK_U01-PEK_U03, PEK_K01-PEK_K03	presentation of the project
P = średnia wszystkich ocen F1+F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_TSW_W02, K1MBM_W23	C1, C2, C3		N1, N2, N3, N4
PEK_U01-PEK_U03	K1MBM_U05, K1MBM_U14, K1MBM_U27	C1, C2, C3		N1, N2, N3, N4
PEK_K01-PEK_K03	K1MBM_K01	C1, C2, C3		N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Adam Kurzawa tel.: 42-35 email: adam.kurzawa@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Planowanie wytwarzania CAD/CAM**
Name in English: **Technology planning CAD/CAM**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031214**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of geometric modeling and CAD systems.
2. Fundamentals of technology designing.
3. Basic knowledge about numerically controlled machine tools.

SUBJECT OBJECTIVES

C1. Gaining knowledge in the field of technology design for CNC machine tools using CAD/CAM systems.
C2. Presentation of modern tools supporting manufacturing.
C3. Discussion of issues of selection, implementation and integration of CAD/CAM systems.
C4. Discussion of issues related to project management in the field of structural design and technology.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Knowledge about existing solutions supporting structural design and technology.
PEK_W02 - Ordered knowledge of technological design in CAM systems.
PEK_W03 - Knowledge regarding the selection, integration and implementation of CAD/CAM systems in enterprises.

II. Relating to skills:
PEK_U01 - Student should be able to analyze parts taking into account that will be manufactured on CNC machine tools. Analysis of the structure manufacturability.
PEK_U02 - Student should be able to prepare geometric data necessary to carry out project work.
PEK_U03 - Student should be able to prepare a technological process for CNC machine tools using selected CAD /CAM systems.

III. Relating to social competences:
PEK_K01 - Ability to work in a team project.
PEK_K02 - Ability to critically evaluate the results and their impact on the functioning of the company.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction to CAD/CAM. A review of available solutions.	2
Lec2	Integration of CAD/CAM systems.	2
Lec3	Project management in an environment of CAD/CAM system. Relationship between documents. Generating the documentation.	2
Lec4	Technological design in CAM systems. The steps and tasks performed.	2
Lec5	Technological design in CAM systems. Functions of CAM.	2
Lec6	Presentation of selected machining strategy.	2
Lec7	Processes verification through computer simulation.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Presentation of the selected environment of CAD/CAM system.	2
Lab2	Solid modeling in a CAD system.	4
Lab3	Surface modeling in a CAD system.	4
Lab4	Preparation of geometric models for processing by milling.	2
Lab5	Technological design in the CAM system - milling module. 2.5D machining.	6
Lab6	Project management. Processes verification through computer simulation. NC code generation.	4
Lab7	Generating tool paths for 3D models where 3 axes control is required.	2
Lab8	Technological design in the CAM system - turning module.	2
Lab9	Use of the FBM method in the design of technology for machined parts.	2

Lab10	Laboratory crediting.	2
		Total hours: 30

TEACHING TOOLS USED
N1. traditional lecture with the use of transparencies and slides N2. problem discussion N3. problem exercises 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,	final test
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Grzesik, Wit. Programowanie obrabiarek NC/CNC / Warszawa: Wydawnictwa Naukowo-Techniczne, 2010.
Honczarenko, Jerzy. Obrabiarki sterowane numerycznie / Warszawa : Wydawnictwa Naukowo-Techniczne, 2008.

SECONDARY LITERATURE

Augustyn, Krzysztof. NX CAM : programowanie ścieżek dla obrabiarek CNC / Gliwice : Helion, 2010.
Kacprzyk, Zbigniew. Komputerowe wspomaganie projektowania : podstawy i przykłady / Warszawa: Oficyna Wydawnicza Politechniki Warszawskiej, 2012.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Technology planning CAD/CAM
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_W23	C1, C3, C4	Lec1, Lec2, Lec3, Lec4, Lec5, Lec6, Lec7	N1, N5
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02	K1MBM_K04, K1MBM_U17	C2, C4	Lab1, Lab2, Lab3, Lab4, Lab5, Lab6, Lab7, Lab8, Lab9, Lab10	N2, N3, N4, N5

SUBJECT SUPERVISOR

dr inż. Jacek Czajka tel.: 31-37 email: jacek.czajka@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie procesów technologicznych**
Name in English: **Technological designe processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031215**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Ability to read and develop of technical drawing at the basic level.
2. Basic knowledge about typical possibilities of cutting machine tools processes.
3. Knowledge about machine tools construction and processing capabilities.

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

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

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Organizational matters. Information on the manufacturing process. Phases of development and product life.	2
Lec2	The general structure of manufacturing, operations and procedures. Method of processing.	2
Lec3	Development of technological process, producibility and type of production.	2
Lec4	Basing on processing and obtained accuracy.	2
Lec5	Selection of materials and semi-finished products, producibility.	2
Lec6	Technological documentation.	2
Lec7	Examples of technological processes of typical machine parts.	2
Lec8	Final test.	1
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Discussion of the course, edition of topics.	2
Proj2	Updating a technical drawings of objects in current standards, the definition of production type.	2
Proj3	Calculating the semi-finished products on account of technological limitations.	2
Proj4	Realization of the project of semifinished product.	2
Proj5	Realization of semi-products documentation.	2
Proj6	Development a framework of technological process for specific parts.	2

Proj7	Filling the technological cards.	2
Proj8	Developing instruction of machining.	2
Proj9	The selection of tools and cutting parameters.	2
Proj10	Selection and characterization of machine tools.	2
Proj11	The calculation of the treatments time execution.	2
Proj12	The calculation of cycle times, auxiliary times and setuptimes.	2
Proj13	Organization of the technological process.	2
Proj14	Prepare of the time cards calculations.	2
Proj15	Presentation of completed projects.	2
		Total hours: 30

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03, PEK_K01, PEK_K02, PEK_K03	Final test.
P = F1		

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Materiały własne: Konspekt do wykładu.
2.Materiały własne: Tabele i wyciągi z norm.
3.Materiały własne: Przewodnik do projektu.
4. Feld M.: Podstawy projektowania procesów technologicznych typowych części maszyn, WNT Warszawa 2003.
5. Dzidowski E.S.: Maszyny i urządzenia do obróbki plastycznej. Wyd. PWr., Wrocław 1988
6. Choroszy B.: Technologia maszyn, Oficyna Wydawnicza PWr, Wrocław 2000.
7. Chudzikiewicz R.: Mechanizacja i automatyzacja odlewni. WNT, Warszawa 1980

SECONDARY LITERATURE

1. Krzyżanowski J.: Wprowadzenie do elastycznych systemów wytwórczych. Oficyna Wydawnicza Politechniki Wrocławskiej. Wrocław 2005
2. Materiały katalogowe

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01 - PEK_W03	K1MBM_W14, K1MBM_W21, K1MBM_W22, K1MBM_W24	C1-C3	Lec1-Lec7	N1, N2, N3, N4
PEK_U01-PEK_U03	K1MBM_TSW_U01, K1MBM_TSW_U02, K1MBM_U02, K1MBM_U14, K1MBM_U26, K1MBM_U31	C3	Proj1 - Proj15	N1-N5
PEK_K01-PEK_K03	K1MBM_K01	C1-C3	Lec1 - Lec7, Proj1 - Proj15	N1-N5

SUBJECT SUPERVISOR

dr inż. Andrzej Roszkowski tel.: (71) 320 2781 email: andrzej.roszkowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowa symulacja procesów kształtowania plastycznego**
Name in English: **Computer simulation of plastic forming processes**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031216**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic understanding of the processes and machinery for plastic forming
2. It has a basic understanding of the foundations of the theory of finite element methods
3. It has a basic understanding of the strength of materials, mechanics and the theory of machines and mechanisms

SUBJECT OBJECTIVES

C1. To gain insight into the field of modern engineering tools for analysis and optimization of plastic forming processes
C2. To gain basic knowledge and skills to build mathematical models of forming processes
C3. To know the influence of the process parameters on the forming forces

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - It knows the construction of mathematical models of plastic forming processes
PEK_W02 - It has a basic knowledge of the possible applications of the finite element method to the process analysis and optimization of forming processes
PEK_W03 - It knows the basic relationships between material properties and parameters of forming process

II. Relating to skills:
PEK_U01 - It gain the skills necessary to build mathematical models of plastic forming processes
PEK_U02 - Is able to perform the calculation and initial optimization of the plastic forming process
PEK_U03 - Is able to identify which of the process parameters significantly affect the forming forces

III. Relating to social competences:
PEK_K01 - It acquires beliefs about the responsibility for the work

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Plastic forming - types of processes, the basic process parameters.	2
Lec2	The model of the process, geometry transfer, calculation model building.	2
Lec3	Fundamentals of plastic deformation.	3
Lec4	Models of materials, stress-strain curves, yield criterion	2
Lec5	Modelling of bulk metal forming processes - extrusion, drawing.	2
Lec6	Modelling of bulk metal forming processes - rolling,forging.	2
Lec7	Modelling of sheet metal forming.	2
		Total hours: 15
Form of classes – Project		Number of hours
Proj1	Introduction to computer simulation of the plastic forming processes in the computing environment.	2
Proj2	Modelling of selected examples of plastic forming processes.	2
Proj3	Analysis and determination of the influence of process parameters on the forming forces (friction, temperature, speed).	2
Proj4	Preparation of design assumptions for the selected item shaped by forming processes.	2
Proj5	Description of the process geometry and its export to the FEM program.	2
Proj6	Building the model in the FEM program.	2
Proj7	Making calculations for the various process parameters and/or the geometry of the process.	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01, PEK_W02, PEK_W03	final 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	project rating
F2	PEK_U01, PEK_U02, PEK_U03	test
P = (F1+F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Joseph R. Davis: Metals handbook. Vol. 14, Forming and forging ASM International Handbook Committee.
Altan, Taylan; Tekkaya, A. Erman: Sheet Metal Forming - Processes and Applications, ASM International.
Hosford, William F.; Caddell, Robert M.: Metal Forming - Mechanics and Metallurgy, Cambridge University Press

SECONDARY LITERATURE

Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003
Morawiecki M., Sadok L., Wosiek E.: Przeróbka plastyczna- podstawy teoretyczne. Wydawnictwo Śląsk 1986
Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer simulation of plastic forming processes
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01, PEK_W02, PEK_W03	K1MBM_TSW_W05	C1, C2, C3	Wy1-Wy7	N1,N4
PEK_U01, PEK_U02, PEK_U03	K1MBM_TSW_U05	C1, C2, C3	Pr1-Pr7	N2,N3
PEK_K01	K1MBM_K04	C3	Pr3	N2

SUBJECT SUPERVISOR

dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Technologie laserowe w wytwarzaniu**
Name in English: **Laser Technology in Manufacturing**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM031217**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

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

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

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	The basics of high-power lasers	2
Lec2	Measurements of the laser beam	2
Lec3	Laser beam forming systems and laser safety	2
Lec4	Impact of the laser beam with matter	2
Lec5	Cutting with laser beam	2
Lec6	Use of laser to welding	2
Lec7	Laserl cladding and micromachining	2
Lec8	Test	1
		Total hours: 15

Form of classes – Laboratory		Number of hours
Lab1	Overview of laser radiation generators	2
Lab2	Monitoring of the laser beam	2
Lab3	Laser cutting	2
Lab4	Welding using the laser beam	2
Lab5	Laserl cladding	2
Lab6	Use of laser scanning head for machining	2
Lab7	Engraving and laser micromachining	2
Lab8	Evaluation	1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. self study - preparation for laboratory class
N3. self study - self studies and preparation for examination
N4. Evaluation
N5. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
J. Kusiński: ”Lasery i ich zastosowanie w inżynierii materiałowej”, Wydawnictwo Naukowe Akapit, 2000; A. Klimpel: "Technologie laserowe w spawalnictwie" Wydawnictwo Politechniki Śląskiej, 2011.

SECONDARY LITERATURE
E. Kannatey-Asibu: “Principles of Laser Materials Processing”, Wiley, 2009.
J.C. Ion: „Laser Processing of Engineering Materials”, Elsevier, 2005

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Laser Technology in Manufacturing
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01-PEK_W03	K1MBM_TSW_W03, K1MBM_W21	C1,C2	Lec1-Lec7	N1- N3, N5
PEK_U01-PEK_U03	K1MBM_TSW_U03, K1MBM_U26, K1MBM_U28	C2, C3	Lab1-Lab7	N2- N5

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **PRACA DYPLOMOWA**
Name in English: **MASTER THESIS**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031252**
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)				360	
Form of crediting				Crediting with grade	
Group of courses					
Number of ECTS points				12	
including number of ECTS points for practical (P) classes				12	
including number of ECTS points for direct teacher-student contact (BK) classes				12.0	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

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

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can critically analyze and evaluate existing manufacturing processes, production systems and technological machines. Can work independently to realize the degree of master's thesis, using research techniques and methods known during studies.

PEK_U02 - Can acquire concrete information from the literature also in foreign languages. Can to interpret and critically evaluate the research results.

PEK_U03 - Knows how to edit a master's thesis complying with prevailing requirements of method and style of writing. Can present it orally to a wider audience using multimedia capabilities, including the occurrence to the diploma committee.

III. Relating to social competences:

PEK_K01 - As a graduate student is aware of being the next leader, who knows how to organize the work and determine the self-priorities for the others, can manage a team of people as well as work together in the group taking the different roles.

PEK_K02 - Is gaining characteristics of a person working alone, according to the principles of ethics with an awareness of the responsibility for their own work.

PEK_K03 - Acquires attention to style and form of expression of own views in native and a foreign languages, especially in English, understands the need of continuing education and developing professional skills throughout their live.

PROGRAMME CONTENT

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01 - PEK_U03 PEK_K01 - PEK_K03	Working in the semester, preparing master's thesis as a work.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Literature of the master's thesis topic agreed with the promoter.

SECONDARY LITERATURE
1. Kozłowski R.: Praktyczny sposób pisania prac dyplomowych; Wolters Kluwer Polska sp. z o.o. 2009;
2. Kalita C.: Zasady pisania licencjackich i magisterskich prac badawczych; Poradnik dla studentów; Wyd. ARTE 2011

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01 - PEK_U03	K1MBM_U41, K1MBM_U42, K1MBM_U45	C1, C2		N1 - N4
PEK_K01 - PEK_K03	K1MBM_K01, K1MBM_K04, K1MBM_K05, K1MBM_K06, K1MBM_K09	C1 - C3		N1 - N4

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Hydraulic, Hydrotronic and Pneumatic Systems**
Name in English: **Hydraulic, Hydrotronic and Pneumatic Systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031329**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. 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 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.	2
Lec2	Positive displacement pumps - systematics, characteristics, efficiencies.	2
Lec3	Valves - systematics, types, functions.	2
Lec4	Efficiency: hydraulic, volumetric and overall.	2
Lec5	Pressure losses in fluid power systems	2
Lec6	Electrohydraulic drives, proportional valves, servovalves	2
Lec7	Pneumatic control systems	2
Lec8	Colloquium	1
		Total hours: 15
Form of classes – Laboratory		Number of hours
Lab1	Acquaint students with the safety rules in the laboratory and its presentation, the conditions of ratings.	2
Lab2	Introduction to hydraulics, Direction control methods in hydraulic systems.	2
Lab3	The in series and parallel connection hydraulic acting elements.	2
Lab4	Pressure transducer - sequence control systems.	2
Lab5	Proximity switch and time delay sequence control systems.	2

Lab6	Introduction to pneummatics, Direction control methods in pneumatic systems.	2
Lab7	Control system of a pneumatic driven vehicle Pneumobil.	2
Lab8	Final test.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Laboratory)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01-PEK_U03 PEK_Ko1-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 .
Kollek W.: Gear pumps (in polish). Zakład Narodowy im. Ossolińskich, Wrocław 1996.
Stryczek S.: Hydrostatic drive (in polish). WNT, 1992.
Lambeck R.: Hydraulic pumps and motors. Marcel Dekker INC. New York 1983.
Pippenger J.: Hydraulic valves and control. Marcel Dekker INC. New York 1984.
Ivantysyn J., Ivantysyn M.:Hydrostatic Pumps and Motors,

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
Hydraulic, Hydrotronic and Pneumatic Systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W08	C1	Lec1, Lec2, Lec3	N1,N2
PEK_W02	K1MBM_W08	C2	Lec4,Lec5, Lec6	N1,N2
PEK_W03	K1MBM_W08, K1MBM_W20	C3	Lec7,Lec8	N1,N2
PEK_U01	K1MBM_U09	C1,C2	Lab1,Lab2, Lab4,Lab5, Lab6	N3,N4,N5
PEK_U02	K1MBM_U09, K1MBM_U24	C3	Lab3,Lab4, Lab7	N3,N4,N5
PEK_U03	K1MBM_U24, K1MBM_U25	C1,C2	Lab8,Lab2	N3,N4,N5
PEK_K01- PEK_K03	K1MBM_K09	C1-C3	Lab1-Lab7	N1-N5

SUBJECT SUPERVISOR

dr hab. inż. Wiesław Fiebig tel.: 71 320-27-00 email: Wieslaw.Fiebig@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie w produkcji**
Name in English: **Management in production**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031340**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and understands the essence of the process of management and it's functions.

SUBJECT OBJECTIVES

C1. Acquiring knowledge about the nature and mechanisms of a manufacturing enterprise.
C2. Acquiring knowledge about the essence of production systems and the management of production systems.
C3. Acquiring essentials of the environment of the production systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student should know the process of management in production and the elements of production process.
PEK_W02 - Student should know the basic types of production processes and methods and techniques of the management of these processes.
PEK_W03 - Student should know the environment of the production process and the influence of changes in the environment on the manufacturing enterprise.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Industrial revolutions. The essence and the development of management in production.	3
Lec2	Manufacturing and service enterprise. The process of management in manufacturing enterprise. The environment of the manufacturing enterprise.	3
Lec3	Production management. The objective, the scope and elements of production management.	3
Lec4	The production system and production processes.	3
Lec5	Techniques of designing production processes. The supply chain.	3
Lec6	Techniques and methods of planning the production.	3
Lec7	Organization of production. Organizational structures. Designing jobs.	3
Lec8	Management of inventory. Materials requirements planning. IT systems in management in production.	3
Lec9	The role of knowledge and innovations in management in production.	3
Lec10	Test	3
		Total hours: 30

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Dan Reid, Nada Sanders, Operations Management. 5th Edition, John Wiley & Sons 2012.
2. Slack Nigel, Brandon-Jones Alistair, Johnston Robert, Operations Management. 7th Edition Pearson 2013.
3. Heizer Jay, Render Barry, Operations Management. 12th Edition, Prentice Hall 2016.
4. Griffin Ricky W., Management. 12th Edition, South-Western Cengage Learning 2016.

SECONDARY LITERATURE

1. Liker Jeffrey, The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer, McGraw-Hill Education 2014.
2. Kumar Anil S., Suresh N., Production Operations And Management. 2nd Edition, New Age International Limited 2008.
3. Liwowski Bolesław, Kozłowski Remigiusz, Podstawowe zagadnienia zarządzania produkcją, Oficyna Ekonomiczna, Kraków 2006.
4. Rogowski Andrzej, Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie, CeDeWu Centrum Doradztwa i Wydawnictw, Warszawa 2010.
5. Chlebus Edward, Techniki komputerowe CAx w inżynierii produkcji, Wydawnictwa Naukowo-Techniczne, Warszawa 2000.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W31	C1	Lec1-Lec2	N1
PEK_W02, PEK_W03	K1MBM_W24	C2, C3	Lec3-Lec9	N1

SUBJECT SUPERVISOR

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

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zarządzanie w produkcji**
Name in English: **Managemet in production**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMM031375**
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)	90				
Form of crediting	Crediting with grade				
Group of courses					
Number of ECTS points	3				
including number of ECTS points for practical (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes					

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and understands the essence of the process of management and it's functions.

SUBJECT OBJECTIVES

C1. Acquiring knowledge about the nature and mechanisms of a manufacturing enterprise.
C2. Acquiring knowledge about the essence of production systems and the management of production systems.
C3. Acquiring essentials of the environment of the production systems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student should know the process of management in production and the elements of production process.
PEK_W02 - Student should know the basic types of production processes and methods and techniques of the management of these processes.
PEK_W03 - Student should know the environment of the production process and the influence of changes in the environment on the manufacturing enterprise.

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Industrial revolutions. The essence and the development of management in production.	2
Lec2	Manufacturing and service enterprise. The process of management in manufacturing enterprise. The environment of the manufacturing enterprise.	2
Lec3	Production management. The objective, the scope and elements of production management. The production system and production processes.	2
Lec4	Techniques of designing production processes. The supply chain.	2
Lec5	Techniques and methods of planning the production.	2
Lec6	Organization of production. Organizational structures. Designing jobs.	2
Lec7	Management of inventory. Materials requirements planning. IT systems in management in production.	2
Lec8	Test	1
		Total hours: 15

TEACHING TOOLS USED

N1. traditional lecture with the use of transparencies and slides

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

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

F1	PEK_W01, PEK_W02, PEK_W03	Test
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
1. Dan Reid, Nada Sanders, Operations Management. 5th Edition, John Wiley & Sons 2012.
2. Slack Nigel, Brandon-Jones Alistair, Johnston Robert, Operations Management. 7th Edition Pearson 2013.
3. Heizer Jay, Render Barry, Operations Management. 12th Edition, Prentice Hall 2016.
4. Griffin Ricky W., Management. 12th Edition, South-Western Cengage Learning 2016.

SECONDARY LITERATURE
1. Liker Jeffrey, The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer, McGraw-Hill Education 2014.
2. Kumar Anil S., Suresh N., Production Operations And Management. 2nd Edition, New Age International Limited 2008.
3. Liwowski Bolesław, Kozłowski Remigiusz, Podstawowe zagadnienia zarządzania produkcją, Oficyna Ekonomiczna, Kraków 2006.
4. Rogowski Andrzej, Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie, CeDeWu Centrum Doradztwa i Wydawnictw, Warszawa 2010.
5. Chlebus Edward, Techniki komputerowe CAx w inżynierii produkcji, Wydawnictwa Naukowo-Techniczne, Warszawa 2000.

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W31	C1	Lec1-Lec2	N1
PEK_W02, PEK_W03	K1MBM_W24	C2, C3	Lec3-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: **Zaawansowane metody modelowania i analizy w systemach CAD/FEM**
Name in English: **Advanced modeling and analysis methods in CAD / FEM systems**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM033011**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of the theory of elasticity, plasticity, dynamics and thermoelasticity
2. Fundamentals of the finite element method.
3. Skill to use CAD / CAE programs.

SUBJECT OBJECTIVES

C1. Getting to know with FEM analysis for large deformations, large displacements and elastic-plastic deformations.
C2. Mastering methods of analyzing dynamics of machine construction.
C3. Introduction to methods of thermoelasticity analysis in steady state and transient.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - He can develop the model and parameters for the states of large deformation, large displacements and elastic-plastic deformations
PEK_U02 - He can model and define parameters of dynamics analysis of machine constructions
PEK_U03 - Can model and define parameters for analysis of thermoelastic problems in steady and transient states

III. Relating to social competences:
PEK_K01 - Acquires the ability to take responsibility for the work done
PEK_K02 - Think and act in a creative way
PEK_K03 - Acquires the skill of teamwork

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to design classes	1
Proj2	Preparation of the model to the analysis of the large displacements and / or large deformations and / or elasto-plastic deformation	2
Proj3	Perform analysis and development of calculation results for large displacements and / or large deformations and / or elasto-plastic deformation	2
Proj4	Modeling for dynamic analysis by modal superposition and / or direct numerical integration of motion equations	2
Proj5	Performing the analysis and development of dynamical analysis results by means of the modal superposition and / or by direct numerical integration of the motion equations	2
Proj6	Preparing the model for thermoelastic analysis in steady state and transient	2
Proj7	Performing the analysis and development of the results from the thermoelastic calculations in steady state and transient state	2
Proj8	Develop a project with advanced MES analysis	2
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. project presentation
N3. report preparation
N4. multimedia 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 PEK_K01, PEK_K02, PEK_K03	Evaluation of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusiński E., Czmochowski J., Smolnicki T. The advanced finite element method in the construction of load-bearing (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000
Rakowski G., Kacprzak Z.: Finite element method in structural mechanics (in Polish), Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016
Zienkiewicz O.C.: Finite Element Method (in Polish), Arkady Warszawa 1972

SECONDARY LITERATURE

Skrzypek J.: Plasticity and creep. Theory, applications, tasks. (in Polish) PWN, Warszawa 1986
Uhl T.: Computer-aided identification of models of mechanical structures (in Polish), WNT Warszawa 1997
Gawroński W., Kruszewski J., Ostachowicz W., Tarnowski J., Wittbrodt E. : Finite Element Method in the dynamics of the construction (in Polish). Arkady. Warszawa, 1984
Giergiel J.: Mechanical vibrations (in Polish), Uczelniane Wydawnictwa Naukowo-Dydaktyczne, Kraków 2000
Gryboś R.: Machine vibrations (in Polish), Wydawnictwo Politechniki Śląskiej, Gliwice 1998
Kostowski E.: Heat flow (in Polish), Wydawnictwo Politechniki Śląskiej, Gliwice 2000
Dobrociński S.: Modeling of thermal stress calculation problems (in Polish). WNT, Warszawa 2000
Kalinowski E.: Heat transfer and heat exchangers (in Polish). Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 1995
Wiśniewski S., Wiśniewski T.: Heat transfer (in Polish). WNT, Warszawa 1994.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced modeling and analysis methods in CAD / FEM systems
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MBM_U01, K1MBM_U05, K1MBM_U18, K1MBM_U19, K1MBM_U21, K1MBM_U22	C1	Proj1, Proj2, Proj3, Proj8	N1, N2, N3, N4

PEK_U02	K1MBM_U05, K1MBM_U08, K1MBM_U18, K1MBM_U21, K1MBM_U22	C2	Proj4, Proj5, Proj8	N1, N2, N3, N4
PEK_U03	K1MBM_U05, K1MBM_U10, K1MBM_U18, K1MBM_U21, K1MBM_U22	C3	Proj6, Proj7, Proj8	N1, N2, N3, N4
PEK_K01 - PEK_K03	K1MBM_K01, K1MBM_K04, K1MBM_K07, K1MBM_K10	C1 - C3	Proj1 - Proj8	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Modelowanie bryłowe i powierzchniowe w systemie CATIA**
Name in English: **Solid and surface modeling in CATIA**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM033012**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge in terms of descriptive geometry.
2. Fundamentals of machines design
3. Ability to use CAD / CAE programs.

SUBJECT OBJECTIVES

C1. Getting acquainted with the methods of creating surface and solid models.
C2. Mastering methods for creating assemblies and defining mechanism animations.
C3. Acquaintance with methods of shaping the strength of thin-walled and solid structures.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Can develop solid or surface model in CATIA
PEK_U02 - He can execute the assembly model and perform a motion animation in CATIA
PEK_U03 - Can perform strength analysis of solid or thin-walled structure in CATIA

III. Relating to social competences:
PEK_K01 - Acquires the ability to take responsibility for the work done
PEK_K02 - Think and act in a creative way
PEK_K03 - Acquires the skill of teamwork

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction, getting to know the CATIA environment, working with a sketchbook	2
Proj2	Fundamentals of solid modeling in CATIA	2
Proj3	Fundamentals of surface modeling in CATIA	2
Proj4	Creating assemblies and motion animation	2
Proj5	Performing stress analysis for solid structures	2
Proj6	Performing stress analysis for thin-walled structures	2
Proj7	Preparation of design documentation	2
Proj8	Development of the project report	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

F1	PEK_U01, PEK_U02, PEK_U03 PEK_K01, PEK_K02, PEK_K03	Evaluation of project preparation
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Rusinski E., Czmochowski J., Smolnicki T. The advanced finite element method in the load-bearing construction (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2000

Rakowski G., Kacprzak Z.: Finite element method in the mechanics of the structure (in Polish), Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016

Wyleżoł M. CATIA. Basics of surface and hybrid modeling (in Polish), Helion, Gliwice 2003

Wełyczko A. CATIA V5. The art of surface modeling (in Polish), Helion 2008

Sokół K. CATIA. Use of the finite element method in engineering calculations (in Polish), Helion 2014

SECONDARY LITERATURE

Wyleżoł M. CATIA v5 Modeling and analysis of kinematic systems (in Polish), Helion 2007

Skarka W., Mazurek A. CATIA. Fundamentals of modeling and recording construction (in Polish), Helion 2005

Pieczonka K.: Engineering of work machines. Vol I. The basics of making, driving, lifting and turning (in Polish), Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2007

Dudczak A.: Excavators. Theory and design (in Polish), PWN, Warszawa 2000

Augustyn J., Śledziewski, Technology of steel welded constructions (in Polish), Arkady, Warszawa 1981

Ferenc K., Ferenc J.: Welded constructions. Designing connections. (in Polish) WNT, Warszawa 2000

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Solid and surface modeling in CATIA
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MBM_U02, K1MBM_U14, K1MBM_U18, K1MBM_U21	U1	Proj1, Proj2, Proj3	N1, N2
PEK_U02	K1MBM_U11, K1MBM_U18, K1MBM_U21	U2	Proj4	N1, N2, N3
PEK_U03	K1MBM_U18, K1MBM_U19, K1MBM_U21, K1MBM_U22	U3	Proj5, Proj6, Proj7, Proj8	N1, N2, N3, N4
PEK_K01 - PEK_K03	K1MBM_K09, K1MBM_K10	C1 - C3	Proj1 - Proj8	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Projektowanie zespołów maszyn roboczych w systemach CAD (Inventor, AutoCAD)**
Name in English: **Design of working machines assemblies in CAD systems (Inventor, AutoCAD)**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM033051**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. He knows the issues related to the use of tools of CAD in the field of design.
2. Be able to work design and construction of simple assemblies; can be used in the practice known computer programs aided engineering.
3. He can build models, solve the basic issues of static, dynamic in machines and vehicles.

SUBJECT OBJECTIVES

C1. Acquiring the ability to synthesize elements and assemblies in machine systems.
C2. Acquiring the ability to use modern methods and tools for virtual design of industrial vehicles and machines.
C3. Consolidation of ability to work in a group.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - can make collections of conceptual solutions kinematic systems of machines and equipment, to make a selection; is able to use modern strategies and techniques in the design of components and units of machines and vehicles.
PEK_U02 - able to carry out the selection of the material or to develop a conceptual design based on databases and assumptions concerning the operational requirements components or assemblies
and equipment
PEK_U03 - is able to acquire and use information from the literature, databases, and other available sources to the activities of engineering in the design, operation of machines

III. Relating to social competences:
PEK_K01 - Acquires care about the aesthetics of the work, including projects and reports.
PEK_K02 - Can properly determine priorities for implementation specified by yourself or other tasks.
PEK_K03 - Able to work in a group, taking on different roles.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Object selection and development of the concept. Defining the proposed facility and determine the system of construction - features, dimensions, load and speed of movement.	2
Proj2	Construction of a geometric model (3D) of the proposed facility.	3
Proj3	Modeling mass properties, connections, kinematic and sensitive subject. Modeling of the drive system facility and extortion external.	2
Proj4	Numerical optimization of dynamic properties of an object, the term burdens for strength calculations.	2
Proj5	Rating geometrical model of the proposed facility. Required modifications and simplified geometric model. Verification of the proposed materials and the selection of the parameters necessary for numerical analysis (FEA).	2
Proj6	Construction of numerical model (FEA) designed components. The choice of method of numerical analysis (FEA) due to a possible geometric nonlinearity and material nonlinearity Identify and analyze the required load combinations. Numerical calculations. Verification and analysis of the results of calculations.	2
Proj7	Optimization of the object, taking into account the criteria adopted, the necessary modifications to the geometry and kinematic and dynamic analysis of the modified object	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Design of working machines assemblies in CAD systems (Inventor, AutoCAD)
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MBM_U08	C1, C2	Proj1-Proj5	N1-N3
PEK_U02	K1MBM_U06	C1, C2	Proj1-Proj5	N1-N3
PEK_U03	K1MBM_U01	C1, C2	Proj1-Proj5	N1-N3
PEK_K01	K1MBM_K01	C2	Proj1-Proj5	N1-N2
PEK_K02	K1MBM_K04	C2	Proj1-Proj5	N1-N2
PEK_K03	K1MBM_K04	C3	Proj1-Proj5	N1-N2

SUBJECT SUPERVISOR

dr inż. Robert Czabanowski tel.: 71 320-28-37 email: robert.czabanowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Obliczenia inżynierskie z użyciem arkusza kalkulacyjnego**
Name in English: **Engineering calculations with usage of spreadsheet**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM033101**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Using a computer as a tool for organization, communication, research, and problem solving.

SUBJECT OBJECTIVES

C1. Presentation of data in graphical form.
C2. Use of iterative methods for solving nonlinear equations and calculating the chosen numerical methods for integration.
C3. Learn about VBA capabilities.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - Can graphically develop data.
PEK_U02 - Can use iterative methods to solve nonlinear equations and to calculate the selected integral with the numerical methods.
PEK_U03 - Can use VBA.

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Import data to a spreadsheet. Formatting data. Tabels.	2
Proj2	Graphical representation of data.	2
Proj3	Solving equations by graphical method.	2
Proj4	Iterative solving of nonlinear equations.	2
Proj5	Numerical integration.	2
Proj6	Correlation and regression.	2
Proj7	VBA	3
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

1. Maciej Gonet "Excel w obliczeniach naukowych i inżynierskich". Helion.
2. Daniel Brzózka "Excel - szybkie przetwarzanie danych. Sztuczki i gotowe rozwiązania". Wydawnictwo: Videopoint.

SECONDARY LITERATURE

1. Jarosław Baca "Excel 2016 i programowanie VBA. Kurs video. Poziom drugi. Zaawansowane techniki tworzenia makr". Wydawnictwo: Videopoint.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Engineering calculations with usage of spreadsheet
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01-PEK_U03	K1MBM_U05, K1MBM_U18	C1-C3		N1,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 projektowania - SolidWorks**
Name in English: **Machine's Engineering Design - SolidWorks**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM033111.**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Project	Number of hours

Proj1		2
Proj2		2
Proj3		2
Proj4		2
Proj5		2
Proj6		2
Proj7		2
Proj8		1
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. project presentation
N3. tutorials

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Machine's Engineering Design - SolidWorks
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K	K1MBM_K02, K1MBM_K05, K1MBM_K07	C2		N2
PEK_U	K1MBM_U18	C4		N3

SUBJECT SUPERVISOR

dr inż. Kamil Waszczuk tel.: (071) 320-27-34 email: Kamil.Waszczuk@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Komputerowo wspomagane wytwarzanie w systemie CAD-CAM**
Name in English: **Computer-aided manufacturing system CAD-CAM**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM033113**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of machining process design.
2. Knowledge in the field of course "Engineering Graphics - Engineering Drawing".
3. Skill to use CAD / CAE programs.

SUBJECT OBJECTIVES

C1. Introduction to methods of technological design in the CAM system for CNC machine tools.
C2. Mastering planning methods of machining operations and the process of cutting.
C3. Presentation of modern tools supporting manufacturing.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Student should be able to prepare geometric data necessary to carry out project work.
PEK_U02 - The student should properly plan the sequence of machining operations and to evaluate the manufacturability of product designs.
PEK_U03 - The student should develop the course of individual operations taking into account technological requirements.

III. Relating to social competences:

PEK_K01 - Acquires the ability to take responsibility for the work done.
PEK_K02 - Think and act in a creative way.
PEK_K03 - Ability to critically evaluate the results and their impact on the functioning of the company.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to classes, discussion of the work plan, introduction to the CAD-CAM environment.	2
Proj2	Modeling of the finished product and the blank to be machined.	2
Proj3	Processing flat surfaces.	2
Proj4	Machining the outer contour.	2
Proj5	Machining the inner contour.	2
Proj6	Hole machining.	2
Proj7	Simulation and verification of the process. Generate code for CNC machine.	2
Proj8	Project presentation and evaluation.	1
		Total hours: 15

TEACHING TOOLS USED

N1. self study - preparation for project class
N2. problem discussion
N3. tutorials
N4. 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 PEK_K01, PEK_K02, PEK_K03	Evaluation of project preparation.
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Grzesik, Wit. Programowanie obrabiarek NC/CNC / Warszawa: Wydawnictwa Naukowo-Techniczne, 2010.
Honczarenko, Jerzy. Obrabiarki sterowane numerycznie / Warszawa : Wydawnictwa Naukowo-Techniczne, 2008.

SECONDARY LITERATURE
Pobożniak, Janysz. Programowanie obrabiarek sterowanych numerycznie w systemie CAD/CAM CATIA V5, Gliwice: Helion, 2014.
Kacprzyk, Zbigniew. Komputerowe wspomaganie projektowania : podstawy i przykłady / Warszawa: Oficyna Wydawnicza Politechniki Warszawskiej, 2012.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Computer-aided manufacturing system CAD-CAM
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02, PEK_K03	K1MBM_K03, K1MBM_K04, K1MBM_K05, K1MBM_U17, K1MBM_U18, K1MBM_U26, K1MBM_U31	C1, C2, C3	Proj1, Proj2, Proj3, Proj4, Proj5, Proj6, Proj7, Proj8	N1, N2, N3, N4

SUBJECT SUPERVISOR

dr inż. Tomasz Jankowski tel.: 41-74 email: tomasz.jankowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Zaawansowane wspomaganie wytwarzania w systemie CATIA**
Name in English: **Advanced computer-aided design in the CATIA system**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM033131**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Skills to use CAD/CAM systems.
2. Knowledge gained during the course of "Engineering Graphics: descriptive geometry".
3. Fundamentals of solid modeling and FEM simulations in CATIA system.

SUBJECT OBJECTIVES

C1. Getting familiar with the use of the constraintless method of building the assembly.
C2. Presentation of modern methods of construction optimization.
C3. Mastering the methods of creating the visualization of machine parts.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can use the skeleton method of building the assembly, without using assembly constraints and adaptive relations.
PEK_U02 - Is able to plan a numerical experiment, know how to automate the optimization of the model using FEM.
PEK_U03 - Is able to render and visualize the constructed model.

III. Relating to social competences:

PEK_K01 - Knows how to think and act in a creative way.
PEK_K02 - Recognizes the need to improve professional, personal and social skills.
PEK_K03 - Appreciates the possibility of using computer tools in the automatization of the optimizationion process and creating a visually attractive graphic design of created models.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	The use of boolean functions in solid modeling.	2
Proj2	Basics of skeleton modeling.	2
Proj3	The use of skeleton modeling to build assemblies of machines.	2
Proj4	Design of numerical experiment (DoE).	2
Proj5	Automatization of structure optimization using FEM.	2
Proj6	Rendering and visualization of CAD models.	2
Proj7	Basics of surface reconstruction, creating a solid model from a point cloud.	2
Proj8	Project presentation and final evaluation.	2
		Total hours: 16

TEACHING TOOLS USED

N1. multimedia presentation
N2. project presentation
N3. report preparation
N4. CAD/FEM system: CATIA
N5. self study - preparation for project class

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Project)

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Michaud M.: Catia. Tools and modules. Engineer's manual! Helion publishing house. 2014

Sokół K.: Catia. The use of the finite element method in engineering calculations. Helion publishing house. 2014

SECONDARY LITERATURE

Rusiński E.: Principles of supporting structures designing of automotive vehicle. Wroclaw University of Technology publishing house. 2002.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Advanced computer-aided design in the CATIA system
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01	K1MBM_U04, K1MBM_U14, K1MBM_U18, K1MBM_U21	C1	Proj1, Proj2, Proj3, Proj8	N1, N4, N5
PEK_U02	K1MBM_U04, K1MBM_U14, K1MBM_U19, K1MBM_U20, K1MBM_U22	C2	Proj4, Proj5, Proj8	N1, N4, N5
PEK_U03	K1MBM_U04, K1MBM_U14, K1MBM_U18, K1MBM_U33	C3	Proj6, Proj7, Proj8	N1, N4, N5
PEK_K01 - PEK_K03	K1MBM_K05, K1MBM_K06, K1MBM_K07	C1 - C3	Proj1 - Proj8	N1-N5

SUBJECT SUPERVISOR

dr inż. Paweł Kaczyński tel.: +48 71 320 3701 email: pawel.kaczynski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Analiza MES w zastosowaniach silnie nieliniowych w pakiecie MSC.MARC**
Name in English: **FEM analysis of strongly nonlinear applications in the MSC.MARC package**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **MMM033132**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. It has a basic understanding of the pechnological processes.
2. It has a basic understanding of the foundations of the theory of finite element methods.
3. It has a basic understanding of the strength of materials and mechanics.

SUBJECT OBJECTIVES

C1. Gain the knowledge in the field of mathematical modeling tools for the analysis and optimization of strongly nonlinear engineering problems.
C2. To gain the basic knowledge and skills to construct mathematical models of the technological processes.
C3. To understand the influence of the process modeling on strongly nonlinear problems.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:
PEK_U01 - It gains the skills necessary to build mathematical models of the technological processes.
PEK_U02 - Is able to perform the calculation and initial optimization of the plastic forming process.
PEK_U03 - Is able to determine the critical parameters of modeling in strongly nonlinear problems.

III. Relating to social competences:
PEK_K01 - It acquires conviction about the responsibility for the work.

PROGRAMME CONTENT

Form of classes – Project		Number of hours
Proj1	Introduction to computer simulation of the technological processes in the computing environment.	1
Proj2	Modelling of selected examples of thermo mechanical forming processes.	2
Proj3	Performing the analysis and determination of the mathematical model for selected material model an boundary of contact.	2
Proj4	Performing the analysis and determination of the mathematical model for selected convergence calculation and method of remesching of elements during solving.	2
Proj5	Development of design assumptions, model construction for selected nonlinear problems.	2
Proj6	Making calculations and development of the results for the various process parameters of modeling.	4
Proj7	Presentation of results, report execution.	2
		Total hours: 15

TEACHING TOOLS USED

N1. multimedia presentation
N2. problem exercises
N3. self study - preparation for project class
N4. 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, PEK_K01	project rating
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Gronostajski Z.: Badania stosowane w zaawansowanych procesach kształtowania plastycznego. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2003

Gabryszewski Z., Gronostajski J.: Mechanika procesów obróbki plastycznej, PWN, Warszawa 1991.

Milenin A.: Podstawy MES. Zagadnienia termomechaniczne. AGH. 2010.

SECONDARY LITERATURE

Marc and Mentat documentation

Ambroziak A., Kłosowski P.: Podstawy obliczeń układów powierzchniowych w sytemie MSC.Marc/Mentat. Wydawnictwo Politechniki Gdańskiej. 2015.

Zienkiewicz O.: Metoda elementów skończonych Warszawa Arkady 1972.

Wiśniewski S., Wisniewski T.: Wymiana ciepła WNT. Warszawa 1997.

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
FEM analysis of strongly nonlinear applications in the MSC.MARC package
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02, PEK_U03	K1MBM_U05, K1MBM_U18, K1MBM_U22, K1MBM_U29	C1, C2, C3	Pr1-Pr7	N1,N2, N3,N4
PEK_K01	K1MBM_K04	C3	Pr3, Pr4, Pr6	N2, N3

SUBJECT SUPERVISOR

dr inż. Sławomir Polak tel.: 21-72 email: slawomir.polak@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Elektrotechnika**
Name in English: **Electrical engineering**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **MMR031001, MMR041001 (MMR031301, MMR041301)**
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 knows and understands basic principles of physics, especially electrostatics and electromagnetism.
2. Student is able to compute differential and integral calculus.
3. Student defines and solves correctly problems connected with the profession.

SUBJECT OBJECTIVES

C1. Basic knowledge about electrical circuits and electromagnetic fields.
C2. Knowledge about construction and work of the electrical machines and devices.
C3. Ability for team work and measurements of electrical machines and devices.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:
PEK_W01 - Student knows basic principles of electrical circuits and electromagnetism and their utilization in electrical machines and devices.
PEK_W02 - Student knows principles, construction and destination of transformers and chokes.
PEK_W03 - Student knows construction and characteristics of electrical machines.

II. Relating to skills:
PEK_U01 - Student is able to build measurement circuit and make measurements of basic electrical quantities.
PEK_U02 - Student is able to make simple laboratory measurements of electrical devices.
PEK_U03 - Student is able to determine of characteristics of basic electrical motors.

III. Relating to social competences:
PEK_K01 - Student is aware of their own responsibility for their work and a willingness to comply with the principles of teamwork.

PROGRAMME CONTENT

Form of classes – Lecture		Number of hours
Lec1	Introduction. Literature. Basic principles of electrical engineering	2
Lec2	Principles of circuit theory. AC and DC current. Power and work.	2
Lec3	Electromagnetism- basic quantities, magnetic properties, magnetic circuits. Electromagnetic induction phenomenon. Self and mutual inductance.	2
Lec4	Electrical and mechanical energy transformation- basic principles and relations, applications.	2
Lec5	R, L, C elements in AC circuits.	2
Lec6	Resonance circuits, real power, reactive power, power factor correction, filters.	2
Lec7	AC circuits. Three-phase voltage generation. Four-cable system. Wye and delta connections.	2
Lec8	Transformers and chokes- construction, principles and work analysis.	2
Lec9	Types of transformers and their applications, autotransformers and current transformers.	2
Lec10	Induction motor- construction, principles of work.	2
Lec11	Types of induction motor works, load characteristics.	2
Lec12	Starting, braking, speed control. Application of induction motors.	2
Lec13	Synchronous machines- construction, principles of work, applications.	2
Lec14	DC machines- construction, principles of work.	2
Lec15	Types of DC motors, load characteristics, starting, braking and speed control, applications.	2
		Total hours: 30
Form of classes – Laboratory		Number of hours
Lab1	Introduction, safety instructions.	1

Lab2	Real power in AC three-phase systems.	2
Lab3	Three-phase transformer measurement.	2
Lab4	Squirrel-cage induction motor measurement.	2
Lab5	Squirrel-cage induction motor supplied with frequency converter.	2
Lab6	DC shunt motor measurement.	2
Lab7	DC series motor measurement.	2
Lab8	Grades.	2
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Lecture)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_W01 PEK_W02 PEK_W03	writing 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_U01 PEK_U01 PEK_K01	laboratory reports
P = F1		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE
Elektrotechnika, skrypt P.Wr. pod redakcją P. Zielińskiego (1990).
Elektrotechnika dla nieelektryków. Ćwiczenia laboratoryjne, Zbiór zadań, skrypt P.Wr. pod redakcją P. Zielińskiego (2000).

SECONDARY LITERATURE
Elektrotechnika i elektronika dla nieelektryków. Podręczniki akademickie, Praca zbio-rowa, WNT 2004
E. Koziej, B. Sochoń: Elektrotechnika i elektronika. PWN 1986

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1MBM_W05	C1	lec1-7	N1, N2
PEK_W02	K1MBM_W05	C2	lec8,9	N1, N2
PEK_W03	K1MBM_W05	C2	lec10-15	N1, N2
PEK_U01	K1MBM_U13, K1MBM_U35	C2, C3	La1, La2	N3
PEK_U02	K1MBM_U13	C2, C3	La2, La3, La4	N3
PEK_U03	K1MBM_U13	C2, C3	La4, La5, La6, La7	N3
PEK_K01	K1MBM_K04	C3	La2, La3, La4, La5, La6, La7, La8	N3

SUBJECT SUPERVISOR

dr hab. inż. Ludwik Antal tel.: 71 320 32 63 email: ludwik.antal@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): **Mechanical Engineering and Machine Building**
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

TEACHING TOOLS USED

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Block of Sports Activities
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
Mechanical Engineering and Machine Building

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_K01	K1MBM_K07, xxxx	wg kart przygotowanych przez SWFiS		wg kart przygotowanych przez SWFiS

SUBJECT SUPERVISOR

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Proseminarium dyplomowe**
Name in English: **Thesis proseminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **optional**
Subject code: **XXX**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

SUBJECT OBJECTIVES

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

III. Relating to social competences:

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1		1
Sem2		2
Sem3		6
Sem4		6
		Total hours: 15

TEACHING TOOLS USED

N1. problem discussion
N2. multimedia presentation

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

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

SECONDARY LITERATURE

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

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

PEK_U01 - PEK_U03	K1MBM_U01, K1MBM_U02, K1MBM_U18, K1MBM_U41, K1MBM_U43, K1MBM_U46	C1, C2		N1, N2
PEK_K01- PEK_K03	K1MBM_K03, K1MBM_K04, K1MBM_K05	C3		N1, N2

SUBJECT SUPERVISOR

dr hab. inż. Jerzy Czmochowski tel.: 71 320 42 84 email: jerzy.czmochowski@pwr.edu.pl

Faculty of Mechanical Engineering

SUBJECT CARD

Name in Polish: **Proseminarium dyplomowe**
Name in English: **Thesis proseminar**
Main field of study (if applicable): **Mechanical Engineering and Machine Building**
Level and form of studies: **I level, full-time**
Kind of subject: **obligatory**
Subject code: **XXX**
Group of courses: **no**

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

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Basic engineering knowledge in the field of manufacturing technology, process equipment and materials science.
2. Ability to acquire the information from different sources also in foreign languages.
3. Can formulate and justify its views, participate in the discussion in the field of science and technology, prepare and discuss own presentation.

SUBJECT OBJECTIVES

C1. Acquire the abilities of developing the editorial and substantive skills in editing master thesis.
C2. Acquiring the abilities to develop research results and to formulate conclusions and to present own work.
C3. Preparing students for the final master exam. The replay of selected information from the field of studies.

SUBJECT EDUCATIONAL EFFECTS

I. Relating to knowledge:

II. Relating to skills:

PEK_U01 - Can in a transparent and communicative way prepare and give a presentation, discuss the plan to achieve the master thesis.
PEK_U02 - Can easily carry on a discussion on master thesis and on topics related to field of study.
PEK_U03 - Can develop and discuss the topics on the diploma examination and answer to questions.

III. Relating to social competences:

PEK_K01 - Has a sense of responsibility for its own work and its impact on the functioning of the company.
PEK_K02 - Understands necessity of critical discussion of results of the done teamwork.
PEK_K03 - Understands the need for lifelong learning and development the professional and social skills.

PROGRAMME CONTENT

Form of classes – Seminar		Number of hours
Sem1	Presentation of the program, the purpose and scope of activities. Overview of the principles of writing master thesis. Distribution of questions to self-develop in the field of the final exam. Determination of the order of master's thesis presentations.	2
Sem2	Discussion of the diploma examination questions by the students in the group A	2
Sem3	Discussion of the diploma examination questions by the students in the group B	2
Sem4	Discussion of the diploma examination questions by the students in the group C	2
Sem5	Presentation of theses implementation plan - I group. Discussion.	2
Sem6	Presentation of theses implementation plan - II group. Discussion.	2
Sem7	Presentation of theses implementation plan - III group. Discussion.	2
Sem8	A summary of the seminar. Discussion. Pass.	1
		Total hours: 15

TEACHING TOOLS USED

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

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT (Seminar)

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
F1	PEK_U01, PEK_U02	Rating the presentations, discussion and active participation skills.
F2	PEK_U03	Rating of the prepared questions for the final exam
P = (0,7F1 + 0,3F2)/2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE

Baranowski B.; Metody twórczego rozwiązywania problemów inżynierskich. Wielkopolska Korporacja Techniczna NOT, Poznań 1999

SECONDARY LITERATURE

Wiszniewski A.; Sztuka pisania. Videograf II, Katowice 2003

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

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_U01, PEK_U02	K1MBM_TSW_U01, K1MBM_TSW_U02, K1MBM_TSW_U03, K1MBM_TSW_U05, K1MBM_U01, K1MBM_U12	C1, C2	S1, S5 - S8	N1, N2
PEK_U03	K1MBM_U01, K1MBM_U04	C3	S1, S5 - S8	N1, N3
PEK_01 - PEK_K03	K1MBM_K01, K1MBM_K04, K1MBM_K06, K1MBM_K09	C1, C2	S1, S5 - S8	N1 - N3

SUBJECT SUPERVISOR

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