5. Faculty of Mechanical Engineering and Mechatronics

Dean: Prof. Mieczysław Wysiecki
al. Piastów 19
70-310 Szczecin
Tel.: (+48 91) 484-57-17
Fax: (+48 91) 449-43-46

http://www.wm.ps.pl/

The Faculty of Mechanical Engineering was founded in 1946. The Faculty of Mechanical Engineering is the largest teaching and research centre of the Szczecin University of Technology. By the end of 1999 about 4,700 of engineers have been educated here. Currently, there are about 3,000 students studying at the Faculty: 600 in Master of Science degree courses, 1800 in Bachelors Science degree courses and 600 in extramural Bachelor of Science degree courses. The Faculty has the authority to award both doctors' degrees: DSc and PhD in the field of Construction and Operation of Machinery. Educational and research activities of the Faculty are focused on mechanics and mechanical engineering, computer aided manufacturing, computer aided machine design, automation, materials engineering, heat engineering, environmental engineering, transport, automotive engineering, management and marketing. Education at the Faculty takes place at four different levels: Master of Science, Engineer diploma, Bachelor of Science diploma, doctoral studies and is offered both on an intramural and extramural basis. There are the following institute and chairs:

- Institute of Materials Engineering
- Institute of Manufacturing Engineering
- Chair of Mechanics and Machine Elements
- Chair of Heat Engineering

Mechanical Engineering and Mechatronic – courses

Course title:	**Steam and Gas Turbine**		
Name of the lecturer:	*Zbigniew Zapałowicz*		
ECTS points:	3	Language of instruction:	English
Semester:	winter or summer	Hours per week:	2h – lectures
Code:		Teaching method:	lecture
Entry requirements:	Thermodynamics, Heat Transfer, Fluid Flow		
Objectives of the course:	Fundamental information about steam and gas turbines.		
Course contents:	Introduction (main information about turbines; axial and radial turbines; steam, gas and water turbines; etc.), Steam flow in guide ring; Steam flow in guide vanes; Impulse stage of steam turbine; Reaction stage of steam turbine; Curtis stage of steam turbine; Multistage steam turbines; Construction of steam turbine and its main parts; Energy balance of steam turbine; energy losses; Power regulation of steam turbine; Operating of steam turbines; Gas turbines in power station; Gas flow in turbine; Constructions of gas turbine; Operating of gas turbines		

Assessment method:	Two control works (projects)
Recommended readings:	1. Janecki S., Krawczuk M., Dynamics of steam turbine rotor blading. Part One. 2. Single blades and packets. Ossolineum. S. Maszyny Przepływowe, 1998 3. Rządkowski R., Dynamics of steam turbine rotor blading. Part Two. 4. Bladed discs. Ossolineum. S. Maszyny Przepływowe, 1998 5. Pfleiderer C., Petermann H., Strőmungsmachinen, Springer Verlag, 1991 6. Von Käppeli E., Strőmungsmachinen an Beispielen, Verlag Harri Deutsch, 1994

Course title:	**Financial Accounting**		
Name of the lecturer:	*Tomasz Sobczak*		
ECTS points:	4	Language of instruction:	English
Semester:	summer	Hours per week:	lectures – 2h
Code:		Teaching method:	lecture

Entry requirements:	
Objectives of the course:	This course focuses on the acquisition of knowledge enabling an understanding of accounting information and its use for management purposes. The student will learn useful accounting principles for decision-making and company valuation, tax issues, analysis of external financial reports.
Course contents:	- Learn to use GAAP (generally accepted accounting principles) - International accounting standards - Accounting systems - Create and analyze balance sheets - Evaluate a company's efficiency and profitability - Study tax law - Learn to prepare tax filings - Use accounting information systems
Assessment method:	
Recommended readings:	1. *Financial Accounting* by Gibbins, edition 2003

Course title:	**Measurements: theory and techniques (II)**		
Name of the lecturer:	*Andrzej Bodnar*		
ECTS points:	3	Language of instruction:	English
Semester:	summer	Hours per week:	lectures – 2h laboratory – 1h
Code:		Teaching method:	lecture and laboratory exercises

Entry requirements:	Passed examinations: mathematics (I) and manufacturing technology (I)
Objectives of the course:	To provide basic knowledge on theory of measurement, selected methods and measuring instruments, part tolerancing, and calculations with tolerated numbers. The course spotlights relationships between measurements and manufacturing process quality control.
Course contents:	Philosophy of measurement. Scales. Direct measurement. Sources of measurement errors. Assessing measurement uncertainty. Indirect measurement and errors propagation. Error corrections. Error models. Interchangeability of parts. Diameter tolerances (ISO). Roughness and accuracy. Calculations with tolerated numbers. Dimensioning. Chains of dimensions. Measuring methods and instruments (micrometric screw, slide callipers, microscopes, projectors, touch probes, sensors). Co-ordinate measurements. How to choose proper measuring instrument for manufacturing process control accounting for accuracy and production conditions. Dynamic measurements. Laboratory exercises: Measurement of outer and inner dimensions with different instruments. Measurements of angles, tapers and profiles. Surface geometrical structure and roughness measurements. Co-ordinate measurements. Checking the accuracy of measuring instruments.
Assessment method:	Examination

Recommended readings:	1. Instrumentation Reference Book. Ed. B.E. Nolting, Butterworth, London 1988 2. Machinery's Handbook. 25th ed., Industrial Press, New York 1996 3. ISO 5725:1994(E), Accuracy (trueness and precision) of Measurement Methods.

Course title:	**Unconventional methods of cutting**		
Name of the lecturer:	*Andrzej Bodnar*		
ECTS points:	1	Language of instruction:	English
Semester:	winter	Hours per week:	1 hour
Code:		Teaching method:	lecture
Entry requirements:	no limitations		
Objectives of the course:	The lecture gives basic knowledge on physics and technology of unconventional methods of cutting (also called "erosion methods").		
Course contents:	Physics, technology, productivity, and other technological features of electro-discharge, chemical, electron, laser beam, and water jet cutting methods (die sinking and wire EDM, ECM, EBM, LBM and WJC). Capabilities. Machining errors. Machines. Process planning and control. Presentation of EDM process on an AGIE machine.		
Assessment method:	Written tests		
Recommended readings:	1. Kalpakjian S.: "Manufacturing Engineering and Technology". 3rd ed., Addison-Wesley Publ. Co. Inc., Reading, Ma 1995, (new ed. 2006)		

Course title:	**Control of Production Systems**		
Name of the lecturer:	*Andrzej Bodnar*		
ECTS points:	4	Language of instruction:	English
Semester:	winter	Hours per week:	3 hours
Code:		Teaching method:	lecture and laboratory
Entry requirements:	Basics of the control theory.		
Objectives of the course:	Taking a machine tool as an example, the lecture gives knowledge on different control methods – logical systems, digital and computerized control, adaptive and fuzzy logic control.		
Course contents:	Examples of automation of processes taken from machine tools, robots and transport systems. Logical control – relays, TTL, programmable logic controllers, basic components of digital control. CNC – requirements, features, structure, interpolation algorithms. Adaptive control of machine tools (ACC and ACO examples). Cutting process monitoring and supervision (monitoring of the tool condition and vibration). Fuzzy logic controllers – building rules and defuzzyfication; some examples. Data transfer in automated systems. Laboratory: Relays and logical elements control. PLC programming. Sensor's data processing for system control and monitoring. Position measurements – encoders.		
Assessment method:	Oral exam		
Recommended readings:	1. Groover M.P.:"Automation, Production Systems, and Computer-Integrated Manufacturing:, 2-nd ed., Prentice Hall, 2001 2. Bolton W.: "Mechatronics", Prentice Hall, 1999		

Course title:	**Termodynamics**		
Name of the lecturer:	*Anna Majchrzycka, Anna.Majchrzycka@ps.pl*		
ECTS points:	5	Language of instruction:	English
Semester:	winter	Hours per week:	Lectures- 2h, tutorials-1h, laboratory-1h
Code:		Teaching method:	Lecture, tutorials and laboratory
Entry requirements:	Mathematics, physics, chemistry recommended		
Objectives of the course:	Thermodynamics is course dealing with energy and its transformation. It is a standard course that covers the First and Second Laws of Thermodynamics and concludes with applications on steam power plants, gas power cycles, and refrigeration. Upon successful completion of this course, the student will understand the fundamentals of energy and energy transfers.		
Course contents:	1.Basic properties and concepts: thermodynamic definitions, thermodynamic processes, irreversible and reversible processes, energy , pressure, temperature. 2. The First Law of Thermodynamics: energy of a system, work, heat, state functions (internal energy, enthalpy),		

	conservation of mass, conservation of energy, adiabatic and cyclic processes. 3.Ideal gas law. Mixtures of ideal gases. 4.The Second Law of Thermodynamics : entropy, thermodynamic cycles, Carnot cycle , maximum efficiency/performance, The Second Law of Thermodynamics. 5.Thermodynamic properties of pure substances and equations of state: liquid and vapor phases, quality of liquid vapor mixture, steam tables, equations of state. 6.Gas processes. 7.The combustion process: fuels, chemical reactions, stoichiometric calculations, mass and energy balance. 8.Properties of moist air, psychrometric charts. 9.Energy conversion-gas cycles : TheSabathe Cycle, Otto Cycle,The Diesel Cycle, The Stirling Cycle,The Ericsson Cycle,The Brayton Cycle. 10.Energy conversion –Vapor cycles: Mollier Diagram, The Rankine Cycle ,refrigeration.
Assessment method:	One written paper - exam One term-time test, laboratory reports and tests
Recommended readings:	1. Benson, Rowland S.- Advanced engineering thermodynamics, 1977 2. Bejan, Adrian - Advanced engineering thermodynamics, 1988 3. De Hoff, Robert T. -Thermodynamics in materials science 1993. 4. Howell, John R.- Fundamentals of engineering thermodynamics : English/SI version, 1987.

Course title:	**Heat Transfer in Materials Engineering**		
Name of the lecturer:	*Anna Majchrzycka, Anna.Majchrzycka@ps.pl*		
ECTS points:	5	Language of instruction:	English
Semester:	winter	Hours per week:	Lectures- 2h, tutorials-1h, laboratory-1h
Code:		Teaching method:	Lecture, tutorials and laboratory

Entry requirements:	Mathematics, physics, chemistry recommended
Objectives of the course:	Heat transfer in Materials Engineering is course introducing the fundamental principles of heat transfer, thermal properties of materials and simple engineering applications. Upon successful completion of this course, the student will understand the fundamentals of heat transfer and effect of thermal properties of materials on heat transfer, and will have skills to perform calculations of heat transfer.
Course contents:	1.Thermal properties of materials :specific heat , thermal ,conductivity, thermal diffusivity. 2.Modes of heat transfer :conductive heat transfer, convective heat transfer ,radiation heat transfer. 3.Steady-state heat transfer :conductive heat transfer in a rectangular Slab , through a tubular pipe, heat conduction in multilayered systems, estimation of convective heat-transfer coefficient, estimation of overall heat-transfer coefficient ,role of insulation in reducing heat loss from process equipment, design of a tubular heat exchanger,importance of surface characteristics in radiative heat transfer, radiative heat transfer between two objects. 4. Unsteady-state heat transfer: importance of external vs internal resistance to heat transfer, finite objects, procedures to use temperature-time charts. 5. Microwave Heating: mechanisms of microwave heating, dielectric properties, conversion of microwave energy into heat, penetration depth of microwaves ,microwave heating of materials
Assessment method:	One written paper - exam One term-time test, laboratory reports and tests.
Recommended readings:	1.Bejan.A - Heat transfer handbook - ed. A Bejan, Allan D. Kraus,2003 2.Chapman A. J.- Fundamentals of heat transfer, 1987. 3.Kays W. M.,London A. L.-Compact Heat Exchangers 4.Kreith, Frank.- Principles of heat transfer, ed. Frank Kreith, Mark S. Bohn.1997 5.Incropera F.P., DeWitt D.P. - Fundamentals of Heat and Mass Transfer., Wiley. 4th Edition, Wiley, 1996

Course title:	**Heat Transfer**		
Name of the lecturer:	*dr Anna Majchrzycka, Anna.Majchrzycka@ps.pl*		
ECTS points:	5	Language of instruction:	English
Semester:	summer	Hours per week:	lectures – 2h tutorials – 2h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Mathematics, physics, chemistry, thermodynamics, mechanics recommended
Objectives of the course:	Heat transfer is course introducing the fundamental principles of heat transfer and simple engineering applications. Upon successful completion of this course, the student will understand the fundamentals of heat transfer and will have skills to perform calculations of heat transfer and simple heat exchangers
Course contents:	Basics of heat transfer: introduction, definitions, modes of heat transfer.; Conduction: Fourier's Law of Heat Conduction, thermal conductivity, steady conduction in solids with plane, cylindrical and spherical isothermal surfaces, interfacial resistance; Theory of convection: free, mixed and forced convection. The Newton's Law of cooling, The heat transfer coefficient; Heat transfer at solid fluid boundaries of uniform heat transfer coefficients at the surfaces. Heat transfer between fluids inside and outside pipes overall heat transfer coefficient, critical and economical thickness of pipe insulation; Dimensional analysis, Π-theorem, application to heat transfer. Reynolds, Prandtl, Nusselt, Stanton, Grashof and Rayleigh numbers; Flow in pipes with uniform surface heat transfer

	coefficient; Boiling. Nucleation, boiling regimes, pool-boiling curve, heat transfer coefficients; Condensation: film condensation and dropwise condensation. Effects of non-condensing gases and vapour velocity on heat transfer coefficient during condensation; Fins , fins' efficiency; Heat exchangers of constant heat transfer coefficients and fluid properties. Logarithmic mean temperature difference. NTU-method; Radiation: introduction, Planck's Law, Wien's Law, Stefan-Boltzmann Law, Kirchhoff's Law , Lambert's Law. Radiation between black surfaces separated by non-absorbing medium, view factor.
Assessment method:	One written paper - exam One term-time test, project of simple heat exchanger
Recommended readings:	1.Bejan.A - Heat transfer handbook - ed. A Bejan, Allan D. Kraus,2003 2.Chapman A. J.- Fundamentals of heat transfer, 1987. 3.Kays W. M.,London A. L.-Compact Heat Exchangers 4.Kreith, Frank.- Principles of heat transfer, ed. Frank Kreith, Mark S. Bohn.1997 5.Incropera F.P., DeWitt D.P. - Fundamentals of Heat and Mass Transfer., Wiley. 4th Edition, Wiley, 1996

Course title:	**Materials Science I**		
Name of the lecturer:	*Prof. Jerzy Nowacki*		
ECTS points:	4	Language of instruction:	English
Semester:	summer	Hours per week:	lectures – 1h tutorials – 2 h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Passed the examination of chemistry and physics
Objectives of the course:	To provide a basic introduction to structures, properties and methods of materials investigation, as well as to the influence of manufacturing processes and exploitation conditions on materials structure transformation.
Course contents:	Material classification, types and properties of materials. Structure of materials, crystalline materials. Amorphous materials, solid solution, intermediate phases. Allotropy, isotropy, anisotropy, lattice defects, diffusion. Deformation of materials, strain hardening, recrystallization. Destruction of materials, cracking, creep, fatigue. Friction and wear. Corrosion. Solidification, equilibrium systems of alloys. Equilibrium system Fe - Fe_3C. Heat and thermo-chemical treatment. Ferrous alloys. Non - ferrous alloys. Magnetic materials. Surface engineering. Selection of materials.
Assessment method:	Examination
Recommended readings:	1. Ashby M. F., Materials Selection in Mechanical Design, Pergamon Press, Oxford UK, 1995 2. Askeland D. R,. The Science and Engineering of Materials, Van Nonstrand Reinhold International London 1988 3. Callister W. D., Materials Science and Engineering, J. Willey & Sons, New York, 1994

Course title:	**Materials Science II**		
Name of the lecturer:	*Prof. Jerzy Nowacki*		
ECTS points:	3	Language of instruction:	English
Semester:	summer	Hours per week:	lectures – 1h tutorials – 1 h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Passed the examination of chemistry and physics
Objectives of the course:	To provide a basic introduction to structures, properties and manufacturing methods of ceramics, polymers and composite materials
Course contents:	Short and long - range order in crystalline ceramics, silicate structures. Imperfections in crystalline ceramic structures, noncrystalline ceramic materials, deformation and failure. Phase diagrams of ceramic materials, processing of ceramics, applications and properties of ceramics. Fitting polymers into categories, structure of polymers, chain formation by the addition mechanism, chain formation. Degree of polymerization, deformation of thermoplastic polymers, effect of temperature on behaviour of thermoplastics, controlling the structure and properties of thermoplastics, elastomers. Thermosetting polymers, additives to polymers, forming of polymers. Particulate-reinforced composits, dispersion-strengthened compositis, true particulate composites, applications of particulate composites, fiber-reinforced composites, predicting properties of fiber-reinforced composites. Characteristics of fiber-reinforced composites, manufacturing fibers and composites, fiber-reinforced systems, laminar composite materials, examples and applications of laminar composites. Manufacturing laminar composites, wood, concrete and asphalt, sandwich structures.
Assessment method:	Examination

Recommended readings:	1. Ashby M. F., Materials Selection in Mechanical Design, Pergamon Press, Oxford UK, 1995 2. Askeland D. R,. The Science and Engineering of Materials, Van Nonstrand Reinhold International London 1988 3. Callister W. D., Materials Science and Engineering, J. Willey & Sons, New York, 1994

Course title:	**Process Control and Automation**		
Name of the lecturer:	*Bogdan Broel-Plater*		
ECTS points:	2	Language of instruction:	English
Semester:	6, summer	Hours per week:	2h – lectures
Code:		Teaching method:	lectures

Entry requirements:	Passed the examination of Mathematics and Physics.
Objectives of the course:	To provde a basic introduction to structures, properties and design methods of industrial automatic control systems.
Course contents:	Control of continuous processes: Basic concepts of automatic control. Identification of control plants. Basic structures of control systems. Industrial controllers and their tuning, self-tuning controllers. Fuzzy logic based control. Process control of plastic extrusion. Control of discrete processes: Boolean (two-valued) logic – basic operations, reduction of logic expressions, Karnaugh map method. Design of a logic control system. Programmable logic controllers. Operating principle of hydraulic control systems. Working liquids used in hydraulic drive and control systems. Operating of hydraulic systems based on throttling control and volume-flow rate control. Fluid velocity control in continuously-actuated and binary-actuated final-control elements. Hydraulic drive and control systems in modern plastic extruders - survey of designs.
Assessment method:	Final test
Recommended readings:	1. Doyle J.C., Francis B.A., Tannenbaum A.T.: Feedback Control Theory 2. Astrom K., Hagglund T.: PID Controllers: Theory, Design and Tuning

Course title:	**Chemistry I**		
Name of the lecturer:	*Zbigniew Rozwadowski*		
ECTS points:	5	Language of instruction:	English
Semester:	1, winter	Hours per week:	lectures – 2h laboratories –1h tutorials – 1h
Code:		Teaching method:	lecture, laboratories and tutorials

Entry requirements:	Passed the examination of physics
Objectives of the course:	To provide
Course contents:	Lectures: The nature of chemistry. The periodic table-a guide to the elements. Classifying matter. Elements. Molecules. Chemical equations and stoichiometry. Reactions in aqueous solution. The atomic nucleus and radioactivity. The arrangement of electrons in atoms. Bonding and molecular structure. Types of chemical reactions and thermodynamics. Entropy and free energy. Chemical Kinetics. Chemical equilibria. The chemistry of acids and bases. pH scale. Acid-base reactions. Oxidation-reduction reactions. Electrochemical cells. Standard potential. Corrosion. States of matter Intermolecular forces. Properties of liquids. Water. The solution processes. Solids. Crystal lattice of various types of solid substances. The chemistry of transition elements. Coordination compounds. Laboratory: General introductions for safe working in laboratory. Chemical equation. Identification of selected cations (Fe^{+2}, Fe^{+3},Cu^{+2}, Zn^{+2}, Al^{+3}, Ca^{+2}, Mg^{+2}). Preparing solutions of known concentration. The effects of the temperature, concentrations of reactants and catalysts on rates of chemical reactions. Chemical equilibrium. Effect upon an equilibrium of changing the concentration of components. Experimental determination of pH. Acid-base titration (quantitative analysis of Na_2CO_3). Measurements of cell e.m.f. (electromotive force). Using standard potentials of metals. Oxidation-Reduction reactions. Corrosion and corrosion protection. Classes. Formulas and basic nomenclature of inorganic compounds. Molecular models. Chemical equations. Stoichiometry. Solution units concentration (molarity, weight percent, mole fraction). Equilibrium law and equilibrium constant. Determination and use of equilibrium constants. Reversibility of the reaction. Acids-base equilibria. pH scale of acidity and alkalinity. Oxidation-Reduction reactions.
Assessment method:	Examination
Recommended readings:	1. Chemistry& Chemical Reactivity; J.C.Kotz, P.T. Treichel Jr., Saunders College Publishing 1999 2. Chemistry in focus; J. Andrew, P. Rispoli; Hodder& Stoughton 1991

Course title:	**Ceramics**

Name of the lecturer:	*Jerzy Nowacki*		
ECTS points:	3	Language of instruction:	English
Semester:	3, winter	Hours per week:	lectures – 2h tutorials – 1h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Passed the examination of chemistry I and fundamentals of material science I
Objectives of the course:	To provide a basic introduction to structures, properties and manufacturing methods of ceramics materials
Course contents:	Introduction. Short-Range Order in Crystalline Ceramic Materials. Long-Range Order in Crystalline Ceramic Materials. Silicate Structures. Imperfections in Crystalline Ceramic Structures. Noncrystalline Ceramic Materials. Deformation and Failure. Phase Diagrams in Ceramic Materials. Processing of Ceramics. Applications and Properties of Ceramics. Concrete. Carbon materials
Assessment method:	Final Test
Recommended readings:	1. Ashby M. F., Materials Selection in Mechanical Design, Pergamon Press, Oxford UK, 1995 2. Askeland D. R,. The Science and Engineering of Materials, Van Nonstrand Reinhold International London 1988 3. Callister W. D., Materials Science and Engineering, J. Willey & Sons, New York, 1994

Course title:	**Thermodynamics for Materials Engineering**		
Name of the lecturer:	*Anna Majchrzycka*		
ECTS points:	5	Language of instruction:	English
Semester:	3, winter	Hours per week:	lectures – 2h tutorials– 1h laboratory – 1h
Code:		Teaching method:	Lecture, tutorials and laboratory.

Entry requirements:	Mathematics, physics, chemistry recommended
Objectives of the course:	Thermodynamics is course dealing with energy and its transformation. It is a standard course that covers the First and Second Laws of Thermodynamics and concludes with applications on steam power plants, gas power cycles, and refrigeration. Upon successful completion of this course, the student will understand the fundamentals of energy and energy transfers.
Course contents:	Basic properties and concepts, work and heat, the first law of thermodynamics - closed systems, thermodynamic properties of pure substances and equations of state, open systems and the first law, the second law of thermodynamics and entropy, energy conversion - gas cycles, energy conversion - vapor cycles, general thermodynamic relations, non-reacting mixtures, chemical reactions and equilibrium.
Assessment method:	One written paper - exam One term-time test, laboratory reports and tests
Recommended readings:	1. Benson, Rowland S.- Advanced engineering thermodynamics,1977 2. Bejan, Adrian - Advanced engineering thermodynamics, 1988 3. De Hoff, Robert T. -Thermodynamics in materials science 1993. 4. Howell, John R.- Fundamentals of engineering thermodynamics: English/SI version, 1987. 3. Ragone, David V.- Thermodynamics of materials. Vol. 1,1995. 4. Ragone, David V.- Thermodynamics of materials. Vol. 2,1995.

Course title:	**Biomaterials**		
Name of the lecturer:	*Mirosława El Fray*		
ECTS points:	4	Language of instruction:	English
Semester:	8, summer	Hours per week:	lectures – 2 h laboratory – 2h
Code:		Teaching method:	lecture

Entry requirements:	Passed the examination of chemistry and physics
Objectives of the course:	This course is aimed at giving an introduction to polymers used widely in biomedical applications; it will also cover metal and ceramic biomaterials. Important issues on the development and the environmental issues of "green" polymers.
Course contents:	Lecture and laboratory. Polymeric biomaterials: basic concepts of biocompatibility; synthetic polymers and composites as implants; biodegradable polymers for tissue engineering; stimuli responsive polymers for drug delivery; metals and ceramic

	in biomedical applications; environmental management of biodegradable polymers.
Assessment method:	Examination
Recommended readings:	1. Black J., Bilogical Performance of Materials, Marcel Dekker, New York, 1999 2. Wise D.L., Biomaterials and Bioengineering Handbook, Marcel Dekker, New York, 2000 3. Ratner B.D., Biomaterials Science, Academic Press, New York 1996 4. Stevens E.S., Green Plastics: An Introduction to the New Science of Biodegradable Plastics, Princeton University Press, 2002.

Course title:	**Chemistry II**		
Name of the lecturer:	*Stanisława Spychaj*		
ECTS points:	2	Language of instruction:	English
Semester:	2, summer	Hours per week:	lectures – 2h
Code:		Teaching method:	lecture
Entry requirements:	Passed the examination of chemistry I		
Objectives of the course:	To provide a basic introduction to structures, properties and methods of synthesis of organic compounds and reactivity of some functional groups.		
Course contents:	Atom structure, geometry of orbitals, hybridization, alkanes, alkenes, alkadienes, alkynes: nomenclature, isomerism, reactivity, alkyl halides, Markovnikov rule, alcohols, thiols, ethers, epoxy compounds, adehydes, ketones, carboxylic acids and their derivatives (esters, halides, anhydrides, soaps), amines, amides - reactivity, synthesis, properties, carbohydrates, Aromaticity: benzene and aromatic compounds; electrophilic aromatic substitution, ortho- metha, para-substituents, orientation effects in substituted benzenes, phenols, aromatic carboxylic acids and their derivatives, sulfonic acids, polycyclic aromatic compounds (naphthene), heterocycles, stereochemistry - optical isomers Organic compounds as substrates in polymer chemistry		
Assessment method:	Final test		
Recommended readings:	1. J.D. Roberts, M.C. Caserio: Basic principles of organic chemistry, New York, 1965 2. R. T. Morrison, R. N. Boyd: Organic chemistry 5th ed., Boston: Allyn & Bacon, 1987 3. Ravve; Principles of polymer chemistry, Plenum Press, New York 1995		

Course title:	**Composites I**		
Name of the lecturer:	*Marcin Krolikowski*		
ECTS points:	4	Language of instruction:	English
Semester:	4, summer	Hours per week:	lectures – 1h laboratory – 1h project – 1h
Code:		Teaching method:	lecture, project and laboratories
Entry requirements:	Passed the courses of Mechanics and Strength Resistance of Materials		
Objectives of the course:	The course should introduce the basic knowledge about composite materials and mechanics.		
Course contents:	Introduction to composite materials idea – basic definitions and naming. Applied composite structure models and simplifications. The problematics of internal stresses – stress tensor. Analysis of deformation geometry – deformations tensor. Elastic properties of fiber reinforced composites from micro-mechanic point of view. Elastic characteristics of composite materials. Isotropic, anisotropic and orthotropic materials. Generalized Hook's rule for isotropic materials. Engineering coefficients of elasticity. Typical (standardized) resin, fiber and polymer composite tests. Estimation of material properties. Special tests of composite properties. Experimental composite strength resistance tests – stretching, pressing, bending, shearing. Composite properties measurements (internal stresses, ply-ply interactions and edge effects). Estimation of characteristics during quasi-static single axis load experiments (pressing, bending, twisting). Examinations of complex stress sets (shock and fatigue). Rheological tests. Project of composites with given characteristics.		
Assessment method:	Examination & Project evaluation		
Recommended readings:			

Course title:	**Composites II**

Name of the lecturer:	*Marcin Krolikowski*		
ECTS points:	4	Language of instruction:	English
Semester:	5, winter	Hours per week:	lectures – 1h project – 2h
Code:		Teaching method:	lecture and project

Entry requirements:	Passed the courses of Composites I
Objectives of the course:	The course should enlarge the knowledge about composite materials and mechanics.
Course contents:	Elastic characteristics of multilayer composites. Theory of laminates. Criteria for strength resistance analysis of composite structure components. Micromechanics of composites. Material effort criteria for multilayer composite materials. Strength resistance of composite materials with skew reinforcement. Rules of laminate composite materials design. Specific properties of laminates. Project of products with application of laminate materials. Application of computer aided design for laminate composites product modeling.
Assessment method:	Final test
Recommended readings:	

Course title:	**Computer Science I**		
Name of the lecturer:	*Tadeusz Ziębakowski*		
ECTS points:	4	Language of instruction:	English
Semester:	1, winter	Hours per week:	lectures – 1h laboratory – 2h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	None
Objectives of the course:	To provide the basic knowledge of programming and designing databases.
Course contents:	Lecture. Basics of computer programming. Fundamental concepts of computer programming, algorithm development, and data structuring, and also programming constructs, including loops, arrays, classes, and files. Programming language concepts will be illustrated with Pascal. Basics of databases. Fundamental concepts and practices in design and implementation of database management systems. Relational databases. Basics tool in a standard database management system: queries, filters, reports. Introduction to SQL. These issues will be illustrated with MS Access. Laboratory. Basics of Pascal (Borland Delphi). Declaration of variables, constants and types. Structural types: records, arrays. Simple and structural instruction: flow control instructions and loops. Procedures and functions - modular programming. Classes, methods - object oriented programming. Databases: design and creating. Working with queries. Creating reports from data. Basics elements of SQL. Creating own simple database management system.
Assessment method:	Final test
Recommended readings:	1. Object Pascal Guide, Borland International, 1983-1997. 2. Prague C.N., Irwin M.R., Reardon J.: Access 2003 Bible, Wiley, 2003.

Course title:	**Corrosion Prevention**		
Name of the lecturer:	*Anna Biedunkiewicz*		
ECTS points:	3	Language of instruction:	English
Semester:	9, summer	Hours per week:	lectures – 1h laboratory – 1h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed the examination of chemistry I and II, strength of materials, fundamentals of material science I and III, fundamentals of electrotechnics, engineering of surface.
Objectives of the course:	To provide a basic knowledge of corrosion prevention.

Course contents:	Lecture. Materials selection: metals and alloys, metal purification, nometallics. Alteration of environment: changing medium, inhibitors. Design: wall thickness, design rules. Cathodic and anodic protection: protective currents, anode selection, prevention of stray-current effects. Coatings: metallic, other inorganic and organic. Economic considerations. Corrosion control standards. Pollution control. Laboratory. Cathodic protection. Anodic protection. Selection of organic coatings for various application. Selection of materials for equipment and piping (plants) for making the minerals acids. Corrosion testing of metals for process industries. Control of internal corrosion in steel pipelines and piping systems. Determination the ability of scale inhibitors to prevent the precipitation of calcium sulfate and calcium carbonate from solution.
Assessment method:	Final test
Recommended readings:	1. H.H. Uhling, Corrosion Handbook, John Willey & Sons 2. J. H. Morgan, Cathodic protection, The Macmillan Company, New York, 1960 3. D.A. Shock, O.L. Riggs, J.D. Sudbury, Corrosion 16 (1960) 47t

Course title:	**Design of Injection Moulds I**		
Name of the lecturer:	*Konrad Kwiatkowski*		
ECTS points:	4	Language of instruction:	English
Semester:	8, summer	Hours per week:	lectures – 2h laboratory – 1h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed the examination of Polymer Processing I, Engineering Graphics I, II and III, Machines for Polymer Processing
Objectives of the course:	To provide a basic knowledge of construction and design of injection moulds.
Course contents:	Lecture. General rules of constructing injection moulds for plastics. Articles of plastics: constructional characteristic. Types, general construction and operations of injection moulds. The principles of designing individual elements of moulds. Several aspects of technology of manufacturing of injection moulds. Moulds and equipment for resins processing. Types of heads. Thermoforming. Laboratory. Simulation of injection moulding.
Assessment method:	Examination
Recommended readings:	1. J. P. Beaum, Runner and gating design handbook: tools for successful injection molding, Hanser, Munich 2004

Course title:	**Design of Injection Moulds II**		
Name of the lecturer:	*Konrad Kwiatkowski*		
ECTS points:	4	Language of instruction:	English
Semester:	9, winter	Hours per week:	lecture – 1h project – 2h
Code:		Teaching method:	lectures and project

Entry requirements:	Passed the examination of Polymer Processing I, Engineering Graphics I, II and III, Machines for Polymer Processing, Design of Injection Moulds I
Objectives of the course:	To provide a basic knowledge of construction and design of injection moulds.
Course contents:	Lecture. Moulds for rubber processing. Special equipment for rubber processing. Special equipment for various technologies of polymer processing. Project. Thermoforming. Designing elements for injection moulds. Designing moulds for plastic articles. Blow extrusion.
Assessment method:	Examination
Recommended readings:	

Course title:	**Dielectrics**		
Name of the lecturer:	*Katarzyna Matyjasek*		
ECTS points:	4	Language of instruction:	English
Semester:	9, winter	Hours per week:	lectures – 2h
Code:		Teaching method:	lecture

Entry requirements:	Passed the examination of Solid State Physics
Objectives of the course:	To provide the general classification of dielectric materials, both from a basic viewpoint and from an applications viewpoint
Course contents:	The structure of crystals. Interatomic bond and classification of solids. Electrical and related properties. Molecular mechanism of polarization. The concept of local field. Clausius – Mossotti formula. Polarization relaxation. Dielectric spectroscopy. Piezoelectricity, pyroelectricity – basic properties and applications. Ferroelectricity – domains and switching. The ferroelectric phase transitions – Landau conception and the lattice vibration viewpoint.
Assessment method:	Final test
Recommended readings:	1. Dielectrics and waves. Arthur von Hippel. 2. Polar dielectrics and their applications. Jack C. Burfoot nad George W. Tailor. 3. Ferroelectricity and related phenomena. T. Mitsui, I. Tatsusaki and N. Nakamura. 4. Introduction to solid – state electronics. G. I. Yepifanov, Yu. A. Moma

Course title:	**Economics**		
Name of the lecturer:	*Elwira Leśna*		
ECTS points:	4	Language of instruction:	English
Semester:	4, summer	Hours per week:	lectures – 2h tutorial – 1h
Code:		Teaching method:	case study, lecture, discussion

Entry requirements:	None
Objectives of the course:	Students are expected to learn basic macro- and microeconomic notions and models.
Course contents:	Part 1 Introduction An introduction to economics and the economy; The tool of economic analysis; Demand, supply and the market. Part 2 Positive Microeconomics The effect of price and income on demand quantities; The theory of consumer choice; Output supply by firms: revenue and cost; Developing the theory of supply: costs and production; Perfect competition and pure monopoly; Market structure and imperfect competition; The analysis of factor markets: labour; Human capital, discrimination and trade unions; Capital and land: completing the analysis of factor markets; Coping with risk in economic life. Part 3 Welfare economics Introduction to welfare economics; Taxes and public spending; Competition policy and industrial policy; Nationalization and privatization; General equilibrium and welfare economics. Part 4 Macroeconomics Introduction to macroeconomics; The determination of national income; Aggregate demand, fiscal policy and foreign trade; Money and modern banking; Central banking and the monetary system; Monetary and fiscal policy in a closed economy; Unemployment; Inflation; Open economy macroeconomics; Long-term growth and short-term fluctuations. Part 5 International economy International trade and commercial policy; The international monetary standards; International finance.
Assessment method:	Final written test, class discussion, attendance
Recommended readings:	1. David Begg, Stanley Fischer, Rudiger Dornbusch, Economics. Second edition, McGRAW-HILL Book Company (UK) Limited 1987; 2. Steven Husted and Michael Melvin, International Economics, Addison-Wesley, 2001.

Course title:	**Electroplating Coatings**		
Name of the lecturer:	*Anna Biedunkiewicz*		
ECTS points:	4	Language of instruction:	English
Semester:	6, summer	Hours per week:	lectures – 1h laboratory – 1h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed the examination of chemistry I and II, fundamentals of material science I and III, fundamentals of electrotechnics and electronics, engineering of surface
Objectives of the course:	To provide a basic knowledge of electroplating processes.
Course contents:	Lecture.

	Principles of electroplating processes: the laws of electrolysis, electrochemical cell, metal deposition process. Polarisation, overpotential, overvoltage. Nernst equation. Butler-Volmer equation. Tafel equation. Current density distribution. Electroplating for the production of electronic components. Electrodeposition of copper. Nickel and nickel alloys. Binary, ternary metals and alloys electroplating. Zinc coatings. Cadmium plating. Chromium plating. Noble metals plating. Nickel hybrid composite coatings. Plating on plastics and ceramics. Laboratory. Nickel and zinc plating. Determination of the tank geometry influence on the layer-thickness distribution. Physicochemical characterization of coating-surface composite. Thickness and tightness of coatings measurements. Adhesion measurements. Determination of the coatings wear mechanisms and resistance.
Assessment method:	Final test
Recommended readings:	1. M. Paunovic, M. Schesinger, Fundamentals of electrochemical deposition, John Wiley, New York, 1998 2. A.J. Bard, Encyclopedia of Electrochemistry of element, Marcel Dekker Inc. New York, 1973 3. A. Brenner, Electrodeposition of alloys I+II, Academic Press, New York 1963 4. T.E.G. Daenen, Plating on ceramics, Galvanotechnic, 4 (2000) 966

Course title:	**Engineering Graphics I**		
Name of the lecturer:	*Magdalena Bockowska*		
ECTS points:	4	Language of instruction:	English
Semester:	1, winter	Hours per week:	lectures – 1h project – 2 h
Code:		Teaching method:	lecture and project
Entry requirements:	No prerequisite, open to all undergraduates.		
Objectives of the course:	To provide a basic introduction to projective geometry, major methods of representation of structure of machine elements, rules of engineering drawing. To obtain skills of reading and generate freehand of technical drawings.		
Course contents:	Axonometric projection. Orthogonal projection. Local view. Full section, part section, offset section, plane section. Intersection of surfaces. Dimensioning. Combined dimensioning. Drawing: isometric, assembly, collective, workshop and diagrammatic. Engineering drawing.		
Assessment method:	Two assessment projects and one theoretical test		
Recommended readings:	1. T. Dobrzański, Rysunek techniczny maszynowy, WNT Warszawa 2000 2. Zbiór PN - Rysunek techniczny i rysunek techniczny maszynowy. 3. I. Rydzanicz, Rysunek techniczny jako zapis konstrukcji. Zadania. WNT, Warszawa, 1999.		

Course title:	**Engineering Graphics II**		
Name of the lecturer:	*Magdalena Bockowska*		
ECTS points:	4	Language of instruction:	English
Semester:	2, summer	Hours per week:	lectures – 1h project – 2 h
Code:		Teaching method:	lecture and project
Entry requirements:	Passed the course of engineering graphics I and informatics I.		
Objectives of the course:	Graphics and modelling fundamentals for engineering design: computer modelling of solid geometry, and generation of engineering drawings. To consolidate skills of reading and generate of technical drawings using computer aided design systems as AutoCAD as SolidWorks. To learn application of parametric solid modelling techniques to computer aided drafting and design.		
Course contents:	Basic overview of CAD systems. Application of CAD systems: AutoCAD and SolidWorks to engineering problems. AutoCAD – generation of technical documentation 2D. SolidWorks – 3D parametric modelling of machine elements.		
Assessment method:	Two assessments tests		
Recommended readings:	1. D. Pitzer, B. Burchard, Inside AutoCAD 2000, Copyrighted Material, USA, www.newriders.com 2. AutoCAD Tutorials, www.cadtutor.net/acad. 3. Designing Parts with SolidWorks 4. D. Planchard & M. Planchard, Assembly Modeling with SolidWorks 2003, SDC Publications 5. D. Planchard & M. Planchard, Drawing and Detailing with SolidWorks 2003, SDC Publications 6. D. Baxter & D. Bunk, Engineering Graphics & Computer Aided Design, Pearson Customer Publishing		

Course title:	**Engineering Graphics III – CAD**

Name of the lecturer:	*Marcin Krolikowski*		
ECTS points:	3	Language of instruction:	English
Semester:	8, summer	Hours per week:	lectures – 1h project – 2 h
Code:		Teaching method:	lecture and project

Entry requirements:	Passed the courses of Engineering Graphics I and II, Mathematics
Objectives of the course:	The course should give knowledge about CAD techniques, used in today's Engineering Practice, including solid and surface modeling focused on the technology of machining the surfaces with respect given to some aspects of industrial design.
Course contents:	CAD (Computer Aided Design)/CAE (Computer Aided Engineering)/CAM (Computer Aided Manufacturing) and what they are for. The short introduction to Product Life Management idea (PLM) and Product Data Management (PDM). The information cycle in computer aided engineering systems. Types of engineering systems for design. Geometry notation in CAD/CAM systems. Reverse Engineering methods – interpolation. Introduction to selected CAD/CAM environment. Advanced solid modeling. Constraining and Parameterization. Gaining the solid information and features. Modification of the design history. Logical solid operations. Introduction to surface modeling. Surface modeling techniques. Surface analysis and checkout. Product modeling and rendering.
Assessment method:	Project evaluation
Recommended readings:	1. Zaid I, CAD/CAM Theory and Practice, McGraw-Hill, 1991, ISBN 0-07-072857-7 2. Context related tutorials of selected CAD/CAM system.

Course title:	**Ecology**		
Name of the lecturer:			
ECTS points:	4	Language of instruction:	English
Semester:	10, summer	Hours per week:	lecture – 2h tutorial – 1h
Code:		Teaching method:	lectures and tutorials

Entry requirements:	Passed examination of Environmental Protection, Packaging I, Recycling I and II.
Objectives of the course:	To provide a general knowledge of Ecology
Assessment method:	Examination
Recommended readings:	1. P. Collin, Dictionary of Ecology and The Environment, Teddington, 1992 2. O. L. Gilbert, The Ecology of Urban Habitats, Chapman and Hall, London 1991

Course title:	**Functional Materials**		
Name of the lecturer:	*Niko Guskos*		
ECTS points:	4	Language of instruction:	English
Semester:	8, summer	Hours per week:	lectures – 4h
Code:		Teaching method:	lecture

Entry requirements:	Quantum physics, solid state physics
Objectives of the course:	On completion of the course, the students should have: • An understanding of what makes a material "functional" in the sense of how different materials can provide responses to extrinsic variables. • A knowledge and understanding of the physio-chemical factors that control the functional responses of materials. • A knowledge of where functional materials can be used with special reference to the areas of Microsystems and Nanotechnology. • A knowledge of how functional materials can be manufactured in the forms relevant to their use and the functional properties required. A knowledge of how functional materials are used in specific applications
Course contents:	• Magnetic and magnetostrictive materials. • Ferroelectrics (eg piezoelectrics, pyroelectrics, dielectrics, electro-optics). • Phase change materials (giant and colossal magneto-resistance, ferroics, shape memory materials). Optical

	transition materials (e.g. photochromics, thermochromics). • Ferroelectric thick and thin films, applications. Spintronics Physics and Materials • Spintronic Functions and Devices • Quantum Information Processing Using Spins
Assessment method:	Percentage of coursework, examination, etc.: 30% by coursework; 70% by exam Coursework will consist of several assignments as well as short quizzes delivered during the lectures.
Recommended readings:	

Course title:	**Environmental Protection**		
Name of the lecturer:	*Elżbieta Senderek*		
ECTS points:	1	Language of instruction:	English
Semester:	7, winter	Hours per week:	lectures – 1h
Code:		Teaching method:	lecture

Entry requirements:	None
Objectives of the course:	To provide a general knowledge of ways of protecting the environment.
Assessment method:	Final test

Course title:	**Fundamentals of Management**		
Name of the lecturer:	*Jolanta Baranowska*		
ECTS points:	1	Language of instruction:	English
Semester:	5, winter	Hours per week:	lectures – 1h tutorial – 1h
Code:		Teaching method:	lecture

Entry requirements:	Passed examination of Economics
Objectives of the course:	To provide a general knowledge of Management
Assessment method:	Final test

Course title:	**Fundamentals of Materials Science I**		
Name of the lecturer:	*Prof. Zbigniew Rosłaniec, Aleksandra Ratajska*		
ECTS points:	2	Language of instruction:	English
Semester:	1, winter	Hours per week:	lectures – 1h
Code:		Teaching method:	lecture

Entry requirements:	Physics and Chemistry form secondary school.
Objectives of the course:	To provide a basic knowledge of polymer materials.
Course contents:	Polymers and polymer materials. Monomer; oligomer. Natural and synthetic polymers: chemical structure, chain structure, isomers. Plastics, resins, elastomers, polymer composites. Engineering materials, high performance polymer materials, functional materials. Structure and physical properties. Processing and applications.
Assessment method:	Final test
Recommended readings:	1. W. D. Callister; Fundamentals of material science and engineering, 2nd edition; John Wiley & Sons, 2005

Course title:	**Fundamentals of Materials Science II**		
Name of the lecturer:	*Prof. Jerzy NowackI, Piotr Tabero*		
ECTS points:	5	Language of instruction:	English
Semester:	2, summer	Hours per week:	lectures – 3h tutorials – 1h
Code:		Teaching method:	lectures and tutorials

Entry requirements:	Passed the examination of chemistry I, physics I, mechanics I

Objectives of the course:	To provide a basic knowledge of types of materials, their structure and mechanical properties.
Course contents:	Introduction to materials. Types of Materials. Structure-Property-Processing Relationship. The Periodic Table. Atomic Bonding. Atomic arrangement. Short-Range Order versus Long-Range Order. Unit Cells. Allotropic Transformations Complex Crystal Structures. Imperfections in the atomic arrangement. Dislocations. Slip Process. Dislocation Interactions. Point Defects. Surface Defects. Atom movement in materials. Self-diffusion. Diffusion in Alloys. Diffusion Mechanisms. Interdiffusion and the Kirkendall Effect. Types of Diffusion. Solidification and grain size strengthening. Nucleation. Growth. Solidification Time. Cooling Curves. Solidification Defects. Solidification and solid solution strengthening. Phases, Solutions, and Solubility. Isomorphous Phase Diagrams. Nonequilibrium Solidification of Solid Solution Alloys. Segregation. Deformation, strain hardening, and annealing. Cold Working. Relationship to the Stress-Strain Curve. Deformation Processing by Hot Working. Solidification and dispersion strengthening. Intermetallic Compounds. Phase Diagrams Containing Three-Phase. Age Hardening or Precipitation Hardening. Structure, energy and chemical bonding, the Schrodinger equation, band theory, coordination numbers and coordination polyhedra, the effective size of atoms, crystalline solid, polycrystalline substances, single crystals, unit-cell nomenclature, lattice points, axial vectors, inter-axial angle, the lattice direction, the lattice planes , the interplanar spacings , the Miller indices, the seven crystal system, the Bravais lattices, the addition rule, the zone equation, metal structures, the reciprocal lattice, the external shape of crystal, the stereographic projection, diffraction of X-rays, electron diffraction and microscopy. Metal structures, atomic coordinates, indexing of directions and planes, the zone equation, the addition rule, use of stereographic projection in crystallography, indexing of electron diffraction patterns.
Assessment method:	Examination
Recommended readings:	1. Course textbook: Reed-Hill, R. E., and R. Abbaschian. Physical Metallurgy Principles. 3rd ed. Boston: PWS-Kent, 1992. ISBN: 0534921736. 2. Barret Ch.S., Massalski T.B. Structure of Metals.- McGraw-Hill.-N.Y.--1966.- 654 p.- Library of Congress Catalog Card Number 65-24520 03815 234567890 MP 732106987 3. Duncan McKie and Christine McKie, Essentials of Crystallography, Blackwell Scientific Publications, Oxford, London, Edinburgh, Boston, Palo Alte, Melbourne, 1986 4. Ulrich Muller, Inorganic Structural Chemistry, John Wiley & Sons, Chichester, New York, Brisbane, Toronto, Singapore, 1993

Course title:	**Fundamentals of Materials Science III**		
Name of the lecturer:	*Walenty Jasiński*		
ECTS points:	3	Language of instruction:	English
Semester:	3, winter	Hours per week:	lectures – 3h
Code:		Teaching method:	lecture
Entry requirements:	Passed the examination of physics I, chemistry I, fundamentals of material science I, metallic materials I		
Objectives of the course:			
Course contents:			
Assessment method:	Examination		
Recommended readings:			

Course title:	**Fundamentals of Materials Science IV**		
Name of the lecturer:	*Anna Biedunkiewicz*		
ECTS points:	5	Language of instruction:	English
Semester:	5, winter	Hours per week:	lectures – 3h laboratory – 2h
Code:		Teaching method:	lectures and laboratory
Entry requirements:	Passed the examination of chemistry I and II, physics I and II, fundamentals of materials science I and III, metallic materials I and II		
Objectives of the course:	To provide a basic knowledge of structural chemistry and of corrosion mechanism.		
Course contents:	Lecture. Structural chemistry of inorganic compounds. Simple and complex of 3D networks. Multifaceted compounds and ions. Sphere packing. Tetrahedral and octahedral structures. Simple structure type AXn. Simple halogens. Structures of binary oxides. Spinels. Structures of binary metal sulfides. Ionic, covalent and metallic nitrides. Types and structures of (simple and complex) carbides. Silicon and silicon compounds (silicate, silica, silicanes, silicone). Structure of selected phases from metal alloys (β-phase in the Cu-Zn system; δ -phase in the Fe-Cr system). Corrosion principles: electrochemical and metallurgical aspects, environmental effects. Applications of thermodynamics to corrosion. Eight forms of corrosion: galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion-corrosion, stress corrosion, hydrogen damage. Electrode kinetics. Predicting corrosion. Corrosion prevention. High – temperature metal – gas reactions. Oxidation resistance. Corrosion testing. Materials: metals and alloys, nonmetallics, thermoplastics, thermosetters and ceramics. Laboratory. Passivity and activity of metals. Electrode kinetics. Activation polarization. Corrosion – rate measurements.		

	Corossion testing in salts. Galvanic or two metal-corrosion – area effect. High temperature gas testing. Cavitation damage. Anodic dissolution behavior of an active passive metals.
Assessment method:	Examination
Recommended readings:	1. A.F.Wells, Structural inorganic chemistry. Oxford University Press 1990; 2. M.G.Fontana, N.D.Greene, Corrosion Engineering, McGraw-Hill Book Company 1978; 3. R.A. McCauley, Corrosion of ceramics, Marcel Dekker, Inc. 1995 4. Pourbaix, M. J. N.: Atlas of electrochemical equilibria in aqueous solutions, Pergamon Press, New York, 1966.

Course title:	**Fundamentals of Materials Science V**		
Name of the lecturer:	*Anna Biedunkiewicz*		
ECTS points:	5	Language of instruction:	English
Semester:	5, winter	Hours per week:	lectures – 3h laboratory – 2h
Code:		Teaching method:	lectures and laboratory
Entry requirements:	Passed the examination of fundamentals of material science I, II, III and IV.		
Objectives of the course:	To provide a basic knowledge of fracture mechanics.		
Course contents:	Elasticity and macroscopic plasticity. Dislocation kinetics and lattice defects. Fundamentals of Fracture Mechanics. Models of failure. Stress concentrations. Center-cracked plate under uniform tension. Criteria for analysis of load-displacement records. Linear elastic fracture mechanics. Fracture toughness. Fatigue and stress corrosion cracking. Fractography and fractographs.		
Assessment method:	Final test		
Recommended readings:	1. ASTM Designation: B 645-84. 2. ASTM Designation: E 1304-89. 3. ASTM Designation: E 813-89. 4. ASTM Designation: E 399-90. 5. Knott J.F. Fundamentals of fracture muchanics.-London:Butterworths.-1973.-274 p.- ISBN 0 408 70529 9. 6. Feltham P. Deformation and strength of materials.- London:Butterworths.-1966.-136 p. 7. Brown W.F., Scawley J.E. Plane strain crack tougthness testing of high strength metallic materials.-Philadelphia: ASTM.-130 p. 8. Gdoutos E.E. Fracture mechanics: An Introduction.- Dordrecht:Springer.-2004.-369 p.-ISBN: 1-4020-2863-6.		

Course title:	**Intellectual Property Protection**		
Name of the lecturer:	*Monika Wielecka*		
ECTS points:	1	Language of instruction:	English
Semester:	7, winter	Hours per week:	lectures – 1h
Code:		Teaching method:	lecture
Entry requirements:	None		
Objectives of the course:	To provide a basic knowledge of intellectual property protection.		
Course contents:	Subjects of the intellectual property protection. International conventions and agreements in field of industrial property protection and copyrights protection. Basic institutions of industrial property law: definition of invention, utility model, industrial design, trademark, topography of integrated circuits, geographical indication. Premise to patentability and capacity to protection. Extent of protection. Procedure of obtain a exclusive rights before the Polish Patent Office, in Europe and all over the world. Proceeding before the Polish Patent Office. Patent information and patent examinations. Copyrights. Repression of unfair competition. Meaning of patent protection in the technology progress.		
Assessment method:	Final test		
Recommended readings:	International Law 1. The Paris Convention (1883) 2. Convention Establishing the World Intellectual Property Organization (Signed at Stockholm on July 14, 1967 and as amended on September 28, 1979) 3. The EPC (European Patent Convention) and Ancillary Regulations to the European Patent Convention 4. Patent Cooperation Treaty (PCT), done at Washington on June 19, 1970, amended on September 28, 1979, modified on February 3, 1984, and October 3, 2001 5. Madrid Agreement (1891), and the Madrid Protocol (1989) 6. Agreement on Trade-Related Aspects of Intellectual Property Rights (or TRIPS Agreement) 7. the Berne Convention for the Protection of Literary and Artistic Works, commonly known as the "Berne Convention" 8. the International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations, better known as the "Rome Convention" Community Law 1. Council Regulation (EC) No 40/94 of 20 December 1993 on the Community trade mark 2. First Directive 89/104/EEC of the Council, of 21 December 1988, to Approximate the Laws of the Member States Relating to Trade Marks 3. Council Regulation (EC) No 6/2002 of 12 December 2001 on Community Designs		

4. Directive 98/71/EC of the European Parliament and of the Council of 13 October 1998 on the legal protection of designs

Course title:	**Machines for Polymer Processing**		
Name of the lecturer:	*Marek Szostak*		
ECTS points:	3	Language of instruction:	English
Semester:	6, summer	Hours per week:	lectures – 2h, laboratory – 1h, project – 1h
Code:		Teaching method:	Lecture, laboratory and project
Entry requirements:	none		
Objectives of the course:			
Course contents:	Lecture and laboratory General information of machines and equipment for polymer processing. Elements in machines. Machines for cleaning, sorting, separating from pollutants. Machines for blending materials in liquid or solid state. Reactors and autoclaves. Machines for granulating. Types of presses. Machines for drying plastics. Injection moulding machines. Single and multi-screw extruders. Production lines for films, pipes, profiles.		
Assessment method:	Examination		
Recommended readings:			

Course title:	**Introduction to Polymer Processing**		
Name of the lecturer:	*Prof. Zbigniew Roslaniec, Konrad Kwiatkowski*		
ECTS points:	4	Language of instruction:	English
Semester:	4, summer	Hours per week:	lectures – 1h, tutorials – 1h, laboratory – 1 h
Code:		Teaching method:	lecture , tutorial and laboratory
Entry requirements:	Passed the examination of Chemistry, Physics and Fundamentals of Material Science I		
Objectives of the course:	To provide a basic introduction to rheology of polymer melt, heat transfer and diffusion in polymers.		
Course contents:	Lectures: Introduction to polymer processing: Physical properties of polymers: trasition and relaxation phenomena. Melt flow properties: geometry of flow, rheological behaviour in simple shear, elongation flow, melt elasticity. Rheology in polymer processing. Thermal conductivity. Diffusion in polymers. Tutorials: Viscous response as a function of stress, sample shearing flow , melt memory, theory of capillary rheometer. Laboratory: Density, water contents, solubility, limiting viscosity number, melt flow index.		
Assessment method:	Examination		
Recommended readings:	1. Cogswell F.N., Polymer melt rheology, Woodhead Pub. Ltd., Cambridge1997 2. Birley A.W., Haworth B., Batchelor J., Physics of Plastics, Hanser, Munich 1991 3. Stastna J., De Kee D., Transport Properties in Polymers, Technomic Pub. Lancaster 1995 4. Meijer H.E.H., Processing of Polymers, Willey VCH, Weinheim 1997		

Course title:	**Mathematics I**		
Name of the lecturer:	*Stanisław Ewert-Krzemieniewski*		
ECTS points:	5	Language of instruction:	English
Semester:	1, winter	Hours per week:	lectures – 3h tutorials – 2 h
Code:		Teaching method:	lecture and tutorials
Entry requirements:	Good knowledge and understanding of mathematics at secondary school level.		
Objectives of the course:	To provide a good knowledge and understanding of the lectured material. Development of the computational skills.		
Course contents:	Complex numbers. Vectors and vectors spaces. Analytic geometry. Lines in space. Planes. Second-degree curves in the plane. Matrices and systems of linear equations. Function. Limits and continuity. Infinite number series. Exponential, logarithmic and other transcendental functions. Derivative and its application. Taylor and Maclaurine formulas. Indefinite integrals. The definite integrals and its application.		

Assessment method:	Examination
Recommended readings:	1. Serge Lang, Undergraduate Algebra. Springer, 1990 2. Serge Lang, A First Course in Calculus. 5. Earl W. Swokowski, Calculus with analytic geometry. 1983 6. I. V. Proskuryakov, Problems in Linear Algebra. Mir, 1978.

Course title:	**Mathematics II**		
Name of the lecturer:	*Stanisław Ewert-Krzemieniewski*		
ECTS points:	5	Language of instruction:	English
Semester:	2,summer	Hours per week:	lectures – 2h tutorials – 2 h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Good knowledge and understanding of mathematics at secondary school level. Passed Mathematics I.
Objectives of the course:	To provide a good knowledge and understanding of the lectured material. Development of the computational skills.
Course contents:	Differential calculus of several variables. Multiple integrals. First order differential equations. Second and higher order linear differential equations and their systems.
Assessment method:	Examination
Recommended readings:	1. Serge Lang, Calculus of Several Variables. Springer, 1996. 2. Alan Jeffrey, Advanced Engineering Mathematics. Harcourt/Academic Press, 2003. 3. Earl W. Swokowski, Calculus with analytic geometry. 1983

Course title:	**Mathematics III**		
Name of the lecturer:	*Prof. Stefan Berczynski, Marek Zasada*		
ECTS points:	4	Language of instruction:	English
Semester:	3, winter	Hours per week:	lectures – 2h laboratory – 1h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed the examination of mathematics I and II.
Objectives of the course:	To provide a basic knowledge of statistics.
Course contents:	Lecture. Descriptive statistics. Probability. Types of random variables. Normal distribution. Confidence intervals. Hypothesis testing. Comparison of two populations. Analysis of variance. Simple linear regression and correlation. Multiple regression. Nonparametric methods and Chi-Square test. Laboratory. Practice with using computational methods of statistical analysis. Application of theoretical aspects of statistics in practice.
Assessment method:	Examination
Recommended readings:	1. Amir D Aczel: "Complete Business Statistics" Irwin 1989.

Course title:	**Mathematics IV**		
Name of the lecturer:	*Stanisław Ewert-Krzemieniewski*		
ECTS points:	4	Language of instruction:	English
Semester:	8, summer	Hours per week:	lectures – 2h tutorials – 1h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Good knowledge and understanding of mathematics at secondary school level. Passed Mathematics I, II.
Objectives of the course:	To provide a good knowledge and understanding of the lectured material. Development of the computational skills.
Course contents:	Vector differential calculus. Curve integrals. Green's theorem. Surface integrals. The Laplace transform. Elements of tensor calculus.
Assessment method:	Examination
Recommended readings:	1. Serge Lang, Calculus of Several Variables. Springer, 1996. 2. Alan Jeffrey, Advanced Engineering Mathematics. Harcourt/Academic Press, 2003.

	3. Earl W. Swokowski, Calculus with analytic geometry. 1983

Course title:	**Mechanics I**		
Name of the lecturer:	*Paweł Gutowski*		
ECTS points:	4	Language of instruction:	English
Semester:	1, winter	Hours per week:	lectures – 2 h tutorials – 1 h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	None
Objectives of the course:	To develop the capacity to predict the effects of force and motion in the course of carrying out the creative design function of engineering.
Course contents:	Introduction to statics: basic concepts, scalars and vectors, units, Newton's laws, law of gravitation. Principles of statics. Constraints and their reactions. Kinds of forces. Two- and three- dimensional convergent force systems. Resultant force. Moment of a force and moment of a couple. Equations of equilibrium in two- and three-dimensional force systems. Types of friction. Rolling resistance. Centres of gravity of lines, areas and volumes. Kinematics of a point: relativity of a motion, trajectory of a motion. Description of a motion: position, velocity and acceleration. Rigid body kine-matics: translatory and rotary motion, plane motion, relative motion (velocity and acceleration). Dynamics of a point, Newton's laws. Small linear vibrations: free and forced, damped and undamped. Resonance. Work of a force and power of a force. Kinetic and potential energy. Mechanical energy. Principle of work and energy. Principle of conservation of momentum. Principle of conservation of moment of momentum. Energy conservation low.
Assessment method:	Examination
Recommended readings:	1. Meriam J. L. and Kraige L.G., Engineering Mechanics, Vol. 1: Statics, John Wiley & Sons 5th edition, New York 2003 2. Meriam J. L. and Kraige L.G., Engineering Mechanics, Vol. 2, Dynamics, John Wiley & Sons 5th edition, New York 2003 3. Hibbeler R. C., Engineering Mechanics, Statics, Macmillan 3rd edition, 2004 4. Hibbeler R. C., Engineering Mechanics, Dynamics, Macmillan 3rd edition, 2004

Course title:	**Mechanics II**		
Name of the lecturer:	*Zbigniew Zarzycki*		
ECTS points:	3	Language of instruction:	English
Semester:	3, winter	Hours per week:	lectures – 2 h tutorials – 1 h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Passed the examination of mechanics I and physics.
Objectives of the course:	To provide a basic introduction to fluids mechanics, especially for non-newton fluids.
Course contents:	Basic concepts. Properties of fluids. Fluids statics. Fluids kinematics. Mass, momentum and energy equations. Dimensional analysis. Navier – Sokes equation. Basis of fluids mechanics of non-newton fluids. Differential analysis of fluid flow problem. The boundary layer.
Assessment method:	Examination
Recommended readings:	1. Cengel Y. A., Cimbala J. M.: Fluid Mechanics. Fundamentals and Applications. McGraw–Hill 2005. 2. Daughertu R., Franzini J.: Fluid Mechanics with engineering Applications. McGraw – Hill Book Company, New York 1997.

Course title:	**Metal and Ceramic Composites**		
Name of the lecturer:	*Prof. Jerzy Nowacki*		
ECTS points:	4	Language of instruction:	English
Semester:	7, winter	Hours per week:	lectures – 2 h
Code:		Teaching method:	lecture

Entry requirements:	Passed the examination of Metallic materials I and II, Ceramics, Composites I and II, Polymer Materials II.
Objectives of the course:	To provide a basic introduction to structures, properties and manufacturing methods of ceramics, polymers and composite materials
Course contents:	Introduction. aniculate-Reinforced Composite Materials. Dispersion-Strengthened Composites. True Paniculate Composites. Applications for Paniculate Composites. Fiber-Reinforced Composites. Predicting Properties of

	Fiber-Reinforced Composites. Characteristics of Fiber-Reinforced Composites. Manufacturing Fibers and Composites Fiber-Reinforced Systems. Laminar Composite Materials. Examples and Applications of Laminar Composites. Manufacturing Laminar Composites. Concrete. Sandwich Structures.
Assessment method:	Examination
Recommended readings:	1. Ashby M. F., Materials Selection in Mechanical Design, Pergamon Press, Oxford UK, 1995 2. Askeland D. R,. The Science and Engineering of Materials, Van Nonstrand Reinhold International London 1988 3. Callister W. D., Materials Science and Engineering, J. Willey & Sons, New York, 1994

Course title:	**Metallic Materials I**		
Name of the lecturer:	*Jolanta Baranowska*		
ECTS points:	3	Language of instruction:	English
Semester:	3, winter	Hours per week:	lectures – 2 h
Code:		Teaching method:	lecture

Entry requirements:	Passed the examination of chemistry I, physics I and II, fundamentals of material science I and II
Objectives of the course:	To provide a basic knowledge of metallic materials.
Course contents:	General properties of metallic state. Deformation of metallic materials. Strengthening of metallic materials. Fe-C phase diagram. Influence of chemical composition on structure and properties of Fe-based alloys. Fundamentals of heat and chemical-heat treatment of Fe-alloys. Industrial Fe-alloys: steels, cast irons. Non-ferrous alloys. Metallic composites. Principles of material selection.
Assessment method:	Final test
Recommended readings:	1. W.D.Callister: Fundamentals of materials science and engineering: an integrated approach, Wiley 2005 2. Annual book of ASTM standards, ASTM 2004 3. T.H.Courtney: Mechanical behavior of materials, McGraw-Hill, 2000 4. K.G.Swift, J.D.Booker: Process selection: from design to manufacture, Arnold, 1998 5. J.Vernon: Introduction to engineering materials, Macmillan, 1992 6. W.D.Callister: Materials Science and Engineering, Wiley, 1991 7. R.T.Detloff: thermodynamics in Materials Science, McGraw-Hill, 1993

Course title:	**Metallic Materials II**		
Name of the lecturer:	*Jolanta Baranowska*		
ECTS points:	4	Language of instruction:	English
Semester:	4,summer	Hours per week:	lectures – 2h aboratory – 2h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed the examination of chemistry I, physics I and II, fundamentals of material science I and II
Objectives of the course:	To extend the knowledge of metallic materials.
Course contents:	Lecture. Corrosion resistant metals. Stainless steel. Corrosion resistant cast iron. Heat and creep resistant steels. and cast iron. Creep resistant Ni- and Co-based alloys. High temperature corrosion and methods protection . Intermetallic compounds. Precipitation hardened steel. Wear mechanisms of alloys. Wear resistant steels and cast iron. Alloys for special applications: with the specific electrical properties, shape memory alloys, metallic alloys. Superconductivity and superconducting alloys. Superplasticity and superplastic metals. Metallic materials with porous structures: metallic foams, metal composites, gasars. Metallurgy of copper.. Metallurgy of aluminium. Application of copper and aluminium Basis of powder metallurgy: Fundamentals and applications of powder metallurgy, manufacture procedure of metals and alloys powders, powders mixing, compacting, heating of powders, finals operations. Laboratory. Groups of alloys and their symbols according to international standards. Preparation of metallographic samples for Light Microscopy Analysis. Cast iron. Structure of steel after heat- and chemical-heat treatment. Tool steel. Iron-based alloys with special properties. Copper alloys. Aluminium, titanium, magnesium alloys. Zn, Sn-, Pb- alloys. Macroscopic testing of materials.
Assessment method:	Examination
Recommended readings:	1. W.D.Callister: Fundamentals of materials science and engineering: an integrated approach, Wiley 2005 2. Annual book of ASTM standards, ASTM 2004 3. T.H.Courtney: Mechanical behaviour of materials, McGraw-Hill, 2000 4. K.G.Swift, J.D.Booker: Process selection: from design to manufacture, Arnold, 1998

5. J.Vernon: Introduction to engineering materials, Macmillan, 1992
6. W.D.Callister: Materials Science and Engineering, Wiley, 1991
7. L.Solyma: Solution manual for lectures on the electrical properties of materials, Oxford Univ. 1994
8. .D.A.Brandt: Metallurgy fundamentals, Goodheart-Willcox, 1992
9. .K.Watanabe, M.Motokawa: Materials science in static high magnetic field, Springer-Verl. 2002
10. J.R.Waldram: Superconductivity of metals and cuprates, Philadelphia, Inst. Of Phys. 1996
11. Ch.Poole, H.A.Farach, R.J.Creswick; Superconductivity, Academic Press, 1995

Course title:	**Methods and Technics of Material Testing III**		
Name of the lecturer:	*Krzysztof Gorący, Magdalena Kwiatkowska*		
ECTS points:	4	Language of instruction:	English
Semester:	5, winter	Hours per week:	lectures – 2h laboratory – 2h
Code:		Teaching method:	lectures and laboratories

Entry requirements:	Passed the examination of Polymers I and II
Objectives of the course:	To provide introduction to polymer testing and investigation of polymer properties.
Course contents:	Thermal analysis, thermal stability, flammability, optical properties of polymers Thermal analysis – principles of methods, apparatus, basic curves, interpretation of curves and results, application. Discussed methods: DSC, DTA, TG, DTG, TMA Thermal stability of polymers – methods of investigation, interpretation of results. Discussed methods: HDT, Vicat, Martens Flammability of polymers - methods of investigation, interpretation of results. Discussed methods: oxygen index, UL 94, temperature of ignition,
Assessment method:	Final test
Recommended readings:	1. Test standards according to PN-ISO, ASTM

Course title:	**Methods and Technics of Material Testing I**		
Name of the lecturer:	*Paweł Gutowski*		
ECTS points:	5	Language of instruction:	English
Semester:	2, summer	Hours per week:	lectures – 2h laboratory – 1h tutorials – 1h
Code:		Teaching method:	lecture, laboratory and tutorials

Entry requirements:	Passed the examination of mechanics I
Objectives of the course:	To provide a basic knowledge of testing mechanical properties of materials.
Course contents:	Lectures. Introductory knowledge and primary notions. Internal actions and stresses. Deformation and strain. The experimental basis of mechanical properties of material tests. Hooke's law for the uniaxial stress state. The principle of force and displacement superposition. Saint-Venant's principle. The strength calculation of axially loaded members. The statically indeterminate axially loaded members and systems. The stress at a point definition. The stress tensor. The principal stresses. The uniaxial and plane stress state analysis. Mohr's circle of stress. The strain analysis in the three-dimensional stress state, the generalised Hooke's law. The shear stress, the pure shear and the technological shear. The moments of inertia of plane cross sections. Torsion of members with circular and rectangular sections. Bending. The shear forces and bending moments diagrams. The normal stresses in plane bending. The differential equation of bending line of beam, determination of deflection and rotation of the section. Elastic and inelastic buckling. The elastic strain energy. The material effort. The fundamental failure theories. Combined stresses, the concurrent bending and torsion, the concurrent bending and tension or compression. Brittle fracture. Creep, the primary rheological models, the stress relaxation. Laboratory. The static tensile test of metals and plastics. The static compression test of metals and plastics. The Charpy impact test. The shearing test. The Brinell, Rockwell and Vickers hardness tests. Determination of Young's modulus, proof stress, and elastic limit. Buckling. Determination of stresses with the use of electrical–resistance strain gauges. The fatigue tests of metals. The creep tests of plastics. Classes. Determination of internal actions in uniaxially loaded members. Determination of stresses, strains and displacements under the tensile and compression. Solving the statically indeterminate axially loaded members and systems. Determination of assembly and thermal stresses. The plain stress analysis, determination of stresses with the use of Mohr's circle. Calculation of inertia moments of plain sections. Torsion of members with circular and rectangular sections. Determination of shear forces and bending moments diagrams in beams. The strength calculation of beams. Calculation of buckling. Combined stresses – strength calculation for the members under the concurrent bending and torsion.
Assessment method:	Examination
Recommended readings:	1. Willems N., Easley J.T., Rolfe S.T.: Strength of materials. McGraw Hill Company, 1981

Course title:	**Packaging I**		
Name of the lecturer:	*Mirosława El Fray*		
ECTS points:	1	Language of instruction:	English
Semester:	6,summer	Hours per week:	lectures – 1h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Passed the examination of Chemistry I, II, III, Physics I and Polymer Materials I, II, III.
Objectives of the course:	This course is aimed at giving an introduction to the active packaging technologies that now play a role in packaging for the improvement of materials (food) preservation, quality, and safety.
Course contents:	Plastics Packaging: properties, processing, applications and regulations; Permeability properties of plastics and elastomers; Film properties of plastics and elastomers.
Assessment method:	Final test
Recommended readings:	1. Susan E.M. Selke, John D. Culter, and Ruben J. Hernandez, Plastics Packaging: Properties, Processing, Applications, and Regulations, 2nd Ed., Hanser Gardner, 2004 2. Joseph F. Hanlon, Robert J. Kelsey, and Hallie E. Forcino, Handbook of Package Engineering, 3rd Ed., Technomic, 1998

Course title:	**Methods and Techniques of Material Testing II**		
Name of the lecturer:	*Andrzej Bodnar*		
ECTS points:	4	Language of instruction:	English
Semester:	4,summer	Hours per week:	lectures – 2h laboratory – 1h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed examinations: Mathematics I and Technology of Production I
Objectives of the course:	To provide basic knowledge on theory of measurement, selected methods and measuring instruments, part tolerancing, and calculations with tolerated numbers. The course spotlights relationships between measurements and manufacturing process quality control.
Course contents:	Lecture. Philosophy of measurement. Scales. Direct measurement. Sources of measurement errors. Assessing measurement uncertainty. Indirect measurement and errors propagation. Error corrections. Error models. Interchangeability of parts. Diameter tolerances (ISO). Roughness and accuracy. Calculations with tolerated numbers. Dimensioning. Chains of dimensions. Measuring methods and instruments (micrometric screw, slide callipers, microscopes, projectors, touch probes, sensors). Co-ordinate measurements. How to choose proper measuring instrument for manufacturing process control accounting for accuracy and production conditions. Dynamic measurements. Laboratory. Measurement of outer and inner dimensions with different instruments. Measurements of angles, tapers and profiles. Surface geometrical structure and roughness measurements. Co-ordinate measurements. Checking the accuracy of measuring instruments.
Assessment method:	Final Test
Recommended readings:	1. Instrumentation Reference Book. Ed. B.E. Nolting, Butterworth, London 1988 2. Machinery's Handbook. 25th ed., Industrial Press, New York 1996 3. ISO 5725:1994(E), Accuracy (trueness and precision) of Measurement Methods.

Course title:	**Methods and Techniques of Material Testing IV**		
Name of the lecturer:	*Paweł Kochmański*		
ECTS points:	4	Language of instruction:	English
Semester:	6,summer	Hours per week:	lectures – 2h laboratory – 2h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed the examination of chemistry and physics
Objectives of the course:	Discussion of the most common metals characterization techniques. Types of information provided by these techniques (structure, chemical composition, properties, etc.). Preparation methods for investigations.
Course contents:	Lecture and laboratory. Macroscopic examination. Light Microscopy. Scanning Electron Microscopy (SEM). Scanning Tunneling Microscopy and Scanning Force Microscopy (STM) and (SFM). Transmission Electron Microscopy (TEM). Energy−Dispersive X−Ray Spectroscopy (EDS). Wavelenght−Dispersive X−Ray Spectroscopy (WDS). Electron Energy−Loss Spectroscopy in the Transmission Electron Microscope (EELS). Scanning Transmission Electron Microscopy (STEM). Electron Probe X−Ray Microanalysis (EPMA). X−Ray Diffraction (XRD). Dilatometry. Quantitive metallography. Magnetic properties examinations. Thermal properties examinations.

Assessment method:	Examination
Recommended readings:	1. C. R. Brundle Ch. A. Evans, Jr., S. Wilson, Encyclopedia Of Materials Characterization, Butterworth-Heinemann, Manning Publications Co. 2. S. Amelinckx, D. van Dyck, J. van Landuyt, G. van Tendeloo, Handbook Of Microscopy, VCH 1997.

Course title:	**Packaging II**		
Name of the lecturer:	*Mirosława El Fray*		
ECTS points:	4	Language of instruction:	English
Semester:	10,summer	Hours per week:	lectures – 1h laboratory – 2h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed the examination of Chemistry I, II, III, Physics I and Packaging I.
Objectives of the course:	This course is aimed at giving an introduction to the active packaging technologies that now play a role in packaging for the improvement of materials (food) preservation, quality, and safety.
Course contents:	Flexible packaging - adhesives, coatings and processes; Rigid plastics packaging - PET packaging technology: barrier materials, converting processes and end-use applications; Recycling packaging materials; Green plastics for food packaging; Intelligent packaging; Storage and distribution.
Assessment method:	Examination
Recommended readings:	1. Richard Coles, Derek McDowell, and Mark J. Kirwan, eds., Food Packaging Technology, Blackwell Publishing, 2003 2. Joseph F. Hanlon, Robert J. Kelsey, and Hallie E. Forcino, Handbook of Package Engineering, 3rd Ed., Technomic, 1998

Course title:	**Physics I**		
Name of the lecturer:			
ECTS points:	5	Language of instruction:	English
Semester:	1, winter	Hours per week:	lectures – 3 laboratory – 1h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	A-level Physics; Basic Calculus
Objectives of the course:	• To provide students with sufficient physics knowledge so that they can proceed to the intermediate and more advanced courses in the BSc Applied Physics program; • To provide basic understanding in classical mechanics and electromagnetism; • To learn problem solving skills. In this course, vector analysis and elementary calculus (including line and surface integral but not vector differentiation) are introduced and used as a tool. Students are expected to be familiar with them after this course.
Course contents:	Review use of calculus. Describing position and motion. Newton's first law. Newton's second law and third law. Fundamental forces in nature. Work. Kinetic energy. Motion of several particles. 1-d and 2-d collisions. Rotational dynamics. Electric charge and Coulomb's law. Electric field. Gauss' law. Electric potential. Capacitance. Current and resistance. Electromotive force and circuits. Magnetic field. Magnetic force. Production of magnetic field. Magnetism and matter. Faraday's law of induction and inductance.
Assessment method:	Coursework (30%) + Exam (70%)
Recommended readings:	Major textbook: 1. D Halliday, R. Resnick, and J. Walker, "Fundamentals of Physics" 5th edition, Wiley (1997); *NOTE:* 6th Edition, Wiley (2001) is now also available. Other textbooks - students may use other similar textbooks as available: 2. R. A. Serway, "Physics for scientists and Engineers with Modern Physics", Saunders (1990) 3. M. Mansfield & C. O'Sullivan, "Understanding Physics", Wiley (1998); 4. J.D. Cutnell & K.W. Johnson, "Physics", Wiley (2001); 3. G.S. Romine, "Applied Physics", Prentice-Hall (2001); 4. P. Hewitt, "Conceptual Physics", 8th edition, Adison-Wesley (1998).

Course title:	**Physics III**		
Name of the lecturer:	*I. E. Lipinski*		
ECTS points:	4	Language of instruction:	English
Semester:	8,su mmer	Hours per week:	lectures – 2h laboratory – 1h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	A-level Physics; Basic Calculus
Objectives of the course:	• To provide students with sufficient physics knowledge so that they can proceed to the intermediate and more advanced courses in the BSc Applied Physics program; • To provide basic understanding in classical mechanics and electromagnetism; • To learn problem solving skills. In this course, vector analysis and elementary calculus (including line and surface integral with vector differentiation) are introduced and used as a tool. Students are expected to be familiar with them after this course.
Course contents:	Review use of calculus. Describing position and motion. Fundamental forces in nature. Physical Fundamentals of Mechanics The language of motion - Hooke's law - The vibration of strings - Harmonic oscillatory motion and waves (Periodic waves , Properties of waves, Wave propagation, Standing waves, Waves fronts and diffraction, Interference, Reflection, Refraction, Intoduction to the resonance, Attenuation and dispersion) Acoustics Maxwell's formulation of the principles of electromagnetism Optics Thermal Radiation Quantum Nature of Light and Wave Properties of Particles Bohr's Atom, X-Rays Radioactivity Fourier transformations and general rules (Fourier transform).
Assessment method:	Coursework (30%) + Exam (70%)
Recommended readings:	Major textbook: 1. D Halliday, R. Resnick, and J. Walker, "Fundamentals of Physics" 5th edition, Wiley (1997); NOTE: 6th Edition, Wiley (2001) is now also available. 2. C Kittel, Introduction to Solid State Physics (1997); 3. R. Eisberg, R. Resnick, Quantum Physics of Atoms, Molecules, Solids, nuclei and Particles, J. Wiley(1993)

Course title:	**Planning and Financing of Investments**		
Name of the lecturer:	*Jolanta Baranowska*		
ECTS points:	5	Language of instruction:	English
Semester:	9, winter	Hours per week:	lectures – 2h laboratory – 1h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	Passed the examination of Economics and Fundamentals of Management
Objectives of the course:	To provide a basic introduction to planning of investments.
Course contents:	Lectures. Fundamentals of investments (types and role). Changes of value of money in time. Internal and external factors for investments in market economy. Market analysis, technological level, capital market. Technological potential of enterprise, human resources, structure and organization of enterprise, financial conditions. Process of investments. Preparation of Business Plan. Methods of calculation and evaluation of financial viability. Tutorials. Preparation of Business Plan for selected enterprises.
Assessment method:	Final test
Recommended readings:	1. Elhanan Helpman: The mystery of economic growth. Cambridge; London: Belknap Press of Harvard University Press, 2004. 2. Daniel W. Halpin, Ronald W. Woodhead: Construction management . New York ; Chichester : John Wiley and Sons, 1998. 3. W. D. Fraser: Principles of property investment and pricing. Basingstoke ; London : Macmillan, 1993. 4. Stephen E. Hargitay: Property investment decisiona quantitative approach, Shi-Ming Yu. London : E and FN Spon, 1993. 5. E. J. McLaney: Business finance : theory and practice. London: Pitman, 1997. 6. H. Millichamp: Finance for non-financial managers an active-learning approach, London : Letts Educational, 1997.

Course title:	**Polymer Coating Materials**		
Name of the lecturer:	*Prof. Tadeusz Spychaj, Krzysztof Gorący*		
ECTS points:	2	Language of instruction:	English
Semester:	6,su mmer	Hours per week:	lectures – 2h
Code:		Teaching method:	lecture

Entry requirements:	None
Objectives of the course:	Introduction to polymer based paint, lacquers and coating materials as well as additives and application methods.

Course contents:	Basic definitions. Typical components of coating materials. Polymers and resins as a basis for paints, lacquers and coating materials. Technology of production of coatings. Solvent coatings, waterborne coatings, powder and other solvent less coatings. Techniques of paint/lacquer applications. Preparing of substrate surface. Characterization of wet and dry coatings, investigations method of their properties. Examples of industrial applications of various paints/lacquers and coatings; automotive industry. Environment protection aspects.
Assessment method:	Examination
Recommended readings:	1. J.V. Koleske; Paint and Coating Testing Manual, ASTM Manual Series 1995 2. A.A. Tracton; Coatings Technology Handbook, CRC Press 2005

Course title:	**Polymer Materials I**		
Name of the lecturer:	*Prof. Zbigniew Roslaniec , Magdalena Kwiatkowska*		
ECTS points:	4	Language of instruction:	English
Semester:	4,su mmer	Hours per week:	lectures – 2h
Code:		Teaching method:	lecture

Entry requirements:	Passed the examination of chemistry I, II and III, fundamentals of materials science I and II
Objectives of the course:	To provide the knowledge of thermoplastic polymers.
Course contents:	Thermoplastic polymers – basic notions, modifying agents, classification of thermoplastics, preparation (obtaining), properties, processing, application. Polyolefines. Polystyren. Vinylofluoride and vinylochloride polymers. Acrylate and methacrylate polymers. Polyvinyl acetate. Polyamides. Polyesters. Polycarbonates. Polyurethanes. Cellulose materials. Thermoplastic elastomers. Chemical and physical modification of thermoplastics. Novel thermoplastics with specific properties for new applications. Modern technologies of thermoplastics synthesis. Influence of chemical structure on physicochemical and mechanical properties. Thermoplastics structure and modification of properties through structure change. Principles of material selection for the sake of required product properties and technological aspects. Ecological aspects and application of thermoplastics.
Assessment method:	Final test
Recommended readings:	1. Domininghaus H., Plastics for engineers, Hanser Publishers, 1993

Course title:	**Polymer Materials II**		
Name of the lecturer:	*Zbigniew Czech, Krzysztof Gorący*		
ECTS points:	4	Language of instruction:	English
Semester:	5, winter	Hours per week:	lectures – 2h laboratory – 1 h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	Passed the examination of Polymer Materials I
Objectives of the course:	To provide basic introduction to structures, properties, synthesis methods, performances, investigations and applications of high performance polymers.
Course contents:	Part I - High performance polymers Definition, classification, types and properties of high performance polymers. Groups of materials: thermoresistance and chemical resistance polymers, Liquid Crystals, fluor polymers, current conducting and antistatic polymers, natural polymers For each group following problem are discussed: physical and chemical structure of materials, specific properties, investigation methods, processing methods and applications. Part II – Reactive polymers Reactive polymers classification, types and properties of them. Description of cross-linking process. Characterization of diverse kinds of resins (phenol-formaldehyde-resins, amine-formaldehyde-resins, polyesters, epoxies, polyurethane, elastomers, silicone, acrylic, polyimide), definition of composite materials, composite properties and the investigations method of their properties, adhesions promoters, pressure-sensitive adhesives and their commercial applications.
Assessment method:	Examination
Recommended readings:	1. W. Szlezynger: Tworzywa sztuczne, wydawnictow Oświatowe FOSZE, Rzeszów 1998 2. W. Królikowski, Z. Kłosowska-Wołkowicz, P. Penczek: Żywice i laminaty poliestrowe. 3. B. Jurkowski, B. Jurkowska: Sporządzanie kompozycji polimerowych 4. H. Saechtling: Tworzywa sztuczne-poradnik

Course title:	**Polymer Materials III**		
Name of the lecturer:	*Prof. Zbigniew Rosłaniec*		
ECTS points:	5	Language of instruction:	English
Semester:	6, su mmer	Hours per week:	lectures – 2h laboratory – 1 h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	Passed the examination of Polymers I and II
Objectives of the course:	To provide the basic knowledge of elastomers.
Course contents:	Lecture. Elastomers: type of elastomer materials and their application; rubber elasticity: stress-strain relationship, elongation and compression set. Rubber compound: rubbers, curing system, fillers, plasticizers, antioxidants. Rubber vulcanisation: chemistry and technology. Rubber processing. Rubber for food application. Thermoplastic elastomers. Laboratory. Rubber compounding. Vulcametric testing. Curing of rubber compounds. Press moulding. Mechanical properties of elastomers I: stress-strain relationship. Mechanical properties of elastomers II: compression set.
Assessment method:	Examination
Recommended readings:	1. N.P. Cheremisinoff (ed.); Elastomer Technology Handbook; CRC Press, London, 1993 2. G. Holden, N.R. Legge, R. Quirk, H.E. Schroeder; Thermoplastic Elastomers,

Course title:	**Polymer Processing I**		
Name of the lecturer:	*Prof. Zbigniew Rosłaniec, Konrad Kwiatkowski*		
ECTS points:	4	Language of instruction:	English
Semester:	5, winter	Hours per week:	lectures – 2h laboratory – 2 h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	Passed the examination of chemistry I and II, polymer materials I and II, fundamentals of polymer processing
Objectives of the course:	To provide the basic knowledge of plastics processing.
Course contents:	Lectures. Specificity and methods of polymers processability. Processability of thermoplastics. Material preparation for moulding: preparation and modification of granulated material, mixing, drying, regeneration of technological waste material, dissolution, emulating, dispersing. Enriching agents. Moulding: press moulding, extrusion moulding, injection moulding, calendaring, blow moulding, vacuous moulding, coating and laminating, powder coating, casting, foaming, spinning. Finishing. Joining: welding, pressure welding, gluing, riveting; flocking, printing, metal plating. Laboratory. Preparation of material for moulding: comminute, granulating, drying. Polymer mixtures. Extrusion moulding of polymers. Extrusion of profiles. Injection moulding of polymers: screw, piston. Coating, spinning and joining of polymer materials.
Assessment method:	Examination
Recommended readings:	1. Birley A.W., Haworth B., Batchelor J.; Physics of Plastics; Hanser Publishers 1992 2. Rosato D. V.; Plastics Processing Data Handbook; 2nd edition, Chapman & Hall, 1997 3. Wilkinson A.N., Ryan A.J.; Polymer Processing and Structure Development; Kluwer Academic Publishers, 1998

Course title:	**Polymer Processing II**		
Name of the lecturer:	*Michał Kacperski*		
ECTS points:	5	Language of instruction:	English
Semester:	6, summer	Hours per week:	lectures – 2h laboratory – 2 h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	Passed the examination of chemistry III, polymer processing I, polymer materials II
Objectives of the course:	To provide the basic knowledge of resins processing.
Course contents:	Lectures. Introduction – general information, mechanism of hardening plastics obtaining, technological properties, processability of unreinforcement resins, preparation of foamed products, processability of reinforcement resins

	(hand-made and spray laminating, pressure methods, RTM, centrifugal casting, production of flat and corrugated boards, winding methods, preparation and processability of SMC and BMC, injection and press moulding, RIM). Laboratory. Hand-made laminating. SMC and BMC technology. Foaming of polymers. Casting of polymer compounds. Production of GF reinforced polyester profiles. Compression moulding technology. Testing of hardening products.
Assessment method:	Examination
Recommended readings:	1. Handbook of polymer composites for engineers / ed. by Leonard Hollaway ; British Plastics Federation; Cambridge, Woodhead Publ., 1994 2. International encyclopedia of composites. red. Stuart M. Lee. -- Vol. 1-6 New York : VCH, 1990 3. Advanced thermoplastic composites : characterization and processing / ed. Hans-Henning Kausch [et al.]. Munich : Hanser, 1993

Course title:	**Psychology**		
Name of the lecturer:	*Elżbieta Rudowicz*		
ECTS points:	2	Language of instruction:	English
Semester:	9, winter	Hours per week:	lectures – 2h
Code:		Teaching method:	lecture

Entry requirements:	None
Objectives of the course:	To provide the principles of psychology.
Course contents:	Major approaches and research methods in psychology: Philosophical issues in psychology; approaches to psychological phenomena; methods in psychological enquiries; ethical concerns in psychological experimentations; fields of psychology Sensation and perception: Sensory modalities and processes; perceptual organization; factors affecting perception; biases and errors in perception, subliminal perception. Basic theories and principles of learning and memory: Classical and operant conditioning; cognitive and social learning; application of learning theories; behaviour modification; theories and processes of memory; forgetting; ways of improving memory. Motivation and emotions: Selected theories of motivation; biological motives and psychological motives; sexual motivation; achievement motivation; nature and theories of emotion; frustration, aggression, happiness; the role of emotions and emotional expressions; concept of emotional intelligence. Social influence and group behaviour: Social perception; attitudes and social interaction; social facilitation and inhibition; social influences: conformity, compliance, and obedience; group processes and dynamics; attraction and friendships. Personality and individuality: Personality theories and related issues; personality development, personality assessment; self-defense mechanisms; Intelligence: Theories of human intelligence and its measurement; mental abilities; different types of ability tests; types of thinking and creativity. Intelligence. Different approaches to conceptualization of intelligence; intelligence and life success; factors affecting intelligence; intelligence testing Thinking and creativity: Modes of thinking and creativity. Divergent and convergent thinking; concept of creativity, factors affecting creative thinking, rules and strategies of problem solving.
Assessment method:	The coursework will consist of two multiple choice tests. Students will be required to carry out two practical exercises related to the concepts studied in the course.
Recommended readings:	

Course title:	**Quantum Mechanics**		
Name of the lecturer:	*Jerzy Kuriata*		
ECTS points:	4	Language of instruction:	English
Semester:	8,summer	Hours per week:	lectures – 2h tutorial – 1h
Code:		Teaching method:	lecture and tutorials

Entry requirements:	General physics, calculus
Objectives of the course:	The knowledge of basic principles of quantum mechanics and their applications
Course contents:	Black body radiation, photoeffect, the Compton effect, wave-corpuscule dualism, linear operators and their properties, postulates of quantum mechanics, the Schrödinger equation, the Heisenberg indeterminacy relation, one-dimensional motion (potential wall , potential barrier, harmonic oscillator), quantization of angular momentum, motion of an electron in a Coulomb field, quantum numbers, orbitals, the Pauli exclusion principle, electronic configuration of atoms.
Assessment method:	Written and oral examination
Recommended readings:	1. PT Mathews "Introduction to Quantum Mechanics", McGraw-Hill Publishing Comp. N.York 2. A.L.I.Schiff "Quantum Mechanics", McGrow-Hill Publishing Comp., N.York

Course title:	**Recycling I**		
Name of the lecturer:	*Prof. Andrzej Błędzki, Volker Sperber*		
ECTS points:	2	Language of instruction:	English
Semester:	6,summer	Hours per week:	lectures – 2h
Code:		Teaching method:	lecture

Entry requirements:	Passed the examination of Polymer Materials I and II
Objectives of the course:	To provide the basic knowledge of recycling.
Course contents:	Recycling – types. The Law regulations of recycling in the world. Economical aspects of recycling of polymer materials. The following stages/levels in recycling. Systems of collecting recyclable materials. Machines and devices for recycling of polymers. Sorting and processing recyclables. Filtration of wastes in melting state. Application of recyclables. Lines for recycling of polymers. Recycling of PVC, PS, PE, PUR. Line for recycling of PET wastes.
Assessment method:	Final test
Recommended readings:	1. J. Scheirs, Polymer Recycling: Science, Technology and Applications. John Wiley and Sons, 1998 2. F. La Mantia, Handbook of plastics recycling.

Course title:	**Superconductivity and Superconductors**		
Name of the lecturer:	*Janusz Typek*		
ECTS points:	2	Language of instruction:	English
Semester:	10,summer	Hours per week:	lectures – 1h
Code:		Teaching method:	lecture

Entry requirements:	Basic knowledge of 1. Electromagnetism 2. Quantum Mechanics 3. Solid State Physics
Objectives of the course:	At the end of the module you should: 1. Be able to describe the physical properties of superconducting systems. 2. Appreciate the microscopic physical processes, which lead to the onset of superconductivity. 3. Understand the theoretical models, which have been devised to describe the behaviour of superconductors. 4. Be able to calculate and estimate basic parameters of the superconducting system.
Course contents:	Properties of superconductors. Onset of zero resistance and the transition temperature. Diamagnetism, penetration depth, critical magnetic field. Thermodynamics of the normal and superconducting phases. Electrodynamics and the London theory. Condensate and the two fluid model. Bardeen Cooper Schrieffer (BCS) microscopic theory. Tunnelling in superconductors. The Josephson effect. Type II Superconductivity. Energy of normal/superconducting interface. Nature of the mixed state. Lower and upper critical fields. Vortices and the vortex array. Discovery of high temperature superconductivity. Structure and properties of HTSC materials in the normal and superconducting state. Theories of the HTSC materials. Applications of superconductors. d.c. and r.f. SQUIDs.
Assessment method:	Attendance 10%, term work 30%, exam 60%.
Recommended readings:	1. J.R.Waldram, Superconductivity of metals and cuprates, Institute of Physics Publishing, Bristol and Philadelphia 1996 2. D.R.Tilley, J.Tilley, Superfluidity and Superconductivity, Adam Hilger 3. M.Cyrot, D.Pavuna, Introduction to Superconductivity and High TC materials, World Scientific 4. H.Ibach, H.Luth, Solid-State Physics, Springer, 1996

Course title:	**Surface Engineering**		
Name of the lecturer:	*Prof. Jolanta Baranowska*		
ECTS points:	3	Language of instruction:	English
Semester:	8,summer	Hours per week:	lecture – 1h laboratory – 2h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	Passed the examination of chemistry I, II and III, and physics I, II
Objectives of the course:	To provide the knowledge of surface and surface layers.
Course contents:	Lecture. Surface of solids. Surface layers and coatings. Energy of surface. Phenomena in solid-gas interface. Sorption, active centres, chemical reactions, catalysis. Diffusion. Structure and surface defects. Phenomena in solid-liquid interface. Wettability, electrode potential, adsorption. Phenomena in the solid-solid interface. Friction, lubrication, wearing. Properties of surface layers. Surface modification: mechanical, chemical, thermal, physical, thermo-

	mechanical, electrochemical treatments. Method of surface characterisation. Laboratory. Electrochemical coatings. Chemical coatings, fluid-bed process for polymer coating. Tests of coatings properties: corrosion resistance, wear resistance, thickness and hardness of coatings.
Assessment method:	Final test
Recommended readings:	1. W.D. Allister: Fundamentals of material science and engineering: an integrated approach, Wiley, 2005 2. E.V.Gorokhov, V.P.Korolev: Durability of steel structure under reconstruction, Brookfield, 1999 3. M.Panovic, M.Schesinger: Fundamentals of electrochemical deposition, Wiley and Sons, 1998. 4. R.Heima: Plasma-spray coatings: principles and applications, VCH, 1996 5. R.Seymur, H.Mark: Handbook of organic coatings: a compressive guide for coating industry, Elsevier, 1990 6. M.G.Hocking, V.Vasantosren, Metallic and ceramic coatings: production, high temperature properties and applications Longman Sci.Techn. 1989 7. E.Rabinowicz: friction and wear of materials, Wiley, 1995 8. T.H.Courtney: Mechanical behavior of materials, McGraw-Hill, 2000 9. V.Kragelskym V.V.Alisin: tribology: Lubricartion, friction and wear, London, Mir 2001

Course title:	**Systems of Quality Management**		
Name of the lecturer:	*Jolanta Baranowska*		
ECTS points:	2	Language of instruction:	English
Semester:	6,summer	Hours per week:	lectures – 2h
Code:		Teaching method:	lecture

Entry requirements:	None
Objectives of the course:	To provide a basic introduction to TQM.
Course contents:	Total Quality Management – TQM. History of Quality and Quality management. Definitions. Tools, methods and techniques used in TQM. Quality Function Deployment, Failure Tree Analysis, Statistical Process Control, FMEA. TQM philosophy: client satisfaction. Ethical aspects, approach to product and manufacturing process, sustainable improvement, benchmarking, concurrent engineering. Quality standard. ISO 9000. Documents: procedures and instructions, Quality book. Accreditation and certification.
Assessment method:	Final test
Recommended readings:	1. R.L.Flood: Beyond TQM, Wiley and Sons, 2003 2. E.E.Lawler: Organizing for high performance, employee, Involvement TQM, Re-engineering and knowledge Management, Wiley and Sons, 2001 3. P.Mear: Quality improvement tools and Techniques, Amazons, 2005 4. ISO Standards: 9000

Course title:	**Technology of Production I**		
Name of the lecturer:	*Małgorzata Garbiak*		
ECTS points:	3 +2	Language of instruction:	English
Semester:	2, summer 3, winter	Hours per week:	lectures – 3h laboratory – 2h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	Passed the examination of chemistry I, physics I, engineering graphics I
Objectives of the course:	To provide a basic knowledge of metallurgy and casting.
Course contents:	Lecture. Methods of ore dressing. Principles of oxides reduction - an example of blast furnace process. Products of blast furnace process, their properties an utilization. Oxidation of tramp elements and impurities during steel melting. Reactions at metal – slag interface. Gases in steel and their removal. Modern technologies of steel melting. Steel teeming process and formation of structure in ingots and during continuous casting. Copper metallurgy: melting of copper matte and converter copper, fire and electrolytic refining. Aluminum metallurgy: Al_2O_3 winning, electrolysis of Al_2O_3, Al refining. Powder metallurgy: powder fabrication, compaction, sintering and treatment of sinters. Hydrometallurgy: basics of extraction methods and their application, electrolytic methods of metal receiving from water solutions. Absorption processes, metal cations receiving. Cementation. Casting methods: sand casting, permanent mold casting, die casting, shell and precision casting. Mechanization of moulds and cores manufacture. Furnaces and cast iron melting. Solidification and development of cast structure. Directional solidification, feeding and chills. Solidification of alloys in metal moulds. Computer simulation in casting design. Laboratory. Testing of moulding sand properties, hand moulding, melting cast iron in crucible induction furnace. Testing of solidification curve of Al-Si alloy. Analysis of casting producibility, developing of production technology. Identification and analysis of casting defects.
Assessment method:	Final test

Recommended readings:	1. Cottrell A.H., An introduction to metallurgy, Edward Arnold, 1975. 2. Kurz W., Fisher D.J., Fundamentals of solidification, Trans. Tech. Publ., 1989. 3. Campbell J., Castings, Butterworth-Heineman, 2nd ed. 2003. 4. P.Beeley, Foundry technology, Butterworth-Heinemann, 2001.

Course title:	**Technology of Production III**		
Name of the lecturer:	*Janusz Cieloszyk*		
ECTS points:	5	Language of instruction:	English
Semester:	5, winter	Hours per week:	lectures – 3h laboratory – 2h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	Passed the examination physics, mathematics, fundamental of machine construction and design
Objectives of the course:	To provide students to the hardware, technology, and programming of modern manufacturing equipment, tools, machine tools and Computer Numerically Controlled (CNC) machine tools.
Course contents:	Lecture and laboratory. Introduction to manufacturing technology (CAD, CAM, CAPP). Development of machine tool technology: rolling, casting, deep drawing, sheet-metal working, electro discharge machining and modern metal cutting. Machinability. Workpiece materials-classification. Tool materials and constructions. Tool wear. Establishing the machining method in relation to surface texture and tolerance. Machining economics. Typical metal cutting process during die and mould products: Parting, Turning, Boring, Milling, Drilling, Grooving, Threading; Grinding, Honing -machine, tools, cutting conditions. Cutting fluid.
Assessment method:	Written Examination, Class Test , Laboratory Work
Recommended readings:	1. Balic J.: Contribution to Integrated Manufacturing, Vienna, 1999 2. Instructions for practise lecture, TU of Szczecin 3. Kaczmarek J.: Principles of Machining by Cutting Abrasion and Erosion. Peter Peregrinus Ltd.1976 4. Modern Metal Cutting, Sandvik Coromant 1994 5. Shaw M. C., Metal Cutting Principles, Oxford Univ. Press., Oxford 1996

Course title:	**Technology of Production II**		
Name of the lecturer:	*Walenty Jasinski*		
ECTS points:	4	Language of instruction:	English
Semester:	4,summer	Hours per week:	lectures – 1h laboratory – 2h
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Passed the examination of chemistry I, physics I, engineering graphics I and II, methods of materials testing I, fundamentals of material science I
Objectives of the course:	To provide a basic knowledge of heat-treatment processes.
Course contents:	Lecture. Classification and nomenclature of heat-treatment processes. Transformation in steel during heating, soaking and cooling. Diagrams TTT of undercooled austenite. Superficial diffusionless heat-treatment. Quenching stresses. Tempering. Hardenability and selection on the ground hardenability. Preparation and selection of protective atmospheres. Heat-treatment in vacuum. Thermo-chemical treatment: nitriding, carburization, carbonitriding, titanizing. The division of plastic forming, forging, forging in multicavities dies, die shearing, drawing, consruction of press-forming dies, drawing tensions and forces state Laboratory. The influence of content of carbon and quenching intensity after austenitizing on hardness. The test temperability and temper brittleness of constructional and tool steels. Heat-treatment of chosen copper and aluminium alloys. Defect and audit of heat-treatment and thermo-chemical treatment. Testing of drawability of sheets, construction of press-forming dies.
Assessment method:	Final test
Recommended readings:	1. Askeland D.R.: The Science and Engineering of Materials. Boston, PWS Publishing Company 1994 2. Guy A.G. Introduction to Materials Science. New York, London, Sydney, McGraw-Hill 1972 3. Callister W.D.: Materials Science and Engineering - An Introduction. NewJork, John Wiley & Sons, Inc.1994. 4. Porter D.A., Easterling K.E.: Phase Transformation in Metals and Alloys, Chapman-Hall, New York 1992

Course title:	**Technology of Production IV**		
Name of the lecturer:	*Marek Zasada*		
ECTS points:	4	Language of instruction:	English
Semester:	8, summer	Hours per week:	lectures – 1h laboratory – 1h project – 1h
Code:		Teaching method:	Lecture, practical classes, laboratory

Entry requirements:	Passed the examination physics, mathematics, fundamental of machine construction, design, technology of manufacturing I, II, III
Objectives of the course:	To develop versatile designers with a knowledge and broad understanding of the technological, manufacturing and creative aspects of design; principally focused on industrially manufactured specially die and mould products,
Course contents:	Manufacturing Technology, manufacturing process of die and mould products, process planning. Technological data base. Positioning and clamping, clamping devices. Tolerances, Knowledge of an advanced CAD/CAM package and an understanding of the principles and techniques of computer-driven manufacturing systems during die and mould products. CNC Machines: Configuration, co-ordinate systems, machine referencing, tool changing. CNC Programming: ISO standards, Manual Data Input, Conversational, Computer-Aided Part Programming. Introduction to CAD/CAM. Write based programs for component: die or mould manufacture on a CNC milling machine.
Assessment method:	Written Examination, Laboratory Work Project Work
Recommended readings:	1. Application Guide :Die & Mould Making, Sandvik Cormoant 2005 2. Balic J.: Contribution to Integrated Manufacturing, Vienna, 1999 3. Die and mould production news, Sandvik Cormoant 2004,2005 4. High speed machining and conventional die and mould machining Sandvik Cormoant 2005 5. Shaw M. C., Metal Cutting Principles, Oxford Univ. Press., Oxford 1999

Course title:	**Fundamentals of Electrotechnics and Electronics**		
Name of the lecturer:	*Prof. Valery Khrisanov*		
ECTS points:	3	Language of instruction:	English
Semester:	1, winter	Hours per week:	lectures – 2h laboratory – 1h
Code:		Teaching method:	lecture and laboratories

Entry requirements:	None
Objectives of the course:	To provide a basic knowledge of electrotechnics and electronics.
Course contents:	Basic terminology of electrotechnics, dependences in electric circuits of the direct current. Thermal effect of electricity. Electromagnetism. Capacitor, capacity. Producing of the alternating current, characterizing parameters of alternating current, dependence in circuits, work and power of the alternating current, compensation for the passive power, 3-phase electricity. Transformers. Asynchronous motors: squirrel-cage and circular motors, starting. selection and applying electric motors. Problems of the control of the speed in driving setups. Electronic elements (diodes, transistors, triak, modular blocks). Optoelectronic elements (light emitting diode, optoisolators, photodiodes, phototransistors, diode displays, photo thyristor). Controlled and uncontrolled rectifiers. Stabilizers of voltage and currents. Drivers of the power of the alternating current. Contact breakers and inverters. Amplifiers. Generators. Linear integrated circuits. Digital integrated circuits. Microprocessors. Possibilities to utilize the computer and the review of standard computer programs. Measurements of nonelectric parameters with electric methods. Digital measuring instruments.
Assessment method:	Final test
Recommended readings:	

Course title:	**Electric Drives**		
Name of the lecturer:	*Andrzej Bodnar*		
ECTS points:	2	Language of instruction:	English
Semester:	summer	Hours per week:	2 hours
Code:		Teaching method:	lecture and laboratory

Entry requirements:	Finished courses on “electrical engineering” and “fundamentals of control systems”.
Objectives of the course:	The lecture gives basic knowledge on drives equipped with electrical motors (motors and control systems of controlled speed drives - rules of functioning and technical solutions).
Course contents:	Electric drives – basic characteristics, nominal values. Fundamental information on DC, AC and stepping motors – construction, static and dynamic characteristics, heating, limitations, speed control, acceleration and braking. Servodrives – structure, transfer functions, dynamic response, control quality, static and dynamic errors. Power units, drive control units – thyrystor controller, PWM converter, vector control. Position measuring systems – encoder, resolver, inductosyn, laser system. Linear drives – motors, features, technological problems. Laboratory: Servodrive testing. Drive efficiency and power loss. Testing positioning accuracy. Tool path errors. Stepping motors.
Assessment method:	Written tests

Recommended readings:	1. Rashid M.H.: "Power Electronics". Pearson Ed. – Prentice Hall, London 2004 2. Harter J.: "Electromechanics: Principles, Concepts and Devices", Prentice Hall, 2001

Course title:	**Reliability, Life and Diagnostics of Machines**		
Name of the lecturer:	*Andrzej Bodnar*		
ECTS points:	2	Language of instruction:	English
Semester:	winter	Hours per week:	1 hour
Code:		Teaching method:	lecture

Entry requirements:	Basic course on statistics; basics of measurements – sensors and methods.
Objectives of the course:	The lecture gives basic knowledge on assessment and testing of life and reliability of technical systems. It sketches also basic theory and methods used in machine diagnostics, monitoring and supervision.
Course contents:	Empirical measures of reliability. Reliability and risk functions. Distributions in modelling of life. Serial, parallel and other systems. Models of failure. Examples of assessing reliability. Improvement of reliability and its costs. Life testing. Diagnostics of systems and processes. Main concept. Diagnostic models. Role of system modelling. Signal analysis. Symptoms. Limit values. Damage location. Examples of diagnosing systems. System monitoring and supervision.
Assessment method:	Written tests
Recommended readings:	1. "Handbook of Reliability Engineering". Ed. Hoang Pham, Springer, London 2003 2. Grosh D.L.: "A Primer of Reliability Theory". Wiley, New York1989 3. Natke H.G., Cempel C.: "Model-Aided Diagnosis of Mechanical Systems. Fundamentals, Detection, Localization, Assessment". Springer, Berlin 1997