Study programme

Chemical and process engineering

first degree study

The profile of studing: general academic

1. Basic information about the course

The name of the field of study	**Chemical and process engineering**
The level of study	**first degree study**
The profile of studing	**general academic**

The name of the core discipline, in which more than half of the learning outcomes are obtained together with the percentage share of the number of ECTS credits for the core discipline in the total number of ECTS credits required to complete studies in the course of study.

The name of the core discipline	Share
chemical engineering	**74 %**

Names of other disciplines together with the percentage share of the number of ECTS credits for other disciplines in the total number of ECTS credits required to complete a course of study. PRS7

	Share
chemical sciences	**16 %**
mechanical engineering	**10 %**

Number of semesters	**7**
Specializations in the course of study	Product design and engineering of pro-ecological processes Processing of polymer materials
Number of ECTS credit points required to complete the studies	**210**
Total number of class hours	Product design and engineering of pro-ecological processes: **2667** Processing of polymer materials : **2667**
Recruitment requirements	Requirements annually determined by the Senate of Rzeszów University of Technology
After graduation, the graduate obtains a professional title	Bachelor of Science (BSc)
Graduate's profile, employment opportunities	The graduate has general knowledge of mathematical-natural sciences and technical sciences. He understands and is able to use basic principles and physical laws that underlie chemical and process engineering to solve technical problems, including: principles of mass, energy and momentum balancing, laws of equilibrium (chemical and phase), laws of process kinetics. The graduate understands the course of processes at stationary and non-stationary state as well as the basics of processes control and safe processes conduction. He can plan and do research, use measuring instruments and interpret the obtained results. He knows the basic methods, techniques and tools used to solve simple engineering tasks in the field of chemical and process engineering, in particular: principles of process and apparatus design, computational and simulation techniques, typical commercially available design supporting programs. Graduates can elaborate their own simple calculation programs, can use professional literature and databases and can prepare the calculation of process costs. The graduate is prepared to take a professional job in the chemical industry and related industries - in positions related to the running and organization of production processes as well as design offices and consulting companies. The graduate has a knowledge of a foreign language at the B2 level of the Common European Framework of Reference for languages of the Council of Europe. The graduate has ingrained habits of continuous education and is prepared to undertake second-degree studies or appropriate post-graduate studies Thanks to the teacher-student interaction, local government activity and activity in scientific circles, the graduate shapes his social attitude, he is well prepared for cooperation with the scientific and industrial surroundings, he has the ability to work in a team and is able to mutual solving of tasks concerning technical problems and problems resulting from functioning in the society.

2. Learning outcomes

Symbol	Contents	References to PRK
K_W01	Has knowledge of mathematics that allows the use of mathematical methods to describe chemical and physical processes and phenomena	**P6S_WG**
K_W02	Has knowledge of physics that allows understanding of physical phenomena in nature and technology	**P6S_WG**
K_W03	Has knowledge necessary to understand the physical and chemical bases of elementary operations and processes in chemical engineering	**P6S_WG**
K_W04	Has knowledge of machine science and chemical apparatus that enables understanding and designing operations and processes of chemical engineering	**P6S_WG**
K_W05	Has knowledge of the basics of balancing and transport of momentum, heat and mass, required to understand, supervise and design unit operations in chemical engineering	**P6S_WG**
K_W06	Has knowledge of general, inorganic, analytical, organic and physical chemistry and thermodynamics useful for describing chemical transformations	**P6S_WG**

K_W07	Has a general orientation in current directions of development in the fields of chemical engineering, as well as chemistry, chemical technology and chemical industry	**P6S_WG**
K_W08	Has elementary knowledge in the field of engineering disciplines related to chemical and process engineering	**P6S_WG**
K_W09	Has basic knowledge in the field of metrology as well as of control and measurement equipment	**P6S_WG**
K_W10	Has elementary knowledge necessary to understand social, economic, legal and other non-technical aspects of engineering activities	**P6S_WK**
K_W11	Has basic knowledge of management, including quality management and running a business	**P6S_WK**
K_W12	Has basic knowledge in the field of intellectual property protection, industrial property protection as well as in copyright and patent law	**P6S_WK**
K_U01	Is able to acquire information from literature, databases and other sources, also in a foreign language, draw appropriate conclusions and formulate own opinions	**P6S_UW**
K_U02	Is able to use computer programs supporting the implementation of tasks typical for chemical and process engineering	**P6S_UW**
K_U03	Is able to plan and conduct experimental research and analysis, as well as computer simulations using the appropriate tools and techniques and interpret the collected results	**P6S_UW**
K_U04	Is able to design basic apparatus used in the chemical and related industries	**P6S_UW**
K_U05	Is able to design and model the course of basic processes and unit operations used in the chemical and related industries	**P6S_UW**
K_U06	Is able to solve practical tasks in the field of chemical engineering based on engineering standards, as well as using experience gained in the chemical and related industries	**P6S_UW**
K_U07	Is able to read and prepare technical documentation in accordance with the principles of engineering graphics	**P6S_UW**
K_U08	Understands and can explain the physical and chemical bases of phenomena occurring during unit processes and operations	**P6S_UW**
K_U09	Is able to analyze the suitability of existing technical solutions and the way they work for the needs of specific industrial processes and operations	**P6S_UW**
K_U10	Is able to select raw materials and appropriate technologies and evaluate the possibility of waste management in the technological processes of the chemical and related industries	**P6S_UW**
K_U11	Is able to design processing operations of polymer materials on an industrial scale in accordance with technological principles	**P6S_UW**
K_U12	Is able to assess the risks associated with the use of chemical products and processes. Is aware and able to perceive non-technical aspects, including ethical and ecological aspects of engineering activities	**P6S_UW**
K_U13	Is able to make a preliminary economic analysis of enterprises in the field of chemical and process engineering	**P6S_UW**
K_U14	Is able to communicate using different techniques in professional environments and in other environments, also in a foreign language	**P6S_UK**
K_U15	Is prepared to work in an industrial environment and knows the safety rules associated with this work	**P6S_UK**
K_U16	Knows a foreign language at B2 CEFR level and is able to use a specialist language in the field of chemical and process engineering	**P6S_UK**
K_U17	Is able to present the results of own research and literature studies in the form of a self-made presentation	**P6S_UK**
K_U18	Is able to plan and organize his own work and work in a team that accomplishes a common task	**P6S_UO**
K_U19	Is aware of the responsibility for his own work and is able to comply with the rules of working in a team	**P6S_UO**
K_U20	Has the ability to self-education, raise professional competences and supplement his knowledge throughout his professional life	**P6S_UU**
K_K01	Is able to critically assess the state of own knowledge and is ready to consult experts in the face of difficulties in solving problems independently	**P6S_KK**
K_K02	Is aware of and understands the role of a chemical engineer in modern society	**P6S_KO**
K_K03	Is able to provide information about the achievements of chemical and process engineering as well as about various aspects of the engineering profession in a commonly understood way	**P6S_KO**
K_K04	Understands the need to act in an entrepreneurial way	**P6S_KO**
K_K05	Is able to responsibly fulfill professional roles by following the rules of professional ethics and caring about the profession and its traditions	**P6S_KR**

The description of learning outcomes includes learning outcomes referred to in the Act of 22 December 2015 on the Integrated Qualification System and takes into account universal characteristics of the first degree cycle specified in this Act and the characteristics of the second degree cycle specified in the regulations issued on the basis of Article 7, section 3 of this Act, including the learning outcomes related to foreign language skills whereas in the case of the course of study leading to the award of the professional title of engineer - a full range of learning outcomes enabling the achievement of engineering competences.

3. Study plans, their parameters, verification methods and educational content

3.1. Product design and engineering of pro-ecological processes

3.1.1. Parameters of the study plan

The total number of ECTS credits that a student must obtain in the course of classes conducted with direct participation of academic teachers or other persons conducting classes.	125 ECTS
The total number of ECTS credits allocated to classes related to scientific activity conducted at the university in a given discipline or disciplines to which the course of study is assigned.	116 ECTS
The total number of ECTS credits required to be obtained by a student in the humanities or social sciences for the courses of study assigned to disciplines within the fields of study other than the humanities or social sciences respectively.	5 ECTS
The total number of ECTS credits allocated to elective courses.	63 ECTS
Total number of ECTS credits allocated to work placements, internships (if the study program includes work placements or internships).	4 ECTS
Hours of apprenticeships, internships (if the study program provides for internships or apprenticeships).	160 h.
The total number of ECTS points that a student must obtain as part of a foreign language course.	9 ECTS

Number of hours of physical education classes.	60 h.

Detailed information about:

1. the relationship between learning outcomes and modular learning outcomes;
2. key learning outcomes in terms of knowledge, skills and social competences, demonstrating their relation to the discipline / disciplines to which the course is assigned;
3. the development of learning outcomes at the level of classes or group of classes, in particular related to the scientific activity conducted at the university;
4. learning outcomes in terms of knowledge, skills and social competences leading to the acquisition of engineering competences, in the case of study programmes on completion of which the student is awarded a professional title of engineer / Master of Engineering;

can be found in the Module Activity Sheets, available at the following URL: http://krk.prz.edu.pl/plany.pl?lng=EN&W=C&K=P&TK=html&S=1495&C=2020, which are an integral part of the study programme.

3.1.2. Plan of study

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/ Seminar	Sum of hours	ECTS	Exam	Mand.
1	ZB	Technical safety and ergonomics	15	0	0	0	15	1	N	
1	CN	General and inorganic chemistry	30	30	0	0	60	6	T	
1	ZH	Academic savoir - vivre	10	0	0	0	10	1	N	
1	FF	Physics	30	30	0	0	60	6	T	
1	ZM	Social competences	10	15	0	0	25	2	N	
1	FM	Mathematics	30	30	0	0	60	6	T	
1	CI	Machines theory and technical mechanics	30	30	0	0	60	4	N	
1	CM	Introduction to materials science	15	15	0	0	30	2	N	
1	ZO	Economic course	30	0	0	0	30	2	N	
Sums for the semester: 1			**200**	**150**	**0**	**0**	**350**	**30**	**3**	**4**
2	CN	General and inorganic chemistry	30	15	30	0	75	6	T	
2	FF	Physics	15	15	15	0	45	4	T	
2	CI	Computer engineering graphics (CAD)	15	0	45	0	60	4	N	
2	FM	Mathematics	30	30	0	0	60	6	T	
2	CI	Machines theory and technical mechanics	30	0	0	15	45	3	N	
2	EM	Metrology and industrial measurements	15	0	15	0	30	2	N	
2	CI	Packages of application software	0	0	30	0	30	2	N	
2	CB	Computer science	15	0	30	0	45	3	N	
Sums for the semester: 2			**150**	**60**	**165**	**15**	**390**	**30**	**3**	**4**
3	CN	Analytical chemistry	15	0	30	0	45	3	N	
3	CF	Physical chemistry	30	30	15	0	75	6	T	
3	CD	Organic chemistry	30	30	30	0	90	7	T	
3	CB	Scientific and technological information	0	0	2	0	2	0	N	
3	DJ	Foreign language	0	30	0	0	30	2	N	
3	FM	Mathematics	15	15	0	0	30	3	N	
3	CI	Fluid dynamics	30	30	0	0	60	5	T	
3	CB	Fundamentals of programming	0	0	30	0	30	2	N	
3	CB	Statistics and results elaboration	15	0	15	0	30	2	N	
3	DL	Physical Education	0	30	0	0	30	0	N	
Sums for the semester: 3			**135**	**165**	**122**	**0**	**422**	**30**	**3**	**2**
4	CF	Physical chemistry	30	30	30	0	90	7	T	
4	DJ	Foreign language	0	30	0	0	30	2	N	
4	CI	Fundamentals of heat and mass transfer	30	30	0	0	60	5	T	
4	CI	Fundamentals of chemical technology	30	30	0	0	60	5	N	
4	CI	Industry processes and process apparatus, process intensification	30	15	0	0	45	4	N	
4	CI	Parametric designing in Autodesk Inventor	0	0	20	0	20	2	N	
4	CI	Engineering thermodynamics	30	30	0	0	60	5	T	
4	DL	Physical Education	0	30	0	0	30	0	N	
Sums for the semester: 4			**150**	**195**	**50**	**0**	**395**	**30**	**3**	**1**
5	CF	Instrumental analysis	30	0	30	0	60	4	N	
5	CI	Diffusion separation processes	30	15	0	15	60	6	T	

5	CI	Product engineering	15	0	15	0	30	2	N	
5	DJ	Foreign language	0	30	0	0	30	2	N	
5	CK	Engineering materials	30	0	30	0	60	4	T	
5	CI	Computer Flow Dynamics (CFD)	0	0	0	30	30	2	N	
5	CI	Industry processes and process apparatus, process intensification	15	15	15	15	60	4	T	
5	CI	Heat transfer equipment design	15	0	15	15	45	2	N	
5	CM	Chemical technology	30	0	45	0	75	4	N	
Sums for the semester: 5			**165**	**60**	**150**	**75**	**450**	**30**	**3**	**1**
6	CS	Polymer chemistry and technology	30	0	30	0	60	4	T	
6	CI	Diffusion separation processes	15	15	15	15	60	6	T	
6	CI	Engineering of powder materials	15	15	0	0	30	2	N	
6	BT	Engineering of wastewater treatment processes	15	0	15	15	45	4	N	
6	CI	Engineering of the sustainable industrial procesess	15	0	0	15	30	2	N	
6	DJ	Foreign language	0	30	0	0	30	3	T	
6	CI	3D Computer Aided Design	0	0	0	30	30	2	N	
6	CI	Selected unit operation	30	15	15	15	75	7	T	
Sums for the semester: 6			**120**	**75**	**75**	**90**	**360**	**30**	**4**	**1**
7	CN	Environmental engineering	30	0	0	0	30	2	N	
7	CI	Renewable sources of energy and energy-saving technologies	30	0	0	15	45	4	N	
7	CX	Professional training	0	0	0	0	0	4	N	
7	CX	Engineering project	0	0	0	120	120	11	N	
7	CI	Process design	15	0	0	30	45	4	N	
7	CI	Chemical reactors	30	30	0	0	60	5	N	
Sums for the semester: 7			**105**	**30**	**0**	**165**	**300**	**30**	**0**	**0**
TOTALS FOR ALL SEMESTERS:			**1025**	**735**	**562**	**345**	**2667**	**210**	**19**	**13**

Note that not being granted credits from the modules marked with a red flag makes it impossible to make an entry for the next semester (even if the total number of ECTS credits is lower than the permissible debt), these are modules continued in the next semester or modules in which failure to achieve all assumed learning outcomes does not allow one to continue studies in the modules included in the next semester's study programme

3.1.3. Elective modules

The following modules are an extension of the table from the chapter 3.1.2. They can be chosen by students regardless of their specialisation / education path.

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/ Seminar	Sum of hours	ECTS	Exam	Mand.
2	ZE	Fundamentals of economics	30	0	0	0	30	2	N	
2	ZO	Fundamentals of management	30	0	0	0	30	2	N	
3	DJ	English (A)	0	30	0	0	30	2	N	
3	DJ	English (B)	0	30	0	0	30	2	N	
3	DJ	French (A)	0	30	0	0	30	2	N	
3	DJ	French (B)	0	30	0	0	30	2	N	
3	DJ	German (A)	0	30	0	0	30	2	N	
3	DJ	German(B)	0	30	0	0	30	2	N	
3	DJ	Russian (A)	0	30	0	0	30	2	N	
3	DJ	Russian (B)	0	30	0	0	30	2	N	
4	DJ	English (A)	0	30	0	0	30	2	N	
4	DJ	English (B)	0	30	0	0	30	2	N	
4	DJ	French (A)	0	30	0	0	30	2	N	
4	DJ	French (B)	0	30	0	0	30	2	N	
4	DJ	German (A)	0	30	0	0	30	2	N	
4	DJ	German(B)	0	30	0	0	30	2	N	
4	DJ	Russian (A)	0	30	0	0	30	2	N	
4	DJ	Russian (B)	0	30	0	0	30	2	N	
5	DJ	English (A)	0	30	0	0	30	2	N	
5	DJ	English (B)	0	30	0	0	30	2	N	
5	DJ	French (A)	0	30	0	0	30	2	N	
5	DJ	French (B)	0	30	0	0	30	2	N	
5	DJ	German (A)	0	30	0	0	30	2	N	
5	DJ	German(B)	0	30	0	0	30	2	N	
5	DJ	Russian (A)	0	30	0	0	30	2	N	
5	DJ	Russian (B)	0	30	0	0	30	2	N	

6	DJ	English (A)	0	30	0	0	30	3	T	
6	DJ	English (B)	0	30	0	0	30	3	T	
6	DJ	French (A)	0	30	0	0	30	3	T	
6	DJ	French (B)	0	30	0	0	30	3	T	
6	DJ	German (A)	0	30	0	0	30	3	T	
6	DJ	German(B)	0	30	0	0	30	3	T	
6	DJ	Russian (A)	0	30	0	0	30	3	T	
6	DJ	Russian (B)	0	30	0	0	30	3	T	

3.1.4. Verification methods of learning outcomes

Detailed rules and methods for the verification and assessment of learning outcomes that allow all learning outcomes to be verified and assessed are described in the Module Activity Sheets. Within the framework of a study programme, verification of learning outcomes is carried out in particular by means of the following methods: written, exam part practical, exam part oral, written pass, pass a part practical, oral pass, essay, colloquium, written test, observation of performance, portfolio, project presentation, written report, oral report, project report, written test.

Detailed information about the verification of learning outcomes achieved by students can be found in the Module Activity Sheets at the URL address: http://krk.prz.edu.pl/plany.pl?lng=EN&W=C&K=P&TK=html&S=1495&C=2020

3.1.5. Programme content

Programme content (educational content) is consistent with the learning outcomes and takes into account, in particular, the current state of knowledge and research methodology in the discipline or disciplines to which the course of study is assigned, as well as the results of scientific activity in this discipline or disciplines. A detailed description of the program content is available in the Module Activity Sheets at the URL: http://krk.prz.edu.pl/plany.pl?lng=EN&W=C&K=P&TK=html&S=1495&C=2020, which are an integral part of the study programme.

3D Computer Aided Design	K_W05, K_W08, K_U02, K_U07, K_U20, K_K01
• Connections of machine parts • Inventor settings and parameters • Inventor 2D modeling possibilities • Examples of the use of selected features of Inventor 3D space • practical exercises of 3D modeling • Fundamentals of stress analysis for model • Strength calculations of the element of chemical apparatus	
Academic savoir - vivre	K_W10, K_U18, K_U19, K_U20, K_K02, K_K03, K_K05
• Principles and norms of behavior in interpersonal relationships. The origin of the concept of etiquette. Legal and moral norms and custom. The universal rules of the etiquette.Personal culture.Importance of good morals in private and professional life.Stereotypy.Good manners and the image. • Classic savoir-vivre rules Fundamentals of priority and principles of its application. Forms of showing respect. Welcome - the rules and exceptions. Titles in the academic environment.Personal and business procedures.Preferred - rules and exceptions. Wishes and congratulations.Faux pas. • Communication etiquette. Standards of good behavior in interpersonal communication. Non-verbal communication. Telephone conversation label. Culture of correspondence.Network. Elegance of public speaking. • The importance of clothing in creating a positive image. Savoir vivre a choice of dress. General dress rules. Clothing accessories. Fashion and extravagance.The most frequent weaknesses in the selection of individual elements of the outfit.The right outer appearance as part of the positive image.	
Analytical chemistry	K_W06, K_U03, K_U08, K_U20
• Classification of analytical chemistry, scale, accuracy and precision of a method. Analytical errors, statistical evaluation of results. General scheme of quantitative analysis. Classification and characteristics of methods of chemical analysis. Theoretical basis of volumetric analysis. Alkacymetric. Reductometry and oxidimetry. Complexometry. Precipitation analysis, effects accompanying solid product separation. Chemical calculations and analyses in the field of volumetric and gravimetric methods. • Alkacymetric: determination of sulphuric acid concentration. • Redox: determination of Fe(II) in Mohr's salt, determination of Cu(II) concentration. • Complexometry: determination of Ca(II) or Mg(II) ionic concentrations. • Precipitation analysis: determination of Cl- ions concentration. • Chemical calculations in the field of volumetric analysis and gravimetric methods.	
Chemical reactors	K_W03, K_W05, K_W07, K_U05, K_U06, K_U20, K_K01
• Kinetics of chemical reactions. Reaction rate vs. concentration and temperature. Calculating the composition of the reaction mixture. • Chemical reactors - material balance. Periodic reactor. Methods of analysis of kinetic data. Simple and complex reactions in a batch reactor. • Continous stirred tank reactor. Cascade of reactors. Plug-flow reactor. Semi-continous reactor. Plug-flow with recycling of flux. • Comparison of reactors for simple reactions. Comparison of reactors for complex reactions.	
Chemical technology	K_W06, K_W07, K_W08, K_U06, K_U08, K_U10, K_U20, K_K01
• Introduction. Principles of Green Chemistry. Current trends in chemical technology. • Raw materials for chemical and petrochemical industry - reproducible, minerals and fossil. Processing of the basic renewable raw materials. • Selected inorganic chemical processes. • Processing of coal. • Processing of natural gas. Syngas and their utilization in fuel production. • Processing of oil. Production of fuels, olefins and aromatics . • Selected processes of the large scale industrial synthesis of organic chemicals. Production of methanol, vinyl chloride, styrene, terephthalic acid, ethylene glycol and others. • Conductiong of the six activities from the group: Synthesis of cyclohexanone oxime and caprolactam, adipic acid, dibutyl phthalate, Processing of raw materials: sugar from sugar beet, biodiesel from vegetable oil, furfural from bran, starch from potatos, cellulose wadding, essential oils . Caustification of soda. Phosphoric acid extraction from ore. Isolation of potassium chloride from sylvinite Preparation of soda ash Sulfur from sulfur ore	
Computer engineering graphics (CAD)	K_W08, K_U02, K_U07, K_U20
• Technical letter • Rectangular projections, axonometric views, views and sections. • Technical charts. • Rules for dimensioning. • Tolerance of dimensions, shape and position. • Determination of surface roughness. • Connections of the machines: separable and inseparable. • Assembly drawings. • Standardized graphical symbols and devices used in the processes of chemical technology. • Preliminary information, start AutoCAD and basic settings. • Creating a drawing template and drawing styles. • Exercises for features and commands of AutoCAD. • Examples of application AutoCAD specific functions. • Constraints - parametric drawing in AutoCAD • Creating technical drawings - projection and dimensioning of a complex geometric solids. • Drawing preparation and printing from the layout level. • Making production and assembly drawings of machines parts. • Reading the technical documentation.	
Computer Flow Dynamics (CFD)	K_W08, K_U02, K_U03, K_U20, K_K01
• Work in sketchpad mod. 2D modeling. Simplifying and repairing of geometry. Parametrization of geometry. • Mesh generation in Ansys Meshing software. Kinds of calculation meshes. Meshing algorithms. Control of quality and size of mesh. Methodology of mesh generation for CFD analysis. • Basics of Fluent Software. Determination of flow model. Determination of boundary conditions. Solver options. • Analysis and interpretation of results.	
Computer science	K_W08, K_U02
• Operating system Windows XP. Computer networks. Electronic mail. Internet basics. Searching for information on the Internet. Discussion groups. Internet aided education. • Microsoft Office package: Word, Excel, PowerPoint. Development of laboratory data. • Chemical structure editors. • Elaboration of a web page. • Definitions of basic concepts: the algorithm, computer program, computer system, informatic system, the operating system. The main components of a computer and their functions. Multiprocessor computer. • Operating systems and their types.	

Computer programs, utilities and tools. MS-Office programs: Word, Excel, PowerPoint. • Computer viruses, protection and prevention. Computer networks (Internet, Intranet). Telecommunications systems. Websites construction. Legal, ethical and social issues of computer science. • Representation formalisms of algorithms: data flow diagram, program flow diagram. Computer program development cycle: specification, design, coding, testing, documentation. • The basic elements of the configuration of software environment and compiler for C++. Construction of programs in C++. Declaration of variables and implementation section of the unit. Data types defined in C++. The concept of object. • Main control statements in C++. Static and dynamic variables. Computer memory management. Programming of branches and loops. The definition of procedures and functions. Program testing according to principles of software engineering	
Diffusion separation processes	K_W03, K_W05, K_U01, K_U05, K_U06, K_U08, K_U20, K_K01
• Absorption. Characteristics of the process. The equilibrium of gas - liquid. The mass balance of the process and the operating line. Methods of mass exchanger high calculation.Hydrodynamic diameter of the apparatus. Apparatus. Distillation and rectification. Liquid - vapor equilibrium for two-and multi-component systems . Simple distillation. Steam distillation. Adjustment of the two-component batch and continuous : the balance sheets, operating lines, minimum and maximum reflux, determination of the number of theoretical plates - graphical and analytical methods. Rectification of multicomponent mixtures. Design issues: the selection of the type of apparatus, the characteristics of the shelves and their efficiency, mass transfer coefficients , packed columns. Extraction in liquid - liquid systems. Basics of physico-chemical extraction : solubility equilibrium, partition coefficient, the selectivity of the solvent , the drip mechanism. Calculation of the mass transfer coefficients in the extraction process. Multi-stage extraction. Determination of the minimum , maximum, and optimal amounts of solvent. Calculating the number of degrees and their efficiency . Extraction column ternary systems : computing the height and diameter of the column . Apparatus . Topics exercises: closely related to themes presented in the lecture. Laboratory: Five laboratory exercises related to the topic of the course Projects : Students perform project of the the mass exchanger fluid - fluid system : the rectification column and/or absorber. • Drying processes. Thermodynamics of drying. The mass and heat transfer in drying processes. Ways of carrying out the process. Drying apparatus. Topics exercises closely related to the issues presented in the lecture.	
Engineering materials	K_W07, K_W08, K_U03, K_U08, K_U10, K_U20, K_K01
• Introduction to materials science • Metallic materials • Ceramic materials • Polimeric materials • Composites, properties of composites • Modulus of elasticity • Yield strength, tensile strength, hardness and ductility • Sudden cracking, toughness and fatigue of materials • The deformation and cracking as a result of creep • Flammability of construction materials • Methods of reducing the flammability of construction materials • Selection of materials • Determination of mechanical properties of fiber composites (1) and metal composites (2)during static stretching. Preparation of plastics by casting and characterization of obtained products. Grain size analysis of powders Water absorption, real and apparent density and porosity of ceramic materials. Determination of rheological properties of polymer compositions.	
Engineering of powder materials	K_W03, K_W05, K_W07, K_U03, K_U06, K_U08, K_U09, K_U20, K_K01
• Definition and classification of powders. Interparticle forces in powders: van der Waals, electrostatics and capillary adhesion forces. Adhesion force measurements methods. Comparison of adhesion forces for individual particles. Bulk powders and mechanical properties of powder bed. Methods for mechanical properties Industrial processes based on powder properties: mixing, granulation and tableting.	
Engineering of the sustainable industrial procesess	K_W08, K_W10, K_U08, K_U09, K_U10, K_U12, K_U19, K_U20, K_K02, K_K05
• Introduction to sustainable (environmentally friendly) industrial processes. Thermodynamic basis of sustainable development. • Chemical and physical indicators of environmental load. 12 principles of green chemistry. Rules of sustainable industrial process design. • Proces intensification. • Minimization of thermal energy consumption and raw materials through process integration.	
Engineering of wastewater treatment processes	K_W08, K_U05, K_U08, K_U20, K_K01
• Wastewater characteristics. Wastewater composition. Effluent disposal. Legislation on waste water treatment. Classification of wastewater treatment methods. Equalization of composition and flow rate. Screening. Bar racks and screens. The process of sedimentation. Grit chambers. Sedimentation tanks. Biological processes - characteristics, kinetics. Basics of modeling biochemical conversions. Removal of organic compounds and nutrients. The reactors used in wastewater treatment plants. Activated sludge method. Technological and technical parameters. Models of processes. Biofilters. Wastewater treatment in natural conditions in the soil environment and the use of plants. Wastewater treatment in natural conditions in the aquatic environment. Processes: flotation, filtration, coalescence, neutralization, adsorption, coagulation, oxidation, disinfection. Nitrification, denitrification, phosphorus removal (chemical, biological), integrated removal of the C, N and P. Methods for the anaerobic treatment of wastewater. Disinfection of wastewater. • Laboratory investigations selected wastewater treatment processes. • Project of municipal wastewater treatment plant,	
Engineering project	K_W07, K_U01, K_U03, K_U17, K_U19, K_U20, K_K01, K_K02, K_K03
• Getting to know the professional literature on the subject • Experimental measurements, the creation of a computer program or other work related to the use of research tools that are appropriate to the studied area and educational profile. Development of research results in the form of a written report. • Discussing how to prepare a multimedia presentation, rules for presenting papers. Presentation of the diploma project. Discussions after the multimedia presentation of the results of own research presented by students.	
Engineering thermodynamics	K_W03, K_W06, K_U06, K_U20, K_K01
• Equations of state of fluids, thermodynamic functions, characteristic processes for non-ideal liquids, thermodynamics of cooling and heating cycles. Equations of state for real solutions, thermodynamic functions for real solutions. Basics of equilibrium in multiphase systems, fugativity, activity, methods of calculation. Phase equilibrium for systems liquid-liquid, liquid-vapor, liquid-solid.	
Environmental engineering	K_W08, K_W10, K_U08, K_U12, K_U19, K_K02
• Fundamentals of ecology. The environment as a system. Cycles of oxygen , CO2, and N2 in nature. Chemical toxic substances in the environment and their biological impact. • Pollution- classification, transformation, the impact on the environment. Risks relating to atmosphere, hydrosphere and lithosphere (air, water and soil). Control and monitoring systems for the industrial environment. • Methods of chemical engineering in removing pollutants from flue gases and natural gas and sewage. Biological methods of wastewater treatment. Methods of disposal of solid impurities . Groundwater and their protection. • Industrial hazards - methods of protection and countermeasures. Environmental risk assessment and industrial risks . Safety management systems and the environment. • Energy production as an important environmental risk factor .Waste, division and classification of waste. Waste management. Hazardous waste management. • Environmental monitoring . Bioindication at the flora and fauna level. • Genetically modified organisms (GMOs). Bioethics.	
Fluid dynamics	K_W01, K_W03, K_W08, K_U05, K_U06, K_U20, K_K01
• Suplementary information from mathematics. Vector operations, Operator of gradient, divergence rotation. Integration along curves. Surface, volume integrals. Ordinal differential equations, sets of differential equations, method of integration. Partial differential equations, Furrier method of solution, method of Laplace transform. Ideal and real fluids, forces acting in fluids. Fluid statics, equilibrium conditions, Pascal, Euler, Archimedes laws. Fluid kinematics. Analytical methods of fluid kinetic. Continuity equation, Euler equation of motion. Laminar and turbulent flow. Boundary layer. General and differential momentum and mass balances. Navier-Stokes equation. Selected analytical solution of Navier-Stokes equation. Theory of turbulence- elements. Elements of rheology. Flow through porous media. Dimensionless analysis: Rayleigh method, Buckingham theorem, method of differential equations.	
Fundamentals of chemical technology	K_W03, K_W05, K_W07, K_U01, K_U06, K_U08, K_U20, K_K01
• Basic definitions. Principles of designing new technologies. Similarity theory and its application. • The properties of gases and liquids. The similarity of properties. Calculating methods of the properties of gases and liquids. • Chemistry of processes. Stoichiometry of reaction. Calculating the composition of the reaction mixture. Heat of reaction . • Chemical affinity. Chemical equilibrium concept and problems. The equilibrium composition of the reaction mixture.	

Fundamentals of heat and mass transfer	K_W03, K_W04, K_W05, K_U04, K_U05, K_U06, K_U19, K_U20, K_K01
• Energy transport. Steady and unsteady heat conduction. First Fourier low and its application. Differential energy balance, method of solution of energy balance equation. Heat convection, heat transfer, Newton equation, overall heat transfer. Energy transport by radiation. Energy transport by convection and radiation. Basics rules of heat exchanger designing. Mass transport. Steady and unsteady diffusion. First and second Fick law. Maxwell-Stefan equations for multicomponent diffusion. Differential mass balance. Exemplary analytical solution of mass balance equation. Estimation of diffusion coefficients. Mass convection, single-phase, two-phase mass transfer. Basics rules of mass exchanger designing. Theoretical one stage exchanger, multi stage exchanger, exchanger with continuous phase contact. Axial dispersion.	
Fundamentals of programming	K_U02, K_U20
• Getting to know the C++ programming environment. Creation a sample program to acquaint the structures, data types and the main control instructions in C++. • Preparation of the own program project and algorithm develop. Implementing the program using elements of object-oriented programming. Running and testing the computer program. Developing of the program documentation. Acceptation of the student work. • Getting to know the C++ programming environment. Creation a sample program to acquaint the structures, data types and the main control instructions in C++. • Preparation of the own program project and algorithm develop. Implementing the program using elements of object-oriented programming. Running and testing the computer program. Developing of the program documentation. Acceptation of the student work.	
General and inorganic chemistry	K_W06, K_U03, K_U08, K_U20
• Concepts and chemical laws. Struture of atom. Periodicity of chemical properties. Ionization energy, electron affinity, electronegativity. Metal and non-metals. Chemical bonds. Covalent bonds. Formal oxidation state. Molecular orbital and valence bond theory. States of matter. Phase transistions. Gas state. Ideal gas state equation. Units of matter. Solid state. Ionic and molecular crystals. Liquids and solutions. Units of concentration. Electrochemical processes and corrosion. Chemical equilibrium. Mass action law. • The basic calculations: fundamental laws. Concentration of solutions: way of expression, conversion of concentration, dilution and mixing of solutions. Stoichiometric calculations based on chemical reaction equation. Elemental and real chemical formula. Yield of reaction. Oxidation and reduction reactions. Gas laws. Reaction kinetics. Chemical static, mass action law, chemical equilibrium. • 1. Liquids and solutions. Colligative properties. 2. Electrolytes. Electrolytic dissociation. Strong and weak electrolytes. 3. Acids and bases. Ampholytes. Buffer solutions. 4. Thermochemistry and thermodynamics.5. Inorganic compounds, classification and terminology 6-9. Properties of elements. Inorganic compounds, preparation methods end properties. Main group metals (1, 2, 13). Elements of group 14-18. 10. D-block elements. Crystal field theory. Spectroscopic and magnetic properties. 11. F-block elements. 12. Complex compounds. Additional compounds. • 1. Electrolytic dissociation of strong and weak electrolytes. Activity and activity coefficient, ionic strength, ionic product of water, pH. 2. Dissociation constant and degree. 3. Buffer solutions. 4. Hydrolysis, the hydrolysis constant and degree. 5. Solubility product. • 1. Basic laboratory operations and equipment. Synthesis of inorganic compounds. 2. Classification of inorganic compounds. 3. Types of chemical reactions. 4. Solutions: preparation and concentration calculations. 5. electrolytes – electrolytic degree and constant, pH, alkacymetric indicators. 6. Buffer solutions. 7. Inorganic complexes. 8. Hydrolysis - the hydrolysis constant and degree. 9. Precipitation, dissolving and chemical conversion of solid compounds. 10. Oxidation and reduction reactions.	
Heat transfer equipment design	K_W03, K_W04, K_W05, K_U04, K_U05, K_U06, K_U08, K_U20, K_K01
• Heat exchangers: principles of operating, construction of exchangers, energetic balances, driving force in heat exchangers: co -current, countercurrent and cross-flow exchangers, wall temperature, calculation of area of heat transfer. Evaporators: evaporation of solutions, evaporation in industry, energetic and mass balances, multistage evaporation, temperature loses in multistage evaporators. • Design of heat exchangers rusing simulation software ASPEN PLUS. • Handling simple equipment for heat exchange, determining heat transfer coeffcients	
Industry processes and process apparatus, process intensification	K_W03, K_W04, K_W09, K_U04, K_U05, K_U06, K_U09, K_U20, K_K01
• Classification of unit operations and process apparatus. Introduction to design and intensification of unit operations. • Intensification of flow processes in simple systems: flow parameters; the effect of flow turbulence on efficiency and cost of processes. • Transport of liquids and gases. Rotodynamic and positive displacement (piston) pumps. Suction and pumping heights. Pumps characteristics. Pumps systems. • Rotodynamic and positive displacement (piston) pumps. Gas compressors. Special pumps and comprssors. Vacuum pumps. • Introduction to fluid flow in complex systems. Dispersed phase characteristics. Comminution of solids and apparatus. Phase contacting methods: in fixed bed, fluidization and pneumatic conveying. • Introduction to mechanical phase separation methods: drag force and falling velocity. • Phase separation methods: sedimentation, filtration, flotation, filtration and centrifuge separation, dust removal. Thickeners for preconcentration, classifiers, filters and centrifugal separators, dust separators. • Mixing of liquids. Power consumption. Stirrers and mixing vessels. • Intensification of unit operations and assessment of construction functionality and process adequatelity of the basic equipment and apparatus types for chemical industry: heat exchangers, evaporators, crystallizers, distillation units and rectification towers, absorbers and adsorbers, extractors and dryers. • Life cycle assessment for product, equipment and industrial installation	
Instrumental analysis	K_W06, K_U03, K_U08, K_U20
• The role and tasks of instrumental analysis in industrial processes. Samples acquisition, storage and preparation for analysis. Classification of instrumental methods. Calibration and calibration plots. Errors of analysis, classification, source and minimization of errors. Optical methods. Polarimetry. Quantitative analysis of elements and compounds using spectroscopic methods. Atomic Emission Spectroscopy - theoretical principles, excitation sources, apparatus, ICP-AES and GDL-AES spectrometers. Atomic Absorption Spectroscopy (AAS) principles and applications. Absorption spectroscopy in UV/VIS. IR absorption spectroscopy - application in quantitative and qualitative analysis of organic compounds. Basic principles of magnetic nuclear resonance. Structural and quantitative analysis on the base of 1H-NMR spectra. Principles of mass spectrometry of organic compounds. Interpretation and analytical application of mass spectra. Chromatographic methods - definition and classification. Chromatography theories and their use in practice. Gas chromatography - influence of chromatographic conditions on separation process and analytical performance. Practical applications. High performance liquid chromatography (HPLC). Apparatus and separation techniques: gradient elution and mobile phase programmed flow speed. Optymalisation of separation processes - theory and practice of stationary and mobile phase selection and separation parameters. HPLC applications. Electroanalytical methods. Potentiometry - principles and instrumentation. Construction, principles of operation and applications of chosen ion-selective electrodes (ISE). Voltammetric methods - the main techniques. Selected applications of voltammetric methods in laboratory and industrial analysis. Conductometry - definition, instrumentation and application. Complementarity of instrumental methods. Hyphenated methods. Criteria of choice of the analytical methods. • Determination of elements by using the atomic absorption spectrometry (AAS). Determination of organic compounds using absorption infrared spectroscopy. Determination of chemical substances using absorption spectriscopy in UV/VIS. Analysis of mixtures of organic compounds with application of 1H-NMR spectroscopy.	
Introduction to materials science	K_W03, K_W08, K_U01, K_U20
• Lecture: Introduction, definition of material, classification of materials in terms of arrangement, -crystals and glasses. The basic terms of crystallography: (space lattice, crystal axis, unit cell, space points, lines and planes). Miller indices of planes, directions in a crystal lattice. Crystallographic systems. Fourteen Bravais. Atom radius and ion radius. Coordination numbers and figures. Symmetry of crystals. Elements of group theory. Classification of crystals in terms of chemical bonding (ionic crystals, covalent crystals, metal crystals, molecular crystals). The most important structures of elements and chemical compounds. Real crystals. Monocrystals and polycrystals • Bravais lattice. Crystal lattice nodes. Symbols of lattice directions and symbols of lattice planes in crystals. Belt of planes. Symmetry in crystals and combination of symmetry. • Classification of crystals in terms of chemical bonding (ionic crystals, covalent crystals, metal crystals, molecular crystals). The influence of chemical bonding and crystal structure on the material properties. • Dense structure pose. Octahedral and tetrahedral gaps. The main crystal structures of elements and chemical compounds. Allotropy and polymorphism • Real crystals. Point defects, dislocations, plane defects. Single crystals and polycrystals. Grain boundary. • .Classes: Symbols of lattice points, lattice directions and lattice planes. Volume and crystallographic density of an unit cell. Atom radius and ion radius. Elements of crystal symmetry. Structures of dense spacing. Real crystals.	
Machines theory and technical mechanics	K_W04, K_U04, K_U06, K_U18, K_U19, K_U20, K_K02

• Basic terms and concepts of mechanics. • Flat, convergent arrangement of forces. • Moment of force. • Reduction and equilibrium of planar systems forces converging and arbitrary. • The sliding and rolling friction. • The center of gravity. • The moment of inertia. • Basic terms and concepts of the strength of materials. • Mechanical properties of construction materials. • Basic cases of stress: compressive, tensile, shear, torsion, bending, buckling, complex strength. • Plane trusses • General rules of designing and construction of chemical apparatus • Standards and standardization, law regulations by Polish Office of Technical Inspection (UDT) • Basic constructive materials used in construction of chemical apparatus: steels and iron-base alloys, other metallic materials, plastics, glass and ceramics, wood. Criteria and rules of constructive material selection. • Machines review and basic machine parts of general purpose: joints, shafts and axles, bearings, couplings, brakes, gears and drives together with their calculation and selection rules • Basic chemical apparatus parts: bodies (shells), heads, connector pipes, openings, vessel accessories, pipelines and their parts, seals and valves together with their calculation and selection rules	
Mathematics	K_W01, K_U20
• Elements of mathematical logic and set theory. Basic properties functions of one real variable, polynomials, Horner's scheme, rational functions and other elementary functions, arc functions. • Sequences of numbers: monotonicity and boundedness of sequences, limit of a sequence, theorems about existence of a limit, Napierian base and its applications. Series of numbers: properties of series of numbers, tests for convergence of series, tests for divergence of series. Limit and continuity of function of real variable: definitions of limit, counting properties of limits of functions, notion of continuity of a function. Asymptotes of a function. • Differential calculus of function of one real variable: notion of derivative of function, derivatives of higher order, derivatives of basic elementary functions, derivative of composite function, De l'Hospital's theorem, mean value theorems, investigation of monotonicity and determination of extrema of functions, convex and concave functions, points of inflexion of graph of function, investigation of the behavior and systematic procedure in graphing of function. • Integral calculus of function of one real variable: notions of primitive function and indefinite integral, integration by parts and by substitution, integration of rational functions, integration of irrational functions, integration of trigonometric functions. Notion of definite integral, applications of definite integrals, improper integrals. • The set of complex numbers: canonical and polar form of a complex number, de Moivre's formula, calculation of power and root of complex numbers. • Matrices: definition, operations on matrixes and its properties, square matrices, determinant and its properties, inverse matrix, rank of a matrix. Systems of linear equations: Kronecker-Capelli's theorem, Cramer's systems. • Ordinary differential equations: notions of general solution and particular solution, initial-value problem, ordinary differential equations of first-order (about separable variables, linear, homogeneous respect to x and y, linear), ordinary differential equations of second-order reducible to equations of first-order, linear equations. • Elements of calculus of vectors and analytic geometry: vectors, operations on vectors and its properties, scalar product of vectors and its properties, vector product and triple scalar product of vectors, equations of a plane and of a straight line in the space. • Basic properties of function of several variables: limit and continuity of functions of several variables, partial derivatives, extrema of functions of several variables. Elements of field theory: scalar and vector fields, gradient, divergence, rotation, potential of vector field. Double and triple integrals - basic concepts. • Relationship of systems of first order differential equations with scalar differential equations of the n-th order. General methods of solving systems of ordinary first order differential equations. Method of elimination, method of first integrals. • Systems of linear first order differential equations. Methods of solving first-order linear differential equations with fixed coefficients and the method of constituting solids for solving non-homogeneous linear systems. • Initial and boundary problems for partial differential equations. Linear and quasi-linear partial differential equations of the first order. • Fourier series. Trigonometric series. Extension in the Fourier series. Convergence conditions of the Fourier series. • The canonical form of the differential partial differential equation of the second order. Fourier method of solving differential differential equations.	
Metrology and industrial measurements	K_W08, K_W09, K_U14, K_U20
• Basic concepts of law and industrial metrology. Historical outline. International System of Units. Standards of physical quantities. • Defining of the measurand and mathematical model of measurement result. Direc and indirect measurement method. Validation of the measurement method. • Basic measurement equipment: digital multimeter, sensor, transducer, meter. Metrological properties of the measurement equipment. Basics of operation of measurement instruments and performing of correct measurements. • Essential concepts of measurement result: accuracy, error, uncertainty, trueness, precision, repeatability, reproducibility. • Indicated value, measured value, measurement error, instrumental error, measurement method error, correction factor. Uncertainty of measurement result. • Ways of declaration of accuracy of measurement equipment. Static characteristic, non-linearity. Relative and absolute maximum permissible error of indication. • Estimation of standard uncertainty with method type A and method type B. Calculation of combined uncertainty and expanded uncertainty. • Verification, calibration, legalisation and adjustment of measurement equipment. Analysis of the manufacturing process capability. Process quality indexes and measurement equipment capability indexes. • Types and specifity of casual, cognitive and verification measurement. Using of the physical quantity standard and the certificate of calibration during measurement. Industrial measurements of temperature, pressure, flow and level. • Notation and interpretation of measurement result. Traceability of the measurement result. Quality, reliability and applicability of performed measurement.	
Organic chemistry	K_W06, K_U03, K_U08, K_U20
• Structure and isomerism of organic compounds. Efects of electronic displacements versus explanation of properties of organic compounds. Classification of organic compounds. • Basis of chemical nomenclature. • Saturated and unsaturated hydrocarbons (alkene, alkadiene and alkyne). Aromatic hydrocarbons – derivatives of benzene. Halogen derivatives of hydrocarbons. Alcohols, phenols and ethers. Aldehyde and ketones. Mono- and policarboxylic acids. Halo-, hydroxy- and oxoacid. • Derivatives of carboxylic acid (halogens, anhydrides, amides). Esters (soap, fats, ester condensation). Nitro compounds and amines. Azo- and diazocompounds, isocyanates. Aminoacids, peptides, proteins. Carbohydrates. Polymers. • Synthesis, separation and purification of some organic compounds and determination of basic physical properties.	
Packages of application software	K_W08, K_U02, K_U03, K_U20
• Application of MS Excel to discretize functions, create simple and advanced plot charts, perform array operations, simple statistical analysis, operations with macros and to solve chemical problems and model simple chemical processes using solver tool. • Application of Origin Lab software to prepare professional 2D and 3D charts, to perform statistical processing of experimental data, to estimate parameters for equation describing experimental data, to perform differentiation and integration of discrete functions • Application of Matlab and/or Maple programs for arithmetic calculations, algebraic transformations, solution of linear and nonlinear equations, inequalities and systems of equations, symbolic and numerical function integration and differentiation, matrix algebra, solving differential equations, graphing functions of one and two variables. Introduction to Programming in Matlab and/or Maple. Creation of simple programs for solving selected mathematical problems. • Application of ChemSketch software to create and edit chemical structures	
Parametric designing in Autodesk Inventor	K_W08, K_U02, K_U03, K_U20
• Autodesk Inventor interface • Parametric drawing of figures on the plane - use of geometric and dimensional constraints • Different drawing methods for obtaining the same solid model • Detecting and correction of mistakes • Tools for creating and modifying 3D elements • Construction elements • Saving the components of the designed unit • Unit assembly of parts - defining degrees of freedom, unit constraints and movement • Using the base of ready-made elements • Creating two-dimensional documentation • Individual design of chemical equipment element • Autodesk Inventor interface • Parametric drawing of figures on the plane - use of geometric and dimensional constraints • Different drawing methods for obtaining the same solid model • Detecting and correction of errors • Tools for creating and modifying 3D elements • Construction elements • Determining the properties of subassembly • Saving the components of the designed unit • Unit assembly of parts - defining degrees of freedom, unit constraints and movement • Using the base of ready-made elements • Creating two-dimensional documentation • Individual design of chemical equipment element	
Physical chemistry	K_W06, K_U03, K_U08, K_U20
• The theory of perfect gases. Equations of state. Dalton's law and Amagat's law. The theories of real gases. The kinetic theory of perfect gases. Chemical thermodynamics. System. Surroundings. Work. Heat. Cyclic processes. Reversible processes. Isothermal reversible expansion of a gas. The first law of thermodynamics. Internal energy. Enthalpy. Heat capacity of gases, liquids and solids. Thermochemistry. Enthalpy of formation of compounds. Heat of solubility. Bond energy. The temperature dependence of reaction rate on temperature. The second and the third law of thermodynamics. Spontaneous transformations. Carnot cycle. Entropy. Entropy changes in reversible and irreversible processes. Entropy of mixing. Gibbs energy. Helmholtz energy. Differentials and derivatives of thermodynamic functions. The influence of pressure and temperature on free energy. Thermodynamic criteria of spontaneity of processes. Partial molar quantities. Chemical potential. Interatomic and intermolecular interactions. Viscosity and surface tension of liquids. Phase equilibria and diagrams. Three-component systems. Phase rule. Clapeyron equation. Clausius-Clapeyron equation. Vapor pressures over ideal solutions. Vapor pressures over real solutions. Solubilities of gases and liquids.	

Thermodynamics of ideal solutions. Activity. Activity coefficient. Boiling temperature – composition diagrams of two-component solutions. Azeotropes. Colligative properties. Diffusion equations. Viscosities of liquids and gases. Colloidal systems and surfactants. Physicochemical properties of colloids. Chemical equilibrium. A thermodynamic equilibrium constant. Chemical equilibrium in gas phase. Gibbs energy function. The influence of pressure and temperature on chemical equilibrium. • Physicochemical calculations connected with theory of perfect and real gases, chemical thermodynamics, phase equilibrium, colligative properties of solutions. • Chemical kinetics. The rate and the order of reaction. Zero, first, second, third and fraction order reactions. Determination of reaction order and rate constant. Dependence of reaction rate and reaction rate constant on temperature. Arrhenius theory and transition state theory. Kinetics of complex reaction. Kinetics of enzymatic reaction. Basics of katalysis. Gibbs-Duhem equation. Gibbs adsorpion equation. Adsorption. Adsorption theories. Langmuir, Freundlich and BET equation. Surface catalytic activity. Electrolyte solutions. Debye-Hückel theory. Activity of electrolyte solutions. Specific and molar conductance of strong and weak electrolytes. Transport numbers. Ionic mobility. Thermodynamics of electrolyte solutions. Electrochemistry. Semicells and electrochemical cells. Conventions. Electrode potential. Chemical reactions in semicells. Nernst equation. Electromotive force of electrochemical cells. Thermodynamics of electrochemical cell. Physicochemical aplications of electrochemical measurements. Batteries and fuel cells. Theoretical basics of molecular spectroscopy. Symmetry elements. • Physicochemical calculations connected with chemical equillibrium, chemical kinetics of simple, complex and enzymatic reactions, theory of electrolyte solutions, ionic conductance and electrodics. • Determination of evaporation enthalpy of a high-boiling liquid. Determination of phase equilibrium in three - component system. Determination of boiling temperature – composition diagram for chloroform – acetone system. Determination of reaction order and rate.Determination of thermical activation of a chemical reaction. Determination of distribution coefficient. Determination of surface tension of liquids. Determination of adsorption isotherm. Determination of limiting molar conductivity of electrolyte solution. Determination of ΔG, ΔH and ΔS of chemical reaction.	
Physical Education	K_U18, K_U19
• Acquainting with the rules of participation in classes and the conditions for obtaining a pass. Discussion of the principles of safe use of sports facilities and equipment and safety rules in force during the course. • Implementation of various sets of warm-up exercises and exercises focused on developing the student's basic motor skills. • Shaping general physical fitness, motor coordination, endurance, flexibility, speed through individual selection of sports activities (eg: football, volleyball, basketball, table tennis) or recreational physical activity (eg: badminton, gym exercises). • Physical fitness test: Multistage 20 m Shuttle Run (Beep test). • Acquainting with the rules of participation in classes and credit conditions. Discussion of swimming pool conditions and safety rules applicable during exercise in the aquatic environment. • Initial adaptation to the aquatic environment: - face dipping, eye opening and orientation under the surface of the water, - mastery of breathing in the aquatic environment, familiarization with the buoyancy of water, - control of lying on the breast and back, - plays and games in water. Warm-up exercises, preparing for exercises in water. Learning how to behave in water in difficult and unusual situations: choking, shrinkage, sinking, etc. • Learning backstroke style: lying on the back, slipping, correct leg work with a board on the hips and without a board, proper work of the arms. Improvement of proper coordination of lower and upper limbs. Learning free style: slipping on the chest, proper leg work combined with breathing, exercise with a board and without a board. Learning the proper work of the arms (swimming with a proper body with a proper breath and exhalation). Learning how to coordinate the work of lower and upper limbs with the determination of proper breathing. Learning breaststroke style: proper work of legs with a board and without boards on the chest and on the back, correct work of arms in a classic style. Coordination of lower and upper limbs and breathing in a classic style. Learning to jump on the legs and on the head. • Fitness test: a 25-meter swimming trial chosen by the student.	
Physics	K_W02, K_U08, K_U20
• Measurements and physical units. Dimensional analysis. Functions of one and several variables. Scalars and vectors. Derivatives in physics. Coordinate Systems. • Motion along a straight Line, Motion in two or three dimensions, kinematics of rotational motion. Newton's laws of motion, Applying Newton's laws Work, power and energy, Potential energy. Conservative forces Momentum, Impulse, and Collisions Dynamics of Rotational Motion, Rotation of Rigid Bodies • Periodic motion, differential equations and complex numbers in physics, resonance. Mechanical waves, wave phenomena, acoustics: sound and hearing • Fluid Mechanics, Introduction to thermodynamiscs: temperature and heat, Thermal properties of matter, Laws of thermodynamics, entropy • Introduction to physical laboratory classes. The uncertainty of the measurements. • Introduction to electromagnetism: Electric charge and electric field, Gauss's law, Work and electric potential. Capacitance and Dielectrics. Conductors, electric current, resistance, circuits and Electromotive force . Magnetic field. The Lorentz force. A electric charge and current-carrying wire in magnetic field. The magnetic field induced by current flow. Hall effect, Cyclotron, mass spectrometer. The phenomenon of magnetic induction. • Electromagnetic waves: dispersion, Interference, diffraction, polarization. Application of optics. • Introduction to modern physics and quantum mechanics, wave-particle duality of light and matter, probability and uncertainty principle Schrodinger equation, free particle, parlicle in potential well, stationary states, atomic structure, condensed matter Introduction to nuclear physics, nuclear reactions, nuclear power, stability and radioactivity, biological effects of radiation	
Polymer chemistry and technology	K_W06, K_W07, K_W08, K_U01, K_U03, K_U06, K_U08, K_U10, K_U12, K_U18, K_U19, K_U20, K_K01
• Introductory remarks; classification of polymers according to Carothers and Flory; examples of polymer types; nomenclature • Historical outline of polymer industry and the polymers produced in the largest quantity. • Thermodynamic and kinetic conditions of polymerization processes.Structure of macromolecules vs. physical properties of polymers • Condensation polymers. Mechanism of polymerization. Main types of commercial condensation polymers • Radical polymerization. Large scale polymers produced by radical polymerization. • Ionic polymerization of unsaturated monomers • Copolymerization. Copolymers produced on industrial scale • Oxirane polymerization. Commercial polymers produced by ring-opening oxirane polymerization. • Polymer tacticity. Coordination polymerization. Polyolefins • Reactions on polymers. Chemical modification of polymers • Native polymers. Biopolymers • Synthesis of selected groups of polymers • Modification of polymers. Identification of main groups of polymers	
Process design	K_W03, K_W05, K_U02, K_U03, K_U05, K_U09, K_U20, K_K01
• Introduction to methods of designing integrated systems technology. Characteristics of simulation software and simulation strategy. Definitions and calculations organization. Basic rules for the selection of thermodynamic models. • Introduction to simulation calculations of technological processes (flow of information, analysis of degrees of freedom, the models selected processes, classification of simulation methods, numerical computation, useful options - design specifications, sensitivity analysis. The calculation of the physicochemical properties of the solutions. • Selection rules and parameters of the processes, apparatuses, the selection of the reactor and the reaction parameters, the separation process - the base. The calculation of chemical reactions and reactors. Calculation of the heat exchangers. • Criteria for evaluation of the project - "pure" chemical technology. Hierarchical method, an example application. Basics of simultaneous methods. Calculation of separators with two liquid phases. • Design Heuristics. The calculation of basic unit operations and analysis of the results (flash calculations, distillation, extractive distillation, absorption). • Systems design process - the base, the scope of the initial project, the organization of the design process, the evaluation criteria the technological system, basic system design strategies. Calculation of pipeline networks and their elements. The calculation of the basic operations of fluid transport (pumps, compressor, expander, valves). • The use of sensitivity analysis as a tool for selection of parameters of the apparatus. • Optimization calculations of the distillation columns.	
Product engineering	K_W03, K_W08, K_U03, K_U05, K_U06, K_U20, K_K01
• Features and properties of the chemical product. Classification of chemical products. Kotler product concept. Basic principles of product design and development. Identifying customer needs. Reverse transformation and forward transformation in product design. Market power of Porter. Fundamentals of market segmentation. Product positioning. Product design for the environment. Identification of product quality features. Methodology House of Quality in product design. Colloidal products, emulsions, emulsion stability, emulsifier selection. Nanotechnology in product design. Simulation and experimental methods i product design. Solvents design. Designing of building materials. Design of adhesives. Designing of fibrous materials.	
Professional training	K_U12, K_U14, K_U15, K_U18, K_U19, K_U20, K_K01, K_K02, K_K05
• Training on safety work and anti fire regulations in plant/company/institution. Extending of knowledge gained on university in practical way. Introducing to work of plant/company/institution and with their internal procedures. Preparation to job in future.	
Renewable sources of energy and energy-saving technologies	K_W08, K_U06, K_U08, K_U10, K_U12, K_U13, K_U20, K_K01

• BIOMASS, BIOGAS, BIOPALIWA • Energy potential of biomass. Energetic use of biomass. Biomass combustion, combustion chemistry. Possible scales of the combustion process. Energy crops. Combination of energy crops and sewage treatment plants. Wood and straw as energy. • Main sources of biogas capture and management: waste water treatment plants, landfills, and farms. Possible scales of biogas production process. Advantages and disadvantages of biogas energy production. • Characteristics and overview of currently used fuels for internal combustion engines. • The problem of energy self-sufficiency in agriculture. • Synthesis of biofuels. Substrates, products, by-products and waste in the technological process. • Biofuels Act. SOLAR ENERGY - THERMAL USE • use of solar thermal energy • solar collectors - theoretical foundations, construction, design, • Passive Solar Energy Systems, • methods of storing heat energy, • Heat pumps and their use for solar energy. SOLAR ENERGY - PHOTOVOLTAIC USAGE Photovoltaics. Types, Economics. Application. HYDRO POWER ENGINEERING • hydrogen as fuel • hydrogen storage • fuel cells GEOTHERMAL POWER ENGINEERING • characteristics of geothermal sources, • ways of using geothermal energy, • Polish geothermal resources. • geothermal installations operated in Poland WATER ENERGY • large hydro power plants, • small hydropower, • Ocean power plants. WIND POWER • Wind energy characteristics, • overview of wind turbine structures, • development of wind energy in Poland and in the world. RENEWAL OF ENERGY USE • Energy-saving technologies in the chemical, • minimizing energy consumption through process integration, • use of waste heat, • energy auditing of industrial facilities. • Low temperature heat pumps, heat transformers, OTEC NATURAL GAS Natural gas and biogas. Ecological characteristics of natural gas. COMPARISON OF RENEWABLE AND CONVENTIONAL ENERGY Nuclear power (radioactive waste, process economics) The future of Polish power industry. Comparison of traditional and renewable energy sources. Importance of science in the development strategy of Poland. Solar ether and hydrogen power. Power Generation Models. Economies of scale. Soft and hard technology. Energy failures. Decentralization of energy sources.

Scientific and technological information	K_U01, K_U02
• Searching for information on the most abstracts and bibliographic important publishing houses (Chemical Abstracts) with the use of index. Search for chemical information in scientific journals available on-line from the Rzeszów University of Technology library.	
Selected unit operation	K_W03, K_W05, K_U05, K_U06, K_U08, K_U19, K_U20, K_K01
• Mechanisms of mass transfer. Diffusion equation and its application. The mass balance in the system liquid-solid • Mass transfer for fluid flow around solid particle for small and large values of Reynolds number. Mass transfer and natural convection. • Objectives and methods of the dissolution process. Basic concepts. The kinetics of dissolution. Different methods of dissolution. • Objectives and methods of crystallization. Basic concepts. Growth of crystals. Phase equilibrium . Mass and heat balance. Special methods of crystallization. • Objectives and methods of membrane processes. The structure and preparation of membranes. Classification of membranes. The driving force and transport resistance. Models of mass transport in the membrane. Applications of membrane processes. • Presentation of commercial apparatus and techniques for mass transfer processes. • Computing procedures and methods for the typical process of mass transfer	
Social competences	K_W10, K_U14, K_U17, K_U19, K_K02, K_K03, K_K05
• Social and interpersonal competences as an ability to achieve social and individual goals while maintaining good relations with interaction partners • Components of social competences • Competencies determining the effectiveness of behavior in the situation of social exposure • Strategies for image formation and self-presentation • Conditions of interpersonal skills and the importance of social competences • Improving skills and abilities relevant to social competences (assertive, cooperative, social, and social resourcefulness) • Developing and improving skills and abilities relevant to social competences (mutual understanding and getting to know each other, creating a climate of mutual trust, helping and influencing, solving problems and conflicts) • Developing and improving skills and abilities essential for social competences (communication skills, assertive skills, skills to strengthen, sustain others, self-expression skills) • Developing and improving skills and abilities relevant to social competences - verbal and non-verbal communication • Improvement of the skills of beneficial self-presentation (especially in professional conditions) • The importance of social competences	
Statistics and results elaboration	K_W08, K_U02, K_U20
• LIMS (Laboratory Information Management System) – selected problems. • Experimental database. Rejection outliers in data. Selective use of data. • Exploratory data analysis of the analytical measurements, descriptive statistics, cross-sectional data, normality tests, statistical graphs. The frequency distribution of a variable. • Statistical hypothesis testing. Parametric and non-parametric tests. • Multiple regression. Study of correlation between variables. • One-way and multiple analysis of variance. Discriminant analysis, factor analysis and principal components analysis. • Fitting the observed variable distribution to a theoretical distribution. • Management of Statistica program data. Parameters of variable distribution. • Study of empirical variable distribution. Statistical inference- nonparametric tests. • Statistical inference- parametric tests. • Analysis of the relationship between variables: linear and non-linear regression. • Analysis of Variance.	
Technical safety and ergonomics	K_W08, K_U12, K_U15, K_K02
• Legislation in the field of labour protection, including the following: the rights and responsibilities of students and staff in the field of safety and liability for violation of safety rules and regulations, liability for accidents, the legislation concerning insurance benefits for safety violation and accidents at work. • Responsibilities of the university in the provision of safe and healthy learning environment: health and safety requirements for school buildings, the requirements for systems and equipment located in the building of the university. • Subject matter and scope of work safety and ergonomics. • Security in terms of the system (security as a management objective, as a legal obligation, a moral norm). • Models of accidents at work (the classic models of accidents, near misses models, modelling human behaviour in emergency situations). • Statistical and behavioural theories of safety. • Ergonomic aspects of the system human – machine – environment. • Assessment of the reliability of the systems: human – computer, driver – car, pilot – airplane, as real cases of human – machine systems. • Methods for measuring the burden of dynamic physical labour and static physical labour. • The study of the burden of mental work. • Dangerous and harmful factors connected with work process and working conditions. • Risk assessment in a selected work position. • Ergonomics in the shaping of working conditions (some ergonomic principles and recommendations for the design of the spatial structure of the workplace, indication and control devices, technological processes, objects). • Ergonomic factors in the organization of work. • Ergonomic assessment of machinery and equipment and improving working conditions. • University rules of conduct in case of accidents and emergencies (fire, accident, etc.) pre-medical aid rules in the event of an accident, fire protection (including evacuation).	

programme content of elective modules

English (A)	K_U14, K_U16, K_U20
• Talking about yourself, famiy, home, likes and dislikes. Question forms. • Talking about important dates and events. Writing formal and informal emails. • Discussing differences between men and women. Expressing opinions. • Describing people. Revision of verb tenses: present and past simple, present and past continuous. • Talking about yourself. Conversation and interviews. • Giving advice on succsessful interviews. Talking about yourself. • Talking about films. Expressing opinion about films. • Talking about life experiences. Verb tenses: present perfect and past simple. • Talking about the media and news. Expressing opinion on conspiracy theories. Matching headlines with explanations. • Talking about stories from the past. Writing a news report. • Talking about lying. Collocations with 'say' and 'tell'. • Tellling a story or anecdote from the past. Listening to people telling anecdotes. • Phrases to describe a good/bad experience. Talking about memorable moments. Writing about one of your happiest memories. • Expressing opinions.Talking about problems of teenagers and their parents. • The future (plans): the present continuous, going to, will, might. Writing messages; learn to use note form. • The future (predictions): will, might, may, could, going to, likely to. Future time markers; idioms • Listening to predictions about the future of communication. Talking about how things will change in the future. • Reading a short story about a misunderstanding. Dealing with misunderstandings. Types of misunderstandings; phrases to clarify/ask someone to reformulate • Listening to telephone conversations involving misunderstandings. Learning to reformulate and retell a story about a misunderstanding. Role-playing resolving a misunderstanding. • Reading an article about millionaires. Modals of obligation: must, have to, should. • Discussing the qualities needed for different jobs. Completing a survey and discussing the results. • Reading about childhood dreams. Reading job advertisements. Used to and would. • Listening to two people describing dream jobs gone wrong. Talking about past habits. Writing a covering letter. • Reaching agreement. Business collocations. Phrases to give opinions, • Listening to people making decisions in a meeting. Learning to manage a discussion; Participating in a meeting and creating a business plan. • Office conversation; phrases to describe routines. Describing a day in your life. • Reading an article about how technology changed the world. Comparatives and superlatives. Vocabulary: technology. • Discussing how technology has changed the world. Talking about different types of transport and their uses. Writing an advantages versus disadvantages essay. • Talking about future hopes and plans. Grammar: Future Perfect, Future Continuous. • Listening to people answering difficult general knowledge	

questions. Doing a short general knowledge questionnaire; answering questions on your area of expertise. • Polite requests. Problems and solutions. • Listening to conversations about technical problems. Learning to respond to requests. Role-playing asking and responding to requests. • Reading about basic emotions. Zero and first conditionals. -ing versus -ed adjectives; multi-word verbs with on, off, up and down • Listening to a radio programme about therapies. Talking about your emotions. Discussing what advice to give people in a variety of situations. • Second conditional. Verb-noun collocations • Discussing what you would do in different hypothetical situations. Writing a letter of advice. • Giving good and bad news. Life events. • Listening to conversations where people receive news. Learning to introduce and respond to news. Role-playing giving someone news • Phrases to describe a good/bad experience. Talk about memorable moments. Writing about one of your happiest memories. • Reading a short introduction to The Secret of Success. Present perfect simple versus continuous. • Present and past modals of ability. Reading a biographical text about the memory men. • Listening to a three-way conversation about memory. Talking about your abilities. Writing a summary. • Clarifying opinions. Reading a story about qualifications. • Listening to a discussion about intelligence. Learning to refer to what you said earlier. Choosing the right candidate for the job. Giving opinions and examples. • Reading a BBC blog about neighbours. Articles. Quantifiers • Describing your neighbourhood and discussing how it could be improved. • Relative clauses. Vocabulary connected with the internet. Reading a website review. • Listening to descriptions of online communities. Comparing real-world and online activities. Writing a website review. • Being a good guest. Welcoming. Reading about how to be a good guest. • Listening to people describing guest/host experiences. Learning to accept apologies. Discussing problematic social situations. • Revision for the written examination. • Grammar practice - preparation for the examination.	
English (B)	K_U14, K_U16, K_U20
• Flatmating, family, personality vocabulary, asking questions. Speaking, listening. • Vocabulary used in informal emails. Writing an informal email, checking accuracy • Feelings, gradable and ungradable adjectives, word formation. Reading, speaking, listening. Grammar: Present Perfect • Advertisements. Making polite phone enquires. Reading, listening, speaking. • Writing a summary of a first encounter story • Social issues. Verbs and nouns with the same form. Grammar: Present Perfect • Preventing crime, surveillance. Giving solutions. Grammar: the Passive • Formal written language. Writing a letter of complaint. • Newspaper extracts. Expressing opinions. Opinion adjectives. Reading and speaking. • Discussing ingredients of happiness; carrying out a happiness survey. Writing tips for being happy for a website. • Games. Discussing behaviuor and annoying habits and routines. Grammar: would/used to.Speaking. • Talking about leisure. Writing an opinion essey. Using linkers. • Talking about holidays. Grammar: Future forms, countable and uncountable nouns. • Describing procedures. Common actions in procedures. Talking about gameshows. Verbs. • talking about unusual experience. Recommending. Writing a story. • Reading a story. Sayings. Grammar: Past tenses. • Telling stories. Talking about experience from the past. Grammar: adverbs. • Wishes and regrets. Multi-word verbs. Grammar: wish/if only • Talking about reading habits, favourite books, likes and dislikes. Reading a summary. • Describing a favourite scene in a film. Writing a description of a favourite scene. • Rading and talking about the worst inventions. Bicycles. Change. Compound nouns. Grammar: articles. • Discussing advertising tactics and the influence of advertising. Grammar: condiotionals. • Marketing and advertising. Writing a report. Learning to make written comparisons. • Brainstorming ideas. Adjectives. Suggesting ideas. Showing reservation. • Presenting a new business idea. Writing: a product leaflet. • Talking about different ages. Word formation - nouns. Grammar: Modal verbs. • Talking about future hopes and plans. Grammar: Future Perfect, Future Continuous. • Writing a letter to your future self. Using linkers of purpose. • Collocations. Convincing. Asking for clarification. • Collocations. Living longer. Taking part in aclass debate. Writing: a forum comment. • Television. different kinds of TV programmes. Interesting facts about TV. Multi-word verbs. Quantifiers. • Retelling real and made-up stories. Reading a questionaire. Grammar: reported speech. • Writing a discursive essay. • Reading a newspaper article. Broadships and tabloids. Predicting. • Mistakes in press and TV. Re-telling a news story. Writing: a news article. • Reading news stories about behaviour in tough situations. Collocations. Difficult decisions. Grammar: conditionals. • Feelings. A quiz on whether you're a morning or an evening person. Different attitude to time. Grammar: -ing form and infinitives. • Idioms connected to time. Writing an informal article. • Adjectives of manner. Talking about how to handle awkward situations. • Describing a family or cultural ritual. Writing about a family ritual. • Watching an extract from a programme about body language. • Discussing how good witness you are. Crime and criminals. Grammar: ing form and infinitives with different meanings. • Synonyms. Verbs with prepositions. Crimes. Grammar: modal verbs. • Reading an advice leaflet bout how to avoid trouble on holiday. Avoiding repetition. Writing a story about a lucky escape. • Reporting a crime. Solving problems. Rephrasing. • People in unusual situations. Survival items. Describing a dangerous adventure. • Professional language: mathematical symbols and terminology. Basic mathematical operations. • Professional language: Fractions, powers, logarithms. • Revision for the written examination. • Revision for the written examination. • Speaking practice • Speaking practice.	
French (A)	K_U14, K_U16, K_U20
• Interrogative pronouns (simple and complex inversion). • Trip around Paris; short advertisements - writing. • Describing events with the use of le passé composé tense. • Vocabulary related to describing the past. • Similarities and differences between Polish and French educational systems. Interpreting figures. • Presenting the university and the field of study. • Describing your last holidays - the use of l'imparfait and le passé composé tenses. • Direct object pronouns in various tenses and moods. • Indirect object pronouns in various tenses and moods. • Living in the city and in the country - advantages and disadvantages; comparatives and superlatives. • Real estate ads analysis; le conditionnel présent mood. • Possessive pronouns. • Hypothesizing and giving opinions; impersonal verb forms. • Describing things; the place of an adjective in a sentence. • Relative pronouns. • Vocabulary related to shopping; negotiating the price. • House chores; sharing duties with the family members. • Favourite dish - preparing a questionnaire; written comments on its results. • Outfits for various occassions; family celebrations. • "Dont" relative pronoun. • Giving personal opinion. • Means of transport - comparison. • A biography of a famous person; le plus-que –parfait tense. • The role of fashion in people's lives - presenting opinions. • Direct and indirect object pronouns COD/COI in the past tense. • The use of past participle with the subject and direct object. • Reported speech - positive sentences. • Car accident - expressing reasons. • Relationships within neighbourhood - describing people. • Hypotheses about text characters. • Sharing a flat - expressing personal opinions. • The „gérondif" mood as a way to express simultaneity, manner, reason. • Entertainment ans free time activities. • Reported questions. • Complex relative pronouns. • Presenting the selected French region. • Active and passive voice. • A film review. • Newspaper article - the use of the passive voice. • Job advertisement, CV, cover letter - documents analysis. • Vocabulary and expressions used in administrative correspondence - writing a cover letter. • A job interview. • Students' work, socializing and building a network of contacts. • The „subjonctif" mood - introduction. • Describing work experience. • Internet as the most popular medium. • Future tenses: le futur proche/ le futur simple; conditional „si+présent+futur simple". • Plans for the future. • Conditional « si+ imparfait+conditionnel présent ». • Expressing wishes. • Adverbs - the place in the sentence. • Private letter and reply to a private letter.	
French (B)	K_U14, K_U16, K_U20
• Describing and reporting events in the past tense. • Paris - the center of fashion. • Pronouns COD/COI in various tenses. • Modern and dying professions. • A famous fashion designer - presentation. • Demonstrative and possessive substatival pronouns. • Simple and complex relative pronouns. • Jeans - a universal timeless outfit. • Complaints and solving problems, giving advice. • Expressing reason and result. • The „subjonctif" mood - expressing purpose. • Traffic regulations - obligations and prohibitions. • Reported questions. • Choosing profession, justyfiyng. • Expressing the reason. • Living in homeland and abroad, giving arguments. • National symbols of Poland and France. • „Le passé simple - literary tense". • Comparisons - various living styles, the comparative of irregular adjectives. • Real estate market in France and in Poland. • Expressing acquiescence. • Emigration and mobility, expressing opinions. • „Le savoir-vivre" - good manners. • What is proper and improper - similarities and differences concerning Polish and French customs. • Negatives - summary. • Expressing prohibition. • Expressing hypothesis. • Passive voice in a newspaper article. • Climate changes - vocabulary related to ecology. • People's eco-friendly habits. • Plans for the future - time expressions. • Pensioners nowadays and in the past; changes in perceiving elderly people. • Setting up a company - development plans. • Inventions which revolutionized people's lives. • Expressing hypothesis and condition. • Eco-firendly solutions for the city, region and country. • Ideal friend; superlatives. • Modern idols. • Presenting the favourite character. • Passions in our lives. • Tense concordance in a short story. • Globalisation, positive and negative consequences. • Verb patterns with an infinitive. • Expressing disagreement towards proposals. • The art of giving arguments in a presentation. • A mobile phone: hell or paradise? • Where does Europe end? - information about the European Union. • Verbs useful for giving arguments. • Arguments cohesion - coherence linkers. • Sentence transformations - expressing coherence. • Higher education - facts and expectations. • Presenting a selected company.	
Fundamentals of economics	K_W10, K_W12, K_U01, K_U13, K_U20, K_K04
• Introduction to Economics (outline of economic thought, the basic concepts, principles and assumptions of microeconomic analysis, the place of economics in the system of social sciences and relationships with other disciplines). Introduction to microeconomics. • The model of the market economy (institutions, productivity, efficiency, actors, resources and streams in the economic system, market - classifications and functioning). • Demand (law of demand, exceptions, determinants, elasticity of demand), supply (the law of supply, exceptions, determinants, elasticity of demand), the balance of the market in the short, medium and long term, the impact of regulated prices on the market, model cobwebs. • Consumer choice (the functioning of households, usability, first and second Gossen law, pension consumer Marshall, the balance of the	

consumer). • The rules of the enterprise (introduction to the theory of enterprise, basic definitions, classifications and processes). • The short run and long run production function in the market, economies of scale, choice of optimal technology. • The instruments of cost management in the enterprise, cost function in the long and short term, costs and liquidity. • Perfect competition and monopolistic competition. • Various degrees of competitiveness in the marketplace: monopolies, oligopolies • Introduction to macroeconomics, the basic phenomena and macroeconomic problems. • The development of economic systems, economic growth - measuring and conditions of the product and national income and its determinants, economic conditions (cycles) and the role of investment in the economy, analysis of the situation in Europe and the world. • The importance of the public finance sector, the organization SFP (sub), the impact of fiscal policy on national income, the role of the state in the economy, the budget as a tool for influencing the economy, the issue of budget deficit and public debt, the impact of public support (including EU funds) for the development of entities the national economy, analysis of the situation in Europe. • The development of the monetary system, the role of money in the economy, money in the strict sense and broad sense, the demand for money, the money supply and the mechanisms of its creation, quantitative theory of money, monetary aggregates. • The banking system of the state, the role of the central bank and monetary policy tools of monetary policy, the interbank market and the activities of commercial banks. • The phenomenon of inflation and its effects on social and economic demand and supply-side causes of inflation, the measurement of inflation - inflation, analysis of the situation in Europe, anti-inflation policy. • The labor market, employment policy, the importance of competence and demographic processes, labor market flexibility, unemployment as a problem of economic and social development. • International economic relations, the foreign exchange market, balance of payments, the single market of the European Union and its importance for the development of Member States, including developing countries. The European Union in the global economy.

Fundamentals of management	K_W10, K_W11, K_W12, K_U13, K_U20, K_K04

• Management as an academic discipline • Company and its environment as an object of management • Management features • Conterporary management problems.

German (A)	K_U14, K_U16, K_U20

• Friendship, meetings, people relationships, relations. Declension - type 'n'. • Describing a person, introductions, characteristics of types of behaviour, features of character. • Presenting one's characteristic. Noun formation. • Reder's magazine - class reunions and locating classmates by internet. Working with a text. • Occupation and work, workplace, presenting one's flaws and strengths. • Talking about the past. Past tense (Präteritum) of regular, irregular and mixed nouns. • Report concerning the internship done. Presenting opinions regarding an employee. • Conditions and forms of work. Requirements and competences. • Working with a video material. Conducted activities and working conditions. • Presenting one's plans and professional plans. • Living conditions, an interview with a real estate agent. Relative pronouns and relative clauses. • Analysis of offers and notices, explaining abbrevations. Adverbials of time. • Living in Germany: informational text, statistics, graphs. • Customer service, phone conversations. Language reactions based on a given situation. • Oral and written complaint. Sentences with „obwohl" and „trotzdem" • Writing a formal letter with a set of fixed phrases. • Inviting to a company promotional meeting - working with a text. • Computerisation of everyday life. Functions of devices/appliances used nowadays and in the future. • Visions of technological progress of the future. Futur I tense. • Using electronic devices in private and professional life - presentation. • Working with a video material - history and development of an enterprise, features of products and their distribution. • Formal and informal invitation. Conditional conjunction "falls". • Business meeting. Rules of participating in a meal and different professional and social situations. • Holiday plans, expressing wishes and intentions. Verbs: 'sollen'. • Media, Germany's press market. • Characteristics of a given magazine - presentation. • Shopping, slecting products, reacting to suggestions and propositions. Sentences with 'zu' before an infinitive. • Conversation between a client and consultant. Typical expressions. • Conversations between a client and consultant. Using typical professional expressions. Setting up a company and customer acquistion. • Choosing a profession. Determining one's own skills and abilities. Causative clauses. • Social competences and career choice test. Employment profiles. Time clauses with 'bevor' and 'während' conjunctions. • Describing personality and aptitudes, expressing opinions and presenting test results. • Miniproject - professional predispositions, weak and strong sides of a candidate, talking with a careers adviser. • Working with a video material - history and development of Hueber publishing house, as well as its products. • Working conditions and concept of an employee-friendly enterprise. Gradation and declension of an adjective. • European Union - employment opportunities in EU countries, its history, as well as inner labour market and main institutions. • Smoking prohibitions in a work place - formulating arguments in favour and against, expressing opinions. Imperative. • Presentation structure, template, typical expressions. • Conditions determining good employment and company's attractiveness. • Wasted chances and opportunities. Unreal clauses in the past. • Reporting experienced failures - a radio audition. Conditional clauses - Konjunktiv II. • Helpline - describing a given situation. 'Wäre / hätte' structures + Partizip II. • Describing controversial events - discussion and commentary. • Expressing disappointment and reacting to it - writing an e-mail, working with a text published on a blog. • Everyday situations that make you happy. Plusquamperfekt tense. • Expressing emotions - language means. • Summarizing the previous year and positive events. Time clauses with 'nachdem'. • Working with a video material - 'Our piece of happiness'. Family history. Important life areas, experiencing success and satisfaction. • Parties, celebrations, events happening in a workplace. • Beginnings of a career. Speed-dating. Employers' expectations. • Comparison of holidays and events. Written invitations for different occassions. • Writing an e-mail and letters - components. Writing invitations.

German(B)	K_U14, K_U16, K_U20

• New communication media. Establishing new contacts: Speed-dating. • Describing one's language skills - working with a video material. Declension of an adjective after definite, indefinite and no article. • Media competences, ability to creatively use internet assets in foreign language learning. Time adverbs. • Bisness meetings in a new environment, forms of greeting and introduction. • Strategies of learning language for special purposes. • Private and business meetings. Modal particles. • Planning and organizing official events. • Spoken and written invitations, establishing the date of the meeting. Rektion of the verb. Adverbial pronouns in questions and answers. • Working with a video material - 'Oktoberfest'. • Planning and preparation of a presentation. • Business lunch. Quiz about etiquette. • Features of a good presentation. • Preparing product presentation. • Planning a holiday, travel bureau's offers. Assumptions - 'werden + wohl' verbs + infinitive. • Accommodation - hotel rating, opinions on internet sites. Relative sentences, relative pronouns. • Public transport in German speaking countries. • Future vehicles and travels. Future tense 'Futur I'. • Working with a video material - dream travels. • Organizing a conference, choosing a hotel, business mail. • Flat market, different forms of accommodation. Complex nouns. • Living community, student's house. Looking for a flat - advertisements. Time prepositions. • A student room, flat appliances, description of functions of furniture and items of every day use. • Switching flats during holiday. Word order. • Multi generation house. • Office and its equipment, positive rapport. • Living business community, pros and cons. • Presenting a profession - working with a video material. • Ideal work place. Conditionals. • Job advertisements, writing a cv. • Different ways of job searching. Advice and tips for job applicants. Sentences with 'damit' and 'um...zu'. • Job applications, talking about your education and work experience. • Small-talk, expressing opinion about one's job - pros and cons. • Famous composers, a biography note. Negative sentences. • Music genres, music instruments, music bands. • Festivals and concerts in German speaking countries. A schedule of musical events. • Planning a shared evening, inviting to a concert, writing a private email. • 'Rammstein' band - presenting a band. Providing argument support one's choice. Sentences with „denn", „weil", „nämlich", „deshalb". • German rock music - working with a video material. • Creating a presentation about German rock music. • Board games, tele shows. Rules of favourite games. Passive voice. • E-commerce, internet shops. • Psychology of selling, interpreting the behaviour of the customer. Passive voice with modal verbs. • Consumers' typical behaviour during shopping. Identification of different behaviour. • Online shopping discussion - pros and cons. • Vocabulary related to finances. • Acquisition of new skills, upgrading one's qualifications, various course offers and certificates. Noun's genitive. • Advanced ways of information searching, remote ways of providing education, education platforms. • Facilities found in a moder language lab. Prepositions of place. • Education system in Germany - a discussion forum. • Technical occupations, handling and description of technical equipment, manuals. Prepositions with dative and accusative. • Malfunctions and technical faults. Imperative. • Complaints - exchaning emails.

Russian (A)	K_U14, K_U16, K_U20

• Healthy diet. • Wedding customs in Poland and Russia. • Family holidays. Sentences with а, и, но, или. • Leisure time. Writing a short play/movie review. • Mass media. Expressing opinion about mass media and their role. • Internet or newspapers. Demonstrative pronouns этот, эта, это, эти, тот, та, то, те. Using пользоваться (чем?) verb. • Disabled are among us. Vocabulary and constructios connected with the topic of disabled. • Popular occupations. Male and female noun forms of different occupations. Negative proniuns никто, ничто, некто, нечто, никогда, некогда, никуда, некуда. • Professional duties. Vocabulary related to activities coonducted in popular jobs. • Job interview. Giving advice concerning job selection and preparation for job interview. • Moscow labour market. Describing pros and cons of certain occupations. Writing a job application. • Working abroad - pros and cons. • Material revision. Talking about the plans after graduation. • Studying in Poland. Names of different universities; popular abbrevations. Vocabulary related to formalities and conditions that have to be met to study. • Studying in Russia. Abbrevations of universities and faculties,Supporting the choice of studies. Writing an email and private letter. • Student life. стать/быть/ работать (кем?)

construction, быть по профессии/по образованию (кем?) construction and несмотря на то,что construction. • Excursions. Describing/planning and narrating excursions. Writing questions regarding holiday offers. • Summer camps. Tourist equipment. Travelling by train. путь noun. • Tourist office. Writing excursion advertising leaflets. Writing a letter of complaint. • Tourism in Poland. Accommodation base - vocabulary. Describing excusrions and sight-seeing. • Tiurism in Russia. Full meaning of турбюро, турбаза, ж/д abbrevations. заказать, забронировать verbs. • Renting a flat for summer. Vocabulary and constructions used in flat-renting advertisements. снимать, снять, сдать в аренду verbs. • Real estate agency. Describing appearance of rooms and their facilities based on illustrations. • House or flat? Where to live? Subjectless sentences. • Material review. Names of tourist equipment. vocabulary and constructions used when describing a flat. • Writing e-mails. Writing a private letter concerning an unfortunate journey. Vocabulary related to private letters. • Our neighbours. Participles: usage and creation. • Our planet Earth. Describing and proposing different ecological actions. Presenting data concerning biodegredation of different common-use products. • Protect nature. Conducting a survey related to pro-ecological behaviour. Writing an essay about environmental danges. • Natural disasters. Describing climate and weather. Vocabulary - natural disasters. • Ecological crisis. Describing climate and weather. Vocabulary - natural disasters. • Cataclisms. Describing activities related to acting in case of cataclisms. Superlative forms. • World of technologies. Talking about scientific inventions and technical novelties. Technical language. • 21st century inventions. Describing information technologies. Describing malfunctions. Vocabulary related to computer and internet. • Technology and us. Naming and describing inventions. Expressing opinions. • We are all equal. Creating utterances about the social roles of men and women. Expressing opinions about partnership. Vocabulary and constructions related to equality and social roles of men and women. • Generation gap. Expressing opinions about generation gap and discussion about the validity of some bans. • Juvenile subcultures. запрещать, запретить verbs. каждый, всякий, любой relative pronouns. • Important dates in our life. Describing dates and events. Complex quantifiers. • Products and services. Reading comprehension. Dialogues concerning malfunctions and repairs of every day objects. • Advertisement's effect on a human. Describing activites related to advertisements. Naming and describing services. • E-commerce. Talking about e-commerce. Accusative of plural living and non-living nouns. • War. Expressing opinions about war service and women participation: discussion. Vocabulary related to war service, conflicts and inner and international problems. • Citizen debt. Reading comprehension. Imperatives: Будь я президентом, не было бы такого!. • Social problems. Naming and describing selected social problems and proposing their solutions. Vocabulary related to selected social problems. • Human and society. Conducting a debate abour homelesness and means of fighting it. Time constructions with prepositions:за and через. • Master and Margaret. Discussing the text. Knowledge about Russia: life and work of Michael Bulhakow. • Slavian mythology. Read comprehension. • Russian painting. Reading comprehension: text about Russian painters. • Russian Federation. Vocabulary related to both the structure, as well as political ststem of Russian Federation. • Russia today. Reading comprehension concerning structure and political system of Russian Federation. • Poland in Europe. Reading comprehension concerning structure and political system of Poland. .	
Russian (B)	K_U14, K_U16, K_U20
• Appearance. • Features of character. • Asking for personal details. Processing and transferring information. • Ethical problems. Personal prononus with or without preposition. • Home products. Present tense. • Real estate, Nouns. • House renovations. Adjectives. • School requirements. Verbs: учить, учиться, изучать. • Systems of educations in Poland and Russia. • School requirements. Prepositions в, на. • Occupations. Verbs related to different occupations. • Professional work. Temporary work. Labour market. Present tense. • Our portfolio. Writing a letter of motivation. Writing a CV. Nouns. • Family holidays. Naming holidays. Possesive pronouns. • Family members. Leisure time and reflexive verbs. • People and relationships. Adverbs of place and direction. • Food and its names. • Restaurants. Numerals 1,2,3,4 in junction with nouns and adjectives. • Describing diets. Expressing opinions. Demonstrative pronouns. Imperative. • Services: buying and saling. Verbs: купить/покупать. • Bank (types of payment). Main numerals. Nouns: рубль. • Products. Advertisements. Adverbs of level and measurement. • Means of transport in Russia. Interesting places in Russia. • Travelling vocabulary. Naming and describing accommodation. Nouns ending -ий -ия, -ие. • Describing excursions and sight-seeing. Expressing opinions. Writing a blog. • Art genres (movies). Cinema genres. • Mass media. Present tenses. • Sport disciplines. Sport venues. • Sporstmen. Sport equipment. Comparatives. • Sport competitions. Nouns with adjectives. • Describing one's well-being. Ilnesses and means of curing them. • Curing and healing processes. Prepositions in constructions related to time and direction. • Addiction. Imperative. • Naming basic technical devices. Activities made with basic technical devices. • Computer and internet. Vocabulary. • Wildlife. Naming plants and animals. Describing landscape. • Catastrophies and natural disasters. Adjectives. • Catastrophies and natural disasters. Adjectives. • Ecology. Describing activities related to protecting natural environment. • Russia. Country's structures and offices. • Social and international organizations. Present tense. • Economics. Inner and international conflicts. • Social life. себя pronoun. друг друга expression. • Social problems. Vocabulary related to current social issues. • Master and Margaret. Reading comprehension. Life and work of Michael Bulhakow. • Mythology. Selected information concerning Slavian mythology. • Wasilij Kandinskij. Reading comprehension. • Iwan Szukszyn. Reading comprehension. • Russian fables. Nouns with adjectives. • Russian holidays. Naming and describing holidays. • Polish holidays. Naming and describing holidays.	

3.2. Processing of polymer materials

3.2.1. Parameters of the study plan

The total number of ECTS credits that a student must obtain in the course of classes conducted with direct participation of academic teachers or other persons conducting classes.	124 ECTS
The total number of ECTS credits allocated to classes related to scientific activity conducted at the university in a given discipline or disciplines to which the course of study is assigned.	118 ECTS
The total number of ECTS credits required to be obtained by a student in the humanities or social sciences for the courses of study assigned to disciplines within the fields of study other than the humanities or social sciences respectively.	5 ECTS
The total number of ECTS credits allocated to elective courses.	63 ECTS
Total number of ECTS credits allocated to work placements, internships (if the study program includes work placements or internships).	4 ECTS
Hours of apprenticeships, internships (if the study program provides for internships or apprenticeships).	160 h.
The total number of ECTS points that a student must obtain as part of a foreign language course.	9 ECTS
Number of hours of physical education classes.	60 h.

Detailed information about:

1. the relationship between learning outcomes and modular learning outcomes;
2. key learning outcomes in terms of knowledge, skills and social competences, demonstrating their relation to the discipline / disciplines to which the course is assigned;
3. the development of learning outcomes at the level of classes or group of classes, in particular related to the scientific activity conducted at the university;
4. learning outcomes in terms of knowledge, skills and social competences leading to the acquisition of engineering competences, in the case of study programmes on completion of which the student is awarded a professional title of engineer / Master of Engineering;

can be found in the Module Activity Sheets, available at the following URL: http://krk.prz.edu.pl/plany.pl?lng=EN&W=C&K=P&TK=html&S=1496&C=2020, which are an integral part of the study programme.

3.2.2. Plan of study

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/	Sum	ECTS	Exam	Mand.

						Seminar	of hours			
1	ZB	Technical safety and ergonomics	15	0	0	0	15	1	N	
1	CN	General and inorganic chemistry	30	30	0	0	60	6	T	
1	ZH	Academic savoir - vivre	10	0	0	0	10	1	N	
1	FF	Physics	30	30	0	0	60	6	T	
1	ZM	Social competences	10	15	0	0	25	2	N	
1	FM	Mathematics	30	30	0	0	60	6	T	
1	CI	Machines theory and technical mechanics	30	30	0	0	60	4	N	
1	CM	Introduction to materials science	15	15	0	0	30	2	N	
1	ZO	Economic course	30	0	0	0	30	2	N	
Sums for the semester: 1			**200**	**150**	**0**	**0**	**350**	**30**	**3**	**4**
2	CN	General and inorganic chemistry	30	15	30	0	75	6	T	
2	FF	Physics	15	15	15	0	45	4	T	
2	CI	Computer engineering graphics (CAD)	15	0	45	0	60	4	N	
2	FM	Mathematics	30	30	0	0	60	6	T	
2	CI	Machines theory and technical mechanics	30	0	0	15	45	3	N	
2	EM	Metrology and industrial measurements	15	0	15	0	30	2	N	
2	CI	Packages of application software	0	0	30	0	30	2	N	
2	CB	Computer science	15	0	30	0	45	3	N	
Sums for the semester: 2			**150**	**60**	**165**	**15**	**390**	**30**	**3**	**4**
3	CN	Analytical chemistry	15	0	30	0	45	3	N	
3	CF	Physical chemistry	30	30	15	0	75	6	T	
3	CD	Organic chemistry	30	30	30	0	90	7	T	
3	CB	Scientific and technological information	0	0	2	0	2	0	N	
3	DJ	Foreign language	0	30	0	0	30	2	N	
3	FM	Mathematics	15	15	0	0	30	3	N	
3	CI	Fluid dynamics	30	30	0	0	60	5	T	
3	CB	Fundamentals of programming	0	0	30	0	30	2	N	
3	CB	Statistics and results elaboration	15	0	15	0	30	2	N	
3	DL	Physical Education	0	30	0	0	30	0	N	
Sums for the semester: 3			**135**	**165**	**122**	**0**	**422**	**30**	**3**	**2**
4	CF	Physical chemistry	30	30	30	0	90	7	T	
4	DJ	Foreign language	0	30	0	0	30	2	N	
4	CI	Fundamentals of heat and mass transfer	30	30	0	0	60	5	T	
4	CI	Fundamentals of chemical technology	30	30	0	0	60	5	N	
4	CI	Industry processes and process apparatus, process intensification	30	15	0	0	45	4	N	
4	CI	Parametric designing in Autodesk Inventor	0	0	20	0	20	2	N	
4	CI	Engineering thermodynamics	30	30	0	0	60	5	T	
4	DL	Physical Education	0	30	0	0	30	0	N	
Sums for the semester: 4			**150**	**195**	**50**	**0**	**395**	**30**	**3**	**1**
5	CF	Instrumental analysis	30	0	30	0	60	4	N	
5	CI	Diffusion separation processes	30	15	0	0	45	5	T	
5	CK	Elements of rheology in polymer processing	15	0	30	0	45	3	N	
5	DJ	Foreign language	0	30	0	0	30	2	N	
5	CK	Engineering materials	30	0	30	0	60	4	T	
5	CI	Computer Flow Dynamics (CFD)	0	0	0	30	30	2	N	
5	CI	Industry processes and process apparatus, process intensification	15	15	15	15	60	4	T	
5	CI	Heat transfer equipment design	15	0	15	15	45	2	N	
5	CM	Chemical technology	30	0	45	0	75	4	N	
Sums for the semester: 5			**165**	**60**	**165**	**60**	**450**	**30**	**3**	**1**
6	CS	Polymer chemistry and technology	30	0	30	0	60	4	T	
6	CI	Diffusion separation processes	15	15	15	15	60	6	T	
6	DJ	Foreign language	0	30	0	0	30	3	T	

6	CS	Modern methods of polymer modification	15	0	20	0	35	3	N	
6	CM	Evaluation of the practical properties of polymer materials	15	0	15	0	30	2	N	
6	CK	Industrial polymer materials	15	0	0	0	15	1	N	
6	CM	Technology of monomers	15	0	15	0	30	2	N	
6	CK	Polymer materials processing	30	0	60	15	105	9	T	
Sums for the semester: 6			**135**	**45**	**155**	**30**	**365**	**30**	**4**	**1**
7	CD	Modern polymer technologies	15	0	10	0	25	2	N	
7	MK	Fundamentals of CAD / CAE in polymer processing	15	0	30	0	45	4	N	
7	CX	Professional training	0	0	0	0	0	4	N	
7	CX	Engineering project	0	0	0	120	120	11	N	
7	CI	Process design	15	0	0	30	45	4	N	
7	CI	Chemical reactors	30	30	0	0	60	5	N	
Sums for the semester: 7			**75**	**30**	**40**	**150**	**295**	**30**	**0**	**0**
TOTALS FOR ALL SEMESTERS:			**1010**	**705**	**697**	**255**	**2667**	**210**	**19**	**13**

Note that not being granted credits from the modules marked with a red flag makes it impossible to make an entry for the next semester (even if the total number of ECTS credits is lower than the permissible debt), these are modules continued in the next semester or modules in which failure to achieve all assumed learning outcomes does not allow one to continue studies in the modules included in the next semester's study programme

3.2.3. Elective modules

The following modules are an extension of the table from the chapter 3.2.2. They can be chosen by students regardless of their specialisation / education path.

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/ Seminar	Sum of hours	ECTS	Exam	Mand.
2	ZE	Fundamentals of economics	30	0	0	0	30	2	N	
2	ZO	Fundamentals of management	30	0	0	0	30	2	N	
3	DJ	English (A)	0	30	0	0	30	2	N	
3	DJ	English (B)	0	30	0	0	30	2	N	
3	DJ	French (A)	0	30	0	0	30	2	N	
3	DJ	French (B)	0	30	0	0	30	2	N	
3	DJ	German (A)	0	30	0	0	30	2	N	
3	DJ	German(B)	0	30	0	0	30	2	N	
3	DJ	Russian (A)	0	30	0	0	30	2	N	
3	DJ	Russian (B)	0	30	0	0	30	2	N	
4	DJ	English (A)	0	30	0	0	30	2	N	
4	DJ	English (B)	0	30	0	0	30	2	N	
4	DJ	French (A)	0	30	0	0	30	2	N	
4	DJ	French (B)	0	30	0	0	30	2	N	
4	DJ	German (A)	0	30	0	0	30	2	N	
4	DJ	German(B)	0	30	0	0	30	2	N	
4	DJ	Russian (A)	0	30	0	0	30	2	N	
4	DJ	Russian (B)	0	30	0	0	30	2	N	
5	DJ	English (A)	0	30	0	0	30	2	N	
5	DJ	English (B)	0	30	0	0	30	2	N	
5	DJ	French (A)	0	30	0	0	30	2	N	
5	DJ	French (B)	0	30	0	0	30	2	N	
5	DJ	German (A)	0	30	0	0	30	2	N	
5	DJ	German(B)	0	30	0	0	30	2	N	
5	DJ	Russian (A)	0	30	0	0	30	2	N	
5	DJ	Russian (B)	0	30	0	0	30	2	N	
6	DJ	English (A)	0	30	0	0	30	3	T	
6	DJ	English (B)	0	30	0	0	30	3	T	
6	DJ	French (A)	0	30	0	0	30	3	T	
6	DJ	French (B)	0	30	0	0	30	3	T	
6	DJ	German (A)	0	30	0	0	30	3	T	
6	DJ	German(B)	0	30	0	0	30	3	T	
6	DJ	Russian (A)	0	30	0	0	30	3	T	
6	DJ	Russian (B)	0	30	0	0	30	3	T	

3.2.4. Verification methods of learning outcomes

Detailed rules and methods for the verification and assessment of learning outcomes that allow all learning outcomes to be verified and assessed are described in the Module Activity Sheets. Within the framework of a study programme, verification of learning outcomes is carried out in particular by means of the following methods: written, exam part practical, exam part oral, written pass, pass a part practical, oral pass, essay, colloquium, written test, observation of performance, portfolio, project presentation, written report, oral report, project report, written test.

Detailed information about the verification of learning outcomes achieved by students can be found in the Module Activity Sheets at the URL address: http://krk.prz.edu.pl/plany.pl?lng=EN&W=C&K=P&TK=html&S=1496&C=2020

3.2.5. Programme content

Programme content (educational content) is consistent with the learning outcomes and takes into account, in particular, the current state of knowledge and research methodology in the discipline or disciplines to which the course of study is assigned, as well as the results of scientific activity in this discipline or disciplines. A detailed description of the program content is available in the Module Activity Sheets at the URL: http://krk.prz.edu.pl/plany.pl?lng=EN&W=C&K=P&TK=html&S=1496&C=2020, which are an integral part of the study programme.

Academic savoir - vivre	K_W10, K_U18, K_U19, K_U20, K_K02, K_K03, K_K05
• Principles and norms of behavior in interpersonal relationships. The origin of the concept of etiquette. Legal and moral norms and custom. The universal rules of the etiquette.Personal culture.Importance of good morals in private and professional life.Stereotypy.Good manners and the image. • Classic savoir-vivre rules Fundamentals of priority and principles of its application. Forms of showing respect. Welcome - the rules and exceptions. Titles in the academic environment.Personal and business procedures.Preferred - rules and exceptions. Wishes and congratulations.Faux pas. • Communication etiquette. Standards of good behavior in interpersonal communication. Non-verbal communication. Telephone conversation label. Culture of correspondence.Network. Elegance of public speaking. • The importance of clothing in creating a positive image. Savoir vivre a choice of dress. General dress rules. Clothing accessories. Fashion and extravagance.The most frequent weaknesses in the selection of individual elements of the outfit.The right outer appearance as part of the positive image.	
Analytical chemistry	K_W06, K_U03, K_U08, K_U20
• Classification of analytical chemistry, scale, accuracy and precision of a method. Analytical errors, statistical evaluation of results. General scheme of quantitative analysis. Classification and characteristics of methods of chemical analysis. Theoretical basis of volumetric analysis. Alkacymetric. Reductometry and oxidimetry. Complexometry. Precipitation analysis, effects accompanying solid product separation. Chemical calculations and analyses in the field of volumetric and gravimetric methods. • Alkacymetric: determination of sulphuric acid concentration. • Redox: determination of Fe(II) in Mohr's salt, determination of Cu(II) concentration. • Complexometry: determination of Ca(II) or Mg(II) ionic concentrations. • Precipitation analysis: determination of Cl- ions concentration. • Chemical calculations in the field of volumetric analysis and gravimetric methods.	
Chemical reactors	K_W03, K_W05, K_W07, K_U05, K_U06, K_U20, K_K01
• Kinetics of chemical reactions. Reaction rate vs. concentration and temperature. Calculating the composition of the reaction mixture. • Chemical reactors - material balance. Periodic reactor. Methods of analysis of kinetic data. Simple and complex reactions in a batch reactor. • Continous stirred tank reactor. Cascade of reactors. Plug-flow reactor. Semi-continous reactor. Plug-flow with recycling of flux. • Comparison of reactors for simple reactions. Comparison of reactors for complex reactions.	
Chemical technology	K_W06, K_W07, K_W08, K_U06, K_U08, K_U10, K_U20, K_K01
• Introduction. Principles of Green Chemistry. Current trends in chemical technology. • Raw materials for chemical and petrochemical industry - reproducible, minerals and fossil. Processing of the basic renewable raw materials. • Selected inorganic chemical processes. • Processing of coal. • Processing of natural gas. Syngas and their utilization in fuel production. • Processing of oil. Production of fuels, olefins and aromatics . • Selected processes of the large scale industrial synthesis of organic chemicals. Production of methanol, vinyl chloride, styrene, terephthalic acid, ethylene glycol and others. • Conductiong of the six activities from the group: Synthesis of cyclohexanone oxime and caprolactam, adipic acid, dibutyl phthalate, Processing of raw materials: sugar from sugar beet, biodiesel from vegetable oil, furfural from bran, starch from potatos, cellulose wadding, essential oils . Caustification of soda. Phosphoric acid extraction from ore. Isolation of potassium chloride from sylvinite Preparation of soda ash Sulfur from sulfur ore	
Computer engineering graphics (CAD)	K_W08, K_U02, K_U07, K_U20
• Technical letter • Rectangular projections, axonometric views, views and sections. • Technical charts. • Rules for dimensioning. • Tolerance of dimensions, shape and position. • Determination of surface roughness. • Connections of the machines: separable and inseparable. • Assembly drawings. • Standardized graphical symbols and devices used in the processes of chemical technology. • Preliminary information, start AutoCAD and basic settings. • Creating a drawing template and drawing styles. • Exercises for features and commands of AutoCAD. • Examples of application AutoCAD specific functions. • Constraints - parametric drawing in AutoCAD • Creating technical drawings - projection and dimensioning of a complex geometric solids. • Drawing preparation and printing from the layout level. • Making production and assembly drawings of machines parts. • Reading the technical documentation.	
Computer Flow Dynamics (CFD)	K_W08, K_U02, K_U03, K_U20, K_K01
• Work in sketchpad mod. 2D modeling. Simplifying and repairing of geometry. Parametrization of geometry. • Mesh generation in Ansys Meshing software. Kinds of calculation meshes. Meshing algorithms. Control of quality and size of mesh. Methodology of mesh generation for CFD analysis. • Basics of Fluent Software. Determination of flow model. Determination of boundary conditions. Solver options. • Analysis and interpretation of results.	
Computer science	K_W08, K_U02
• Operating system Windows XP. Computer networks. Electronic mail. Internet basics. Searching for information on the Internet. Discussion groups. Internet aided education. • Microsoft Office package: Word, Excel, PowerPoint. Development of laboratory data. • Chemical structure editors. • Elaboration of a web page. • Definitions of basic concepts: the algorithm, computer program, computer system, informatic system, the operating system. The main components of a computer and their functions. Multiprocessor computer. • Operating systems and their types. Computer programs, utilities and tools. MS-Office programs: Word, Excel, PowerPoint. • Computer viruses, protection and prevention. Computer networks (Internet, Intranet). Telecommunications systems. Websites construction. Legal, ethical and social issues of computer science. • Representation formalisms of algorithms: data flow diagram, program flow diagram. Computer program development cycle: specification, design, coding, testing, documentation. • The basic elements of the configuration of software environment and compiler for C++. Construction of programs in C++. Declaration of variables and implementation section of the unit. Data types defined in C++. The concept of object. • Main control statements in C++. Static and dynamic variables. Computer memory management. Programming of branches and loops. The definition of procedures and functions. Program testing according to principles of software engineering	
Diffusion separation processes	K_W03, K_W05, K_U01, K_U05, K_U06, K_U08, K_U09, K_U20, K_K01
• Absorption. Characteristics of the process. The equilibrium of gas - liquid. The mass balance of the process and the operating line. Methods of mass exchanger high calculation.Hydrodynamic diameter of the apparatus. Apparatus. Distillation and rectification. Liquid - vapor equilibrium for two-and multi-component systems . Simple distillation. Steam distillation. Adjustment of the two-component batch and continuous : the balance sheets, operating lines, minimum and maximum reflux, determination of the number of theoretical plates - graphical and analytical methods. Rectification of multicomponent mixtures. Design issues: the selection of the type of apparatus, the characteristics of the shelves and their efficiency, mass transfer coefficients , packed columns. Extraction in liquid - liquid systems. Basics of physico-chemical extraction : solubility equilibrium, partition coefficient, the selectivity of the solvent , the drip mechanism. Calculation of the mass transfer coefficients in the extraction process. Multi-stage extraction. Determination of the minimum , maximum, and optimal amounts of solvent. Calculating the number of degrees and their efficiency . Extraction column ternary systems : computing the height and diameter of the column . Apparatus . Topics exercises: closely related to themes presented in the lecture. Laboratory: Five laboratory exercises related to the topic of the course Projects : Students perform project of the the mass exchanger fluid - fluid system : the rectification column and/or absorber. • Drying processes. Thermodynamics of drying. The mass and heat transfer in drying processes. Ways of carrying out the process. Drying apparatus. Topics exercises closely related to the issues presented in the lecture.	
Elements of rheology in polymer processing	K_W03, K_W05, K_U02, K_U05, K_U08, K_U19, K_U20, K_K01

• Fundamental definitions in rheology: stress, deformation, kinematics of deformation. • Rheological equation of state, rigid substance, liquid substance. • Definition of viscoelasticity of polymers, mechanical models. • Viscosity of polymer during flow. Rheological properties of alloys and solutions of polymers. • actical application of rheology: isothermal flow and nonisothermal flow through channels with different sections; polymer flow in single-screw extruder and double-screw extruder (isothermal, adiabatic and polytropic regime). • Determination of flow curves of polymer melts by using plastometer. Analysis of the flowing of thixotropic liquids. Determination of glass transition temperatures of polymers by using Höppler consistometer. Determination of the heat resistance of selected thermoplastics. Determination of the hardness of plastics. Determination of the processing properties of rubber compounds by using wulcameter.	
Engineering materials	K_W07, K_W08, K_U03, K_U08, K_U10, K_U20, K_K01
• Introduction to materials science • Metallic materials • Ceramic materials • Polimeric materials • Composites, properties of composites • Modulus of elasticity • Yield strength, tensile strength, hardness and ductility • Sudden cracking, toughness and fatigue of materials • The deformation and cracking as a result of creep • Flammability of construction materials • Methods of reducing the flammability of construction materials • Selection of materials • Determination of mechanical properties of fiber composites (1) and metal composites (2)during static stretching. Preparation of plastics by casting and characterization of obtained products. Grain size analysis of powders Water absorption, real and apparent density and porosity of ceramic materials. Determination of rheological properties of polymer compositions.	
Engineering project	K_W07, K_U01, K_U03, K_U17, K_U19, K_U20, K_K01, K_K02, K_K03
• Getting to know the professional literature on the subject • Experimental measurements, the creation of a computer program or other work related to the use of research tools that are appropriate to the studied area and educational profile. Development of research results in the form of a written report. • Discussing how to prepare a multimedia presentation, rules for presenting papers. Presentation of the diploma project. Discussions after the multimedia presentation of the results of own research presented by students.	
Engineering thermodynamics	K_W03, K_W06, K_U06, K_U20, K_K01
• Equations of state of fluids, thermodynamic functions, characteristic processes for non-ideal liquids, thermodynamics of cooling and heating cycles. Equations of state for real solutions, thermodynamic functions for real solutions. Basics of equilibrium in multiphase systems, fugativity, activity, methods of calculation. Phase equilibrium for systems liquid-liquid, liquid-vapor, liquid-solid.	
Evaluation of the practical properties of polymer materials	K_W03, K_W07, K_U02, K_U06, K_U08, K_U20, K_K01
• Characteristic of the basic physical properties of polymeric materials: density, porosity, solubility, moisture content, absorbability, etc. • Classification of the polymer materials taking into account methods of processing and the practical applications. • Determination of strength properties (static and dynamic) of polymeric materials. Thermal properties and flamability of plastics. Determination of temperature of phase transition (glass transition, melting, crystallization). Testing method of heat resistance. Aassessment of thermal resistance under prolonged loud. Methods of evaluation of aging and chemical resistance. Determination of electric, magnetic, acustic, optical properties of polymeric materials. Analysis of polymer morphology. • Learning computer software used to operate the equipments used during laboratory lessons and to interpret obtained results. • Preparation of samples for analysis. • Thermal analysis of plastics – determination of glass transition temperature and degree of crystallinity by DSC. The analysis of the reactivity of the epoxy resins by differential scanning calorimetry (DSC). Dynamic mechanical analysis DMA of selected polymer materials.	
Fluid dynamics	K_W01, K_W03, K_W08, K_U05, K_U06, K_U20, K_K01
• Suplementary information from mathematics. Vector operations, Operator of gradient, divergence rotation. Integration along curves. Surface, volume integrals. Ordinal differential equations, sets of differential equations, method of integration. Partial differential equations, Furrier method of solution, method of Laplace transform. Ideal and real fluids, forces acting in fluids. Fluid statics, equilibrium conditions, Pascal, Euler, Archimedes laws. Fluid kinematics. Analytical methods of fluid kinetic. Continuity equation, Euler equation of motion. Laminar and turbulent flow. Boundary layer. General and differential momentum and mass balances. Navier-Stokes equation. Selected analytical solution of Navier-Stokes equation. Theory of turbulence- elements. Elements of rheology. Flow through porous media. Dimensionless analysis: Rayleigh method, Buckingham theorem, method of differential equations.	
Fundamentals of CAD / CAE in polymer processing	K_W08, K_U02, K_U03, K_U05, K_U20, K_K01
• Student knows the methods of 3D-CAD design dedicated to incremental manufacturing systems • Student is able to perform 3D-CAD model data processing and prepare data for the manufacturing process • Student is able to use the selected system of incremental prototyping • Student can do prototype using indirect prototyping method • Student can perform postprocessing and finishing works on the prototype • Student learns methods of modeling and processing data for the process of rapid prototyping of products, closely observing the content of the lecture • Student learns the methods and ways of data processing in the RP process, closely observes the contents of the lecture, asks questions for additional information. • Student learns modern RP methods of performing physical models and possibilities of practical application of prototypes	
Fundamentals of chemical technology	K_W03, K_W05, K_W07, K_U01, K_U06, K_U08, K_U20, K_K01
• Basic definitions. Principles of designing new technologies. Similarity theory and its application. • The properties of gases and liquids. The similarity of properties. Calculating methods of the properties of gases and liquids. • Chemistry of processes. Stoichiometry of reaction. Calculating the composition of the reaction mixture. Heat of reaction . • Chemical affinity. Chemical equilibrium concept and problems. The equilibrium composition of the reaction mixture.	
Fundamentals of heat and mass transfer	K_W03, K_W04, K_W05, K_U04, K_U05, K_U06, K_U19, K_U20, K_K01
• Energy transport. Steady and unsteady heat conduction. First Fourier low and its application. Differential energy balance, method of solution of energy balance equation. Heat convection, heat transfer, Newton equation, overall heat transfer. Energy transport by radiation. Energy transport by convection and radiation. Basics rules of heat exchanger designing. Mass transport. Steady and unsteady diffusion. First and second Fick law. Maxwell-Stefan equations for multicomponent diffusion. Differential mass balance. Exemplary analytical solution of mass balance equation. Estimation of diffusion coefficients. Mass convection, single-phase, two-phase mass transfer. Basics rules of mass exchanger designing. Theoretical one stage exchanger, multi stage exchanger, exchanger with continuous phase contact. Axial dispersion.	
Fundamentals of programming	K_U02, K_U20
• Getting to know the C++ programming environment. Creation a sample program to acquaint the structures, data types and the main control instructions in C++. • Preparation of the own program project and algorithm develop. Implementing the program using elements of object-oriented programming. Running and testing the computer program. Developing of the program documentation. Acceptation of the student work. • Getting to know the C++ programming environment. Creation a sample program to acquaint the structures, data types and the main control instructions in C++. • Preparation of the own program project and algorithm develop. Implementing the program using elements of object-oriented programming. Running and testing the computer program. Developing of the program documentation. Acceptation of the student work.	
General and inorganic chemistry	K_W06, K_U03, K_U08, K_U20
• Concepts and chemical laws. Struture of atom. Periodicity of chemical properties. Ionization energy, electron affinity, electronegativity. Metal and non-metals. Chemical bonds. Covalent bonds. Formal oxidation state. Molecular orbital and valence bond theory. States of matter. Phase transistions. Gas state. Ideal gas state equation. Units of matter. Solid state. Ionic and molecular crystals. Liquids and solutions. Units of concentration. Electrochemical processes and corrosion. Chemical equilibrium. Mass action law. • The basic calculations: fundamental laws. Concentration of solutions: way of expression, conversion of concentration, dilution and mixing of solutions. Stoichiometric calculations based on chemical reaction equation. Elemental and real chemical formula. Yield of reaction. Oxidation and reduction reactions. Gas laws. Reaction kinetics. Chemical static, mass action law, chemical equilibrium. • 1. Liquids and solutions. Colligative properties. 2. Electrolytes. Electrolytic dissociation. Strong and weak electrolytes. 3. Acids and bases. Ampholytes. Buffer solutions. 4. Thermochemistry and thermodynamics.5. Inorganic compounds, classification and terminology 6-9. Properties of elements. Inorganic compounds, preparation methods end properties. Main group metals (1, 2, 13). Elements of group 14-18. 10. D-block elements. Crystal field theory. Spectroscopic and magnetic properties. 11. F-block elements. 12. Complex compounds. Additional compounds. • 1. Electrolytic dissociation of strong and weak electrolytes. Activity and activity	

coefficient, ionic strength, ionic product of water, pH. 2. Dissociation constant and degree. 3. Buffer solutions. 4. Hydrolysis, the hydrolysis constant and degree. 5. Solubility product. • 1. Basic laboratory operations and equipment. Synthesis of inorganic compounds. 2. Classification of inorganic compounds. 3. Types of chemical reactions. 4. Solutions: preparation and concentration calculations. 5. electrolytes – electrolytic degree and constant, pH, alkacymetric indicators. 6. Buffer solutions. 7. Inorganic complexes. 8. Hydrolysis - the hydrolysis constant and degree. 9. Precipitation, dissolving and chemical conversion of solid compounds. 10. Oxidation and reduction reactions.	
Heat transfer equipment design	K_W03, K_W04, K_W05, K_U04, K_U05, K_U06, K_U08, K_U20, K_K01
• Heat exchangers: principles of operating, construction of exchangers, energetic balances, driving force in heat exchangers: co -current, countercurrent and cross-flow exchangers, wall temperature, calculation of area of heat transfer. Evaporators: evaporation of solutions, evaporation in industry, energetic and mass balances, multistage evaporation, temperature loses in multistage evaporators. • Design of heat exchangers rusing simulation software ASPEN PLUS. • Handling simple equipment for heat exchange, determining heat transfer coeffcients	
Industrial polymer materials	K_W03, K_W08, K_U01, K_U08, K_U11, K_U20, K_K01
• Types of polymer materials used in industry • Classification of polymers by their range of application	
Industry processes and process apparatus, process intensification	K_W03, K_W04, K_W09, K_U04, K_U05, K_U06, K_U09, K_U20, K_K01
• Classification of unit operations and process apparatus. Introduction to design and intensification of unit operations. • Intensification of flow processes in simple systems: flow parameters; the effect of flow turbulence on efficiency and cost of processes. • Transport of liquids and gases. Rotodynamic and positive displacement (piston) pumps. Suction and pumping heights. Pumps characteristics. Pumps systems. • Rotodynamic and positive displacement (piston) pumps. Gas compressors. Special pumps and comprssors. Vacuum pumps. • Introduction to fluid flow in complex systems. Dispersed phase characteristics. Comminution of solids and apparatus. Phase contacting methods: in fixed bed, fluidization and pneumatic conveying. • Introduction to mechanical phase separation methods: drag force and falling velocity. • Phase separation methods: sedimentation, filtration, flotation, filtration and centrifuge separation, dust removal. Thickeners for preconcentration, classifiers, filters and centrifugal separators, dust separators. • Mixing of liquids. Power consumption. Stirrers and mixing vessels. • Intensification of unit operations and assessment of construction functionality and process adequatelity of the basic equipment and apparatus types for chemical industry: heat exchangers, evaporators, crystallizers, distillation units and rectification towers, absorbers and adsorbers, extractors and dryers. • Life cycle assessment for product, equipment and industrial installation	
Instrumental analysis	K_W06, K_U03, K_U08, K_U20
• The role and tasks of instrumental analysis in industrial processes. Samples acquisition, storage and preparation for analysis. Classification of instrumental methods. Calibration and calibration plots. Errors of analysis, classification, source and minimization of errors. Optical methods. Polarimetry. Quantitative analysis of elements and compounds using spectroscopic methods. Atomic Emission Spectroscopy - theoretical principles, excitation sources, apparatus, ICP-AES and GDL-AES spectrometers. Atomic Absorption Spectroscopy (AAS) principles and applications. Absorption spectroscopy in UV/VIS. IR absorption spectroscopy - application in quantitative and qualitative analysis of organic compounds. Basic principles of magnetic nuclear resonance. Structural and quantitative analysis on the base of 1H-NMR spectra. Principles of mass spectrometry of organic compounds. Interpretation and analytical application of mass spectra. Chromatographic methods - definition and classification. Chromatography theories and their use in practice. Gas chromatography - influence of chromatographic conditions on separation process and analytical performance. Practical applications. High performance liquid chromatography (HPLC). Apparatus and separation techniques: gradient elution and mobile phase programmed flow speed. Optymalisation of separation processes - theory and practice of stationary and mobile phase selection and separation parameters. HPLC applications. Electroanalytical methods. Potentiometry - principles and instrumentation. Construction, principles of operation and applications of chosen ion-selective electrodes (ISE). Voltammetric methods - the main techniques. Selected applications of voltammetric methods in laboratory and industrial analysis. Conductometry - definition, instrumentation and application. Complementarity of instrumental methods. Hyphenated methods. Criteria of choice of the analytical methods. • Determination of elements by using the atomic absorption spectrometry (AAS). Determination of organic compounds using absorption infrared spectroscopy. Determination of chemical substances using absorption spectriscopy in UV/VIS. Analysis of mixtures of organic compounds with application of 1H-NMR spectroscopy.	
Introduction to materials science	K_W03, K_W08, K_U01, K_U20
• Lecture: Introduction, definition of material, classification of materials in terms of arrangement, -crystals and glasses. The basic terms of crystallography: (space lattice, crystal axis, unit cell, space points, lines and planes). Miller indices of planes, directions in a crystal lattice. Crystallographic systems. Fourteen Bravais. Atom radius and ion radius. Coordination numbers and figures. Symmetry of crystals. Elements of group theory. Classification of crystals in terms of chemical bonding (ionic crystals, covalent crystals, metal crystals, molecular crystals). The most important structures of elements and chemical compounds. Real crystals. Monocrystals and polycrystals • Bravais lattice. Crystal lattice nodes. Symbols of lattice directions and symbols of lattice planes in crystals. Belt of planes. Symmetry in crystals and combination of symmetry. • Classification of crystals in terms of chemical bonding (ionic crystals, covalent crystals, metal crystals, molecular crystals). The influence of chemical bonding and crystal structure on the material properties. • Dense structure pose. Octahedral and tetrahedral gaps. The main crystal structures of elements and chemical compounds. Allotropy and polymorphism • Real crystals. Point defects, dislocations, plane defects. Single crystals and polycrystals. Grain boundary. • .Classes: Symbols of lattice points, lattice directions and lattice planes. Volume and crystallographic density of an unit cell. Atom radius and ion radius. Elements of crystal symmetry. Structures of dense spacing. Real crystals.	
Machines theory and technical mechanics	K_W04, K_U04, K_U06, K_U18, K_U19, K_U20, K_K02
• Basic terms and concepts of mechanics. • Flat, convergent arrangement of forces. • Moment of force. • Reduction and equilibrium of planar systems forces converging and arbitrary. • The sliding and rolling friction. • The center of gravity. • The moment of inertia. • Basic terms and concepts of the strength of materials. • Mechanical properties of construction materials. • Basic cases of stress: compressive, tensile, shear, torsion, bending, buckling, complex strength. • Plane trusses • General rules of designing and construction of chemical apparatus • Standards and standardization, law regulations by Polish Office of Technical Inspection (UDT) • Basic constructive materials used in construction of chemical apparatus: steels and iron-base alloys, other metallic materials, plastics, glass and ceramics, wood. Criteria and rules of constructive material selection. • Machines review and basic machine parts of general purpose: joints, shafts and axles, bearings, couplings, brakes, gears and drives together with their calculation and selection rules • Basic chemical apparatus parts: bodies (shells), heads, connector pipes, openings, vessel accessories, pipelines and their parts, seals and valves together with their calculation and selection rules	
Mathematics	K_W01, K_U20
• Elements of mathematical logic and set theory. Basic properties functions of one real variable, polynomials, Horner's scheme, rational functions and other elementary functions, arc functions. • Sequences of numbers: monotonicity and boundedness of sequences, limit of a sequence, theorems about existence of a limit, Napierian base and its applications. Series of numbers: properties of series of numbers, tests for convergence of series, tests for divergence of series. Limit and continuity of function of real variable: definitions of limit, counting properties of limits of functions, notion of continuity of a function. Asymptotes of a function. • Differential calculus of function of one real variable: notion of derivative of function, derivatives of higher order, derivatives of basic elementary functions, derivative of composite function, De l'Hospital's theorem, mean value theorems, investigation of monotonicity and determination of extrema of functions, convex and concave functions, points of inflexion of graph of function, investigation of the behavior and systematic procedure in graphing of function. • Integral calculus of function of one real variable: notions of primitive function and indefinite integral, integration by parts and by substitution, integration of rational functions, integration of irrational functions, integration of trigonometric functions. Notion of definite integral, applications of definite integrals, improper integrals. • The set of complex numbers: canonical and polar form of a complex number, de Moivre's formula, calculation of power and root of complex numbers. • Matrices: definition, operations on matrixes and its properties, square matrices, determinant and its properties, inverse matrix, rank of a matrix. Systems of linear equations: Kronecker-Capelli's theorem, Cramer's systems. • Ordinary differential equations: notions of general solution and particular solution, initial-value problem, ordinary differential equations of first-order (about separable variables, linear, homogeneous respect to x and y, linear), ordinary differential equations of second-order reducible to equations of first-order, linear equations. • Elements of calculus of vectors and analytic geometry: vectors, operations on vectors and its properties, scalar product of vectors and its properties, vector product and	

triple scalar product of vectors, equations of a plane and of a straight line in the space. • Basic properties of function of several variables: limit and continuity of functions of several variables, partial derivatives, extrema of functions of several variables. Elements of field theory: scalar and vector fields, gradient, divergence, rotation, potential of vector field. Double and triple integrals - basic concepts. • Relationship of systems of first order differential equations with scalar differential equations of the n-th order. General methods of solving systems of ordinary first order differential equations. Method of elimination, method of first integrals. • Systems of linear first order differential equations. Methods of solving first-order linear differential equations with fixed coefficients and the method of constituting solids for solving non-homogeneous linear systems. • Initial and boundary problems for partial differential equations. Linear and quasi-linear partial differential equations of the first order. • Fourier series. Trigonometric series. Extension in the Fourier series. Convergence conditions of the Fourier series. • The canonical form of the differential partial differential equation of the second order. Fourier method of solving differential differential equations.	
Metrology and industrial measurements	K_W08, K_W09, K_U14, K_U20
• Basic concepts of law and industrial metrology. Historical outline. International System of Units. Standards of physical quantities. • Defining of the measurand and mathematical model of measurement result. Direc and indirect measurement method. Validation of the measurement method. • Basic measurement equipment: digital multimeter, sensor, transducer, meter. Metrological properties of the measurement equipment. Basics of operation of measurement instruments and performing of correct measurements. • Essential concepts of measurement result: accuracy, error, uncertainty, trueness, precision, repeatability, reproducibility. • Indicated value, measured value, measurement error, instrumental error, measurement method error, correction factor. Uncertainty of measurement result. • Ways of declaration of accuracy of measurement equipment. Static characteristic, non-linearity. Relative and absolute maximum permissible error of indication. • Estimation of standard uncertainty with method type A and method type B. Calculation of combined uncertainty and expanded uncertainty. • Verification, calibration, legalisation and adjustment of measurement equipment. Analysis of the manufacturing process capability. Process quality indexes and measurement equipment capability indexes. • Types and specifity of casual, cognitive and verification measurement. Using of the physical quantity standard and the certificate of calibration during measurement. Industrial measurements of temperature, pressure, flow and level. • Notation and interpretation of measurement result. Traceability of the measurement result. Quality, reliability and applicability of performed measurement.	
Modern methods of polymer modification	K_W03, K_W07, K_U06, K_U08, K_U20, K_K01
• Modification of polymers as a method of obtaining new materials. Chemical modification: block copolymers, alternating and graft copolymers with vinyl and diene copolymers. Ionomers. Physical modification: examples of physical modification, types and properties of polymer fillers, types of fibrous fillers, plasticisation of polymeric materials. Nanomaterials obtained by physical modification. Methods of surface modification of polymeric materials. Trends in modyfication of polymers.Polymer modification in the paint and varnish industry. • Chemical modification of polymers towards increasing hydrophobicity • Synthesis and physical modification of high-solid coatings • Preparation and characterization of polymer superabsorbent • Synthesis of polyurethane cationomer	
Modern polymer technologies	K_W03, K_W07, K_W08, K_U05, K_U08, K_U18, K_U20, K_K01
• Carbonic polymers, graphene and its analogues. Polycarbines, polyacetylene, topochemical polymerization. • Fulerenes and polyfulerenes and their modifications. • Supramolecular polymers - charge transfer complexes, inclusion complexes, supramolecular recognition, self-organization of matter • Topological polymers – polycatenanes , polyrotaxanes and polyxarenes , polymers with molecular traces • Smart polymers	
Organic chemistry	K_W06, K_U03, K_U08, K_U20
• Structure and isomerism of organic compounds. Efects of electronic displacements versus explanation of properties of organic compounds. Classification of organic compounds. • Basis of chemical nomenclature. • Saturated and unsaturated hydrocarbons (alkene, alkadiene and alkyne). Aromatic hydrocarbons – derivatives of benzene. Halogen derivatives of hydrocarbons. Alcohols, phenols and ethers. Aldehyde and ketones. Mono- and policarboxylic acids. Halo-, hydroxy- and oxoacid. • Derivatives of carboxylic acid (halogens, anhydrides, amides). Esters (soap, fats, ester condensation). Nitro compounds and amines. Azo- and diazocompounds, isocyanates. Aminoacids, peptides, proteins. Carbohydrates. Polymers. • Synthesis, separation and purification of some organic compounds and determination of basic physical properties.	
Packages of application software	K_W08, K_U02, K_U03, K_U20
• Application of MS Excel to discretize functions, create simple and advanced plot charts, perform array operations, simple statistical analysis, operations with macros and to solve chemical problems and model simple chemical processes using solver tool. • Application of Origin Lab software to prepare professional 2D and 3D charts, to perform statistical processing of experimental data, to estimate parameters for equation describing experimental data, to perform differentiation and integration of discrete functions • Application of Matlab and/or Maple programs for arithmetic calculations, algebraic transformations, solution of linear and nonlinear equations, inequalities and systems of equations, symbolic and numerical function integration and differentiation, matrix algebra, solving differential equations, graphing functions of one and two variables. Introduction to Programming in Matlab and/or Maple. Creation of simple programs for solving selected mathematical problems. • Application of ChemSketch software to create and edit chemical structures	
Parametric designing in Autodesk Inventor	K_W08, K_U02, K_U03, K_U20
• Autodesk Inventor interface • Parametric drawing of figures on the plane - use of geometric and dimensional constraints • Different drawing methods for obtaining the same solid model • Detecting and correction of mistakes • Tools for creating and modifying 3D elements • Construction elements • Saving the components of the designed unit • Unit assembly of parts - defining degrees of freedom, unit constraints and movement • Using the base of ready-made elements • Creating two-dimensional documentation • Individual design of chemical equipment element • Autodesk Inventor interface • Parametric drawing of figures on the plane - use of geometric and dimensional constraints • Different drawing methods for obtaining the same solid model • Detecting and correction of errors • Tools for creating and modifying 3D elements • Construction elements • Determining the properties of subassembly • Saving the components of the designed unit • Unit assembly of parts - defining degrees of freedom, unit constraints and movement • Using the base of ready-made elements • Creating two-dimensional documentation • Individual design of chemical equipment element	
Physical chemistry	K_W06, K_U03, K_U08, K_U20
• The theory of perfect gases. Equations of state. Dalton's law and Amagat's law. The theories of real gases. The kinetic theory of perfect gases. Chemical thermodynamics. System. Surroundings. Work. Heat. Cyclic processes. Reversible processes. Isothermal reversible expansion of a gas. The first law of thermodynamics. Internal energy. Enthalpy. Heat capacity of gases, liquids and solids. Thermochemistry. Enthalpy of formation of compounds. Heat of solubility. Bond energy. The temperature dependence of reaction rate on temperature. The second and the third law of thermodynamics. Spontaneous transformations. Carnot cycle. Entropy. Entropy changes in reversible and irreversible processes. Entropy of mixing. Gibbs energy. Helmholtz energy. Differentials and derivatives of thermodynamic functions. The influence of pressure and temperature on free energy. Thermodynamic criteria of spontaneity of processes. Partial molar quantities. Chemical potential. Interatomic and intermolecular interactions. Viscosity and surface tension of liquids. Phase equilibria and diagrams. Three-component systems. Phase rule. Clapeyron equation. Clausius-Clapeyron equation. Vapor pressures over ideal solutions. Vapor pressures over real solutions. Solubilities of gases and liquids. Thermodynamics of ideal solutions. Activity. Activity coefficient. Boiling temperature – composition diagrams of two-component solutions. Azeotropes. Colligative properties. Diffusion equations. Viscosities of liquids and gases. Colloidal systems and surfactants. Physicochemical properties of colloids. Chemical equilibrium. A thermodynamic equilibrium constant. Chemical equilibrium in gas phase. Gibbs energy function. The influence of pressure and temperature on chemical equilibrium. • Physicochemical calculations connected with theory of perfect and real gases, chemical thermodynamics, phase equilibrium, colligative properties of solutions. • Chemical kinetics. The rate and the order of reaction. Zero, first, second, third and fraction order reactions. Determination of reaction order and rate constant. Dependence of reaction rate and reaction rate constant on temperature. Arrhenius theory and transition state theory. Kinetics of complex reaction. Kinetics of enzymatic reaction. Basics of katalysis. Gibbs-Duhem equation. Gibbs adsorpion equation. Adsorption. Adsorption theories. Langmuir, Freundlich and BET equation. Surface catalytic activity. Electrolyte solutions. Debye-Hückel theory. Activity of electrolyte solutions. Specific and molar conductance of strong and weak electrolytes. Transport numbers. Ionic mobility. Thermodynamics of electrolyte solutions. Electrochemistry. Semicells and electrochemical cells. Conventions. Electrode potential. Chemical reactions in semicells. Nernst equation. Electromotive force of electrochemical cells. Thermodynamics of electrochemical cell. Physicochemical aplications of electrochemical measurements. Batteries and fuel cells. Theoretical basics of molecular spectroscopy. Symmetry elements. • Physicochemical calculations connected with chemical equillibrium, chemical kinetics of simple, complex and enzymatic reactions, theory of electrolyte solutions, ionic conductance and electrodics. • Determination of evaporation enthalpy of a high-boiling	

liquid. Determination of phase equilibrium in three - component system. Determination of boiling temperature – composition diagram for chloroform – acetone system. Determination of reaction order and rate.Determination of thermical activation of a chemical reaction. Determination of distribution coefficient. Determination of surface tension of liquids. Determination of adsorption isotherm. Determination of limiting molar conductivity of electrolyte solution. Determination of ΔG, ΔH and ΔS of chemical reaction.	
Physical Education	K_U18, K_U19
• Acquainting with the rules of participation in classes and the conditions for obtaining a pass. Discussion of the principles of safe use of sports facilities and equipment and safety rules in force during the course. • Implementation of various sets of warm-up exercises and exercises focused on developing the student's basic motor skills. • Shaping general physical fitness, motor coordination, endurance, flexibility, speed through individual selection of sports activities (eg: football, volleyball, basketball, table tennis) or recreational physical activity (eg: badminton, gym exercises). • Physical fitness test: Multistage 20 m Shuttle Run (Beep test). • Acquainting with the rules of participation in classes and credit conditions. Discussion of swimming pool conditions and safety rules applicable during exercise in the aquatic environment. • Initial adaptation to the aquatic environment: - face dipping, eye opening and orientation under the surface of the water, - mastery of breathing in the aquatic environment, familiarization with the buoyancy of water, - control of lying on the breast and back, - plays and games in water. Warm-up exercises, preparing for exercises in water. Learning how to behave in water in difficult and unusual situations: choking, shrinkage, sinking, etc. • Learning backstroke style: lying on the back, slipping, correct leg work with a board on the hips and without a board, proper work of the arms. Improvement of proper coordination of lower and upper limbs. Learning free style: slipping on the chest, proper leg work combined with breathing, exercise with a board and without a board. Learning the proper work of the arms (swimming with a proper body with a proper breath and exhalation). Learning how to coordinate the work of lower and upper limbs with the determination of proper breathing. Learning breaststroke style: proper work of legs with a board and without boards on the chest and on the back, correct work of arms in a classic style. Coordination of lower and upper limbs and breathing in a classic style. Learning to jump on the legs and on the head. • Fitness test: a 25-meter swimming trial chosen by the student.	
Physics	K_W02, K_U08, K_U20
• Measurements and physical units. Dimensional analysis. Functions of one and several variables. Scalars and vectors. Derivatives in physics. Coordinate Systems. • Motion along a straight Line, Motion in two or three dimensions, kinematics of rotational motion. Newton's laws of motion, Applying Newton's laws Work, power and energy, Potential energy. Conservative forces Momentum, Impulse, and Collisions Dynamics of Rotational Motion, Rotation of Rigid Bodies • Periodic motion, differential equations and complex numbers in physics, resonance. Mechanical waves, wave phenomena, acoustics: sound and hearing • Fluid Mechanics, Introduction to thermodynamiscs: temperature and heat, Thermal properties of matter, Laws of thermodynamics, entropy • Introduction to physical laboratory classes. The uncertainty of the measurements. • Introduction to electromagnetism: Electric charge and electric field, Gauss's law, Work and electric potential. Capacitance and Dielectrics. Conductors, electric current, resistance, circuits and Electromotive force . Magnetic field. The Lorentz force. A electric charge and current-carrying wire in magnetic field. The magnetic field induced by current flow. Hall effect, Cyclotron, mass spectrometer. The phenomenon of magnetic induction. • Electromagnetic waves: dispersion, Interference, diffraction, polarization. Application of optics. • Introduction to modern physics and quantum mechanics, wave-particle duality of light and matter, probability and uncertainty principle Schrodinger equation, free particle, parlicle in potential well, stationary states, atomic structure, condensed matter Introduction to nuclear physics, nuclear reactions, nuclear power, stability and radioactivity, biological effects of radiation	
Polymer chemistry and technology	K_W06, K_W07, K_W08, K_U01, K_U03, K_U06, K_U08, K_U10, K_U12, K_U18, K_U19, K_U20, K_K01
• Introductory remarks; classification of polymers according to Carothers and Flory; examples of polymer types; nomenclature • Historical outline of polymer industry and the polymers produced in the largest quantity. • Thermodynamic and kinetic conditions of polymerization processes.Structure of macromolecules vs. physical properties of polymers • Condensation polymers. Mechanism of polymerization. Main types of commercial condensation polymers • Radical polymerization. Large scale polymers produced by radical polymerization. • Ionic polymerization of unsaturated monomers • Copolymerization. Copolymers produced on industrial scale • Oxirane polymerization. Commercial polymers produced by ring-opening oxirane polymerization. • Polymer tacticity. Coordination polymerization. Polyolefins • Reactions on polymers. Chemical modification of polymers • Native polymers. Biopolymers • Synthesis of selected groups of polymers • Modification of polymers. Identification of main groups of polymers	
Polymer materials processing	K_W05, K_W08, K_U02, K_U03, K_U05, K_U08, K_U11, K_U20, K_K01
• Auxiliaries for plastics processing. Preparation of plastics for processing. Forming treatment. Extrusion and related technologies. Injection and related technologies. Application, spraying. Dipping Coating. Lamination. Pressing and pressing. Rolling and calendering. Foaming Sintering. Finishing of plastics. Secondary molding. Joining and bending. Surface treatment of products: dyeing, printing, metallization. Chip processing. Improving the surface. Design: Basic tools used in plastics processing Injection molds for thermoplastics. Application of CAD CAM software in the design. Laboratory: Investigation of the influence of compression molding parameters of thermosetting molds on the properties of moldings. Setting up the thermoplastic injection process. Study of the effect of injection molding parameters of thermoplastics on the strength properties of moldings. Examination of extrusion performance of plastic profiles. Study of the effect of extrusion blowing parameters on the properties of polyolefin films. Polyester-glass composites (laminates). Metal bonding. Determining the optimum rolling time of the rubber blends. Study on the effect of selected parameters on the strength of seams welded from polymeric films. Processing of polychlorovinyl pastes. Galvanic metallization of plastics 11. Production of plastic products by casting method 12.Termoforming	
Process design	K_W03, K_W05, K_U02, K_U03, K_U05, K_U09, K_U20, K_K01
• Introduction to methods of designing integrated systems technology. Characteristics of simulation software and simulation strategy. Definitions and calculations organization. Basic rules for the selection of thermodynamic models. • Introduction to simulation calculations of technological processes (flow of information, analysis of degrees of freedom, the models selected processes, classification of simulation methods, numerical computation, useful options - design specifications, sensitivity analysis. The calculation of the physicochemical properties of the solutions. • Selection rules and parameters of the processes, apparatuses, the selection of the reactor and the reaction parameters, the separation process - the base. The calculation of chemical reactions and reactors. Calculation of the heat exchangers. • Criteria for evaluation of the project - "pure" chemical technology. Hierarchical method, an example application. Basics of simultaneous methods. Calculation of separators with two liquid phases. • Design Heuristics. The calculation of basic unit operations and analysis of the results (flash calculations, distillation, extractive distillation, absorption). • Systems design process - the base, the scope of the initial project, the organization of the design process, the evaluation criteria the technological system, basic system design strategies. Calculation of pipeline networks and their elements. The calculation of the basic operations of fluid transport (pumps, compressor, expander, valves). • The use of sensitivity analysis as a tool for selection of parameters of the apparatus. • Optimization calculations of the distillation columns.	
Professional training	K_U12, K_U14, K_U15, K_U18, K_U19, K_U20, K_K01, K_K02, K_K05
• Training on safety work and anti fire regulations in plant/company/institution. Extending of knowledge gained on university in practical way. Introducing to work of plant/company/institution and with their internal procedures. Preparation to job in future.	
Scientific and technological information	K_U01, K_U02
• Searching for information on the most abstracts and bibliographic important publishing houses (Chemical Abstracts) with the use of index. Search for chemical information in scientific journals available on-line from the Rzeszów University of Technology library.	
Social competences	K_W10, K_U14, K_U17, K_U19, K_K02, K_K03, K_K05
• Social and interpersonal competences as an ability to achieve social and individual goals while maintaining good relations with interaction partners • Components of social competences • Competencies determining the effectiveness of behavior in the situation of social exposure • Strategies for image formation and self-presentation • Conditions of interpersonal skills and the importance of social competences • Improving skills and abilities relevant to social competences (assertive, cooperative, social, and social resourcefulness) • Developing and improving skills and abilities relevant to social competences (mutual understanding and getting to know each other, creating a climate of mutual trust, helping and influencing, solving problems and conflicts) • Developing and improving skills and abilities essential for social competences (communication skills,	

assertive skills, skills to strengthen, sustain others, self-expression skills) • Developing and improving skills and abilities relevant to social competences - verbal and non-verbal communication • Improvement of the skills of beneficial self-presentation (especially in professional conditions) • The importance of social competences	
Statistics and results elaboration	K_W08, K_U02, K_U20
• LIMS (Laboratory Information Management System) – selected problems. • Experimental database. Rejection outliers in data. Selective use of data. • Exploratory data analysis of the analytical measurements, descriptive statistics, cross-sectional data, normality tests, statistical graphs. The frequency distribution of a variable. • Statistical hypothesis testing. Parametric and non-parametric tests. • Multiple regression. Study of correlation between variables. • One-way and multiple analysis of variance. Discriminant analysis, factor analysis and principal components analysis. • Fitting the observed variable distribution to a theoretical distribution. • Management of Statistica program data. Parameters of variable distribution. • Study of empirical variable distribution. Statistical inference- nonparametric tests. • Statistical inference- parametric tests. • Analysis of the relationship between variables: linear and non-linear regression. • Analysis of Variance.	
Technical safety and ergonomics	K_W08, K_U12, K_U15, K_K02
• Legislation in the field of labour protection, including the following: the rights and responsibilities of students and staff in the field of safety and liability for violation of safety rules and regulations, liability for accidents, the legislation concerning insurance benefits for safety violation and accidents at work. • Responsibilities of the university in the provision of safe and healthy learning environment: health and safety requirements for school buildings, the requirements for systems and equipment located in the building of the university. • Subject matter and scope of work safety and ergonomics. • Security in terms of the system (security as a management objective, as a legal obligation, a moral norm). • Models of accidents at work (the classic models of accidents, near misses models, modelling human behaviour in emergency situations). • Statistical and behavioural theories of safety. • Ergonomic aspects of the system human – machine – environment. • Assessment of the reliability of the systems: human – computer, driver – car, pilot – airplane, as real cases of human – machine systems. • Methods for measuring the burden of dynamic physical labour and static physical labour. • The study of the burden of mental work. • Dangerous and harmful factors connected with work process and working conditions. • Risk assessment in a selected work position. • Ergonomics in the shaping of working conditions (some ergonomic principles and recommendations for the design of the spatial structure of the workplace, indication and control devices, technological processes, objects). • Ergonomic factors in the organization of work. • Ergonomic assessment of machinery and equipment and improving working conditions. • University rules of conduct in case of accidents and emergencies (fire, accident, etc.) pre-medical aid rules in the event of an accident, fire protection (including evacuation).	
Technology of monomers	K_W03, K_W07, K_U06, K_U08, K_U10, K_U18, K_U20, K_K01
• Introduction. Olefinic monomers. Dienes. • Vinyl and acrylic monomers. • Polyols • Formaldehyde. Oxiranes and polyols • Carboxylic acids and their derivatives. • Aliphatic and aromatic polyamines. • Diisocyanates. • Phenols. Urea and melamine. • Synthesis of three selected monomers.	

programme content of elective modules

English (A)	K_U14, K_U16, K_U20
• Talking about yourself, famiy, home, likes and dislikes. Question forms. • Talking about important dates and events. Writing formal and informal emails. • Discussing differences between men and women. Expressing opinions. • Describing people. Revision of verb tenses: present and past simple, present and past continuous. • Talking about yourself. Conversation and interviews. • Giving advice on succsessful interviews. Talking about yourself. • Talking about films. Expressing opinion about films. • Talking about life experiences. Verb tenses: present perfect and past simple. • Talking about the media and news. Expressing opinion on conspiracy theories. Matching headlines with explanations. • Talking about stories from the past. Writing a news report. • Talking about lying. Collocations with 'say' and 'tell'. • Tellling a story or anecdote from the past. Listening to people telling anecdotes. • Phrases to describe a good/bad experience. Talking about memorable moments. Writing about one of your happiest memories. • Expressing opinions.Talking about problems of teenagers and their parents. • The future (plans): the present continuous, going to, will, might. Writing messages; learn to use note form. • The future (predictions): will, might, may, could, going to, likely to. Future time markers; idioms • Listening to predictions about the future of communication. Talking about how things will change in the future. • Reading a short story about a misunderstanding. Dealing with misunderstandings. Types of misunderstandings; phrases to clarify/ask someone to reformulate • Listening to telephone conversations involving misunderstandings. Learning to reformulate and retell a story about a misunderstanding. Role-playing resolving a misunderstanding. • Reading an article about millionaires. Modals of obligation: must, have to, should. • Discussing the qualities needed for different jobs. Completing a survey and discussing the results. • Reading about childhood dreams. Reading job advertisements. Used to and would. • Listening to two people describing dream jobs gone wrong. Talking about past habits. Writing a covering letter. • Reaching agreement. Business collocations. Phrases to give opinions, • Listening to people making decisions in a meeting. Learning to manage a discussion; Participating in a meeting and creating a business plan. • Office conversation; phrases to describe routines. Describing a day in your life. • Reading an article about how technology changed the world. Comparatives and superlatives. Vocabulary: technology. • Discussing how technology has changed the world. Talking about different types of transport and their uses. Writing an advantages versus disadvantages essay. • Talking about future hopes and plans. Grammar: Future Perfect, Future Continuous. • Listening to people answering difficult general knowledge questions. Doing a short general knowledge questionnaire; answering questions on your area of expertise. • Polite requests. Problems and solutions. • Listening to conversations about technical problems. Learning to respond to requests. Role-playing asking and responding to requests. • Reading about basic emotions. Zero and first conditionals. -ing versus -ed adjectives; multi-word verbs with on, off, up and down • Listening to a radio programme about therapies. Talking about your emotions. Discussing what advice to give people in a variety of situations. • Second conditional. Verb-noun collocations • Discussing what you would do in different hypothetical situations. Writing a letter of advice. • Giving good and bad news. Life events. • Listening to conversations where people receive news. Learning to introduce and respond to news. Role-playing giving someone news • Phrases to describe a good/bad experience. Talk about memorable moments. Writing about one of your happiest memories. • Reading a short introduction to The Secret of Success. Present perfect simple versus continuous. • Present and past modals of ability. Reading a biographical text about the memory men. • Listening to a three-way conversation about memory. Talking about your abilities. Writing a summary. • Clarifying opinions. Reading a story about qualifications. • Listening to a discussion about intelligence. Learning to refer to what you said earlier. Choosing the right candidate for the job. Giving opinions and examples. • Reading a BBC blog about neighbours. Articles. Quantifiers • Describing your neighbourhood and discussing how it could be improved. • Relative clauses. Vocabulary connected with the internet. Reading a website review. • Listening to descriptions of online communities. Comparing real-world and online activities. Writing a website review. • Being a good guest. Welcoming. Reading about how to be a good guest. • Listening to people describing guest/host experiences. Learning to accept apologies. Discussing problematic social situations. • Revision for the written examination. • Grammar practice - preparation for the examination.	
English (B)	K_U14, K_U16, K_U20
• Flatmating, family, personality vocabulary, asking questions. Speaking, listening. • Vocabulary used in informal emails. Writing an informal email, checking accuracy • Feelings, gradable and ungradable adjectives, word formation. Reading, speaking, listening. Grammar: Present Perfect • Advertisements. Making polite phone enquires. Reading, listening, speaking. • Writing a summary of a first encounter story • Social issues. Verbs and nouns with the same form. Grammar: Present Perfect • Preventing crime, surveillance. Giving solutions. Grammar: the Passive • Formal written language. Writing a letter of complaint. • Newspaper extracts. Expressing opinions. Opinion adjectives. Reading and speaking. • Discussing ingredients of happiness; carrying out a happiness survey. Writing tips for being happy for a website. • Games. Discussing behaviuor and annoying habits and routines. Grammar: would/used to.Speaking. • Talking about leisure. Writing an opinion essey. Using linkers. • Talking about holidays. Grammar: Future forms, countable and uncountable nouns. • Describing procedures. Common actions in procedures. Talking about gameshows. Verbs. • talking about unusual experience. Recommending. Writing a story. • Reading a story. Sayings. Grammar: Past tenses. • Telling stories. Talking about experience from the past. Grammar: adverbs. • Wishes and regrets. Multi-word verbs. Grammar: wish/if only • Talking about reading habits, favourite books, likes and dislikes. Reading a summary. • Describing a favourite scene in a film. Writing a description of a favourite scene. • Rading and talking about the worst inventions. Bicycles. Change. Compound nouns. Grammar: articles. • Discussing advertising tactics and the influence of advertising. Grammar: condiotionals. • Marketing and advertising. Writing a report. Learning to make written comparisons. • Brainstorming ideas. Adjectives. Suggesting ideas. Showing reservation. • Presenting a new business idea. Writing: a product leaflet. • Talking about different ages. Word formation - nouns. Grammar: Modal verbs. • Talking about future hopes and plans. Grammar: Future Perfect, Future Continuous. • Writing a letter to your future self. Using linkers of purpose. • Collocations. Convincing. Asking for clarification. • Collocations. Living longer. Taking part in aclass debate. Writing: a forum comment. • Television. different kinds of TV programmes. Interesting facts about TV. Multi-	

word verbs. Quantifiers. • Retelling real and made-up stories. Reading a questionaire. Grammar: reported speech. • Writing a discursive essay. • Reading a newspaper article. Broadships and tabloids. Predicting. • Mistakes in press and TV. Re-telling a news story. Writing: a news article. • Reading news stories about behaviour in tough situations. Collocations. Difficult decisions. Grammar: conditionals. • Feelings. A quiz on whether you're a morning or an evening person. Different attitude to time. Grammar: -ing form and infinitives. • Idioms connected to time. Writing an informal article. • Adjectives of manner. Talking about how to handle awkward situations. • Describing a family or cultural ritual. Writing about a family ritual. • Watching an extract from a programme about body language. • Discussing how good witness you are. Crime and criminals. Grammar: ing form and infinitives with different meanings. • Synonyms. Verbs with prepositions. Crimes. Grammar: modal verbs. • Reading an advice leaflet bout how to avoid trouble on holiday. Avoiding repetition. Writing a story about a lucky escape. • Reporting a crime. Solving problems. Rephrasing. • People in unusual situations. Survival items. Describing a dangerous adventure. • Professional language: mathematical symbols and terminology. Basic mathematical operations. • Professional language: Fractions, powers, logarithms. • Revision for the written examination. • Revision for the written examination. • Speaking practice • Speaking practice.

French (A)	K_U14, K_U16, K_U20

• Interrogative pronouns (simple and complex inversion). • Trip around Paris; short advertisements - writing. • Describing events with the use of le passé composé tense. • Vocabulary related to describing the past. • Similarities and differences between Polish and French educational systems. Interpreting figures. • Presenting the university and the field of study. • Describing your last holidays - the use of l'imparfait and le passé composé tenses. • Direct object pronouns in various tenses and moods. • Indirect object pronouns in various tenses and moods. • Living in the city and in the country - advantages and disadvantages; comparatives and superlatives. • Real estate ads analysis; le conditionnel présent mood. • Possessive pronouns. • Hypothesizing and giving opinions; impersonal verb forms. • Describing things; the place of an adjective in a sentence. • Relative pronouns. • Vocabulary related to shopping; negotiating the price. • House chores; sharing duties with the family members. • Favourite dish - preparing a questionnaire; written comments on its results. • Outfits for various occassions; family celebrations. • "Dont" relative pronoun. • Giving personal opinion. • Means of transport - comparison. • A biography of a famous person; le plus-que –parfait tense. • The role of fashion in people's lives - presenting opinions. • Direct and indirect object pronouns COD/COI in the past tense. • The use of past participle with the subject and direct object. • Reported speech - positive sentences. • Car accident - expressing reasons. • Relationships within neighbourhood - describing people. • Hypotheses about text characters. • Sharing a flat - expressing personal opinions. • The „gérondif" mood as a way to express simultaneity, manner, reason. • Entertainment ans free time activities. • Reported questions. • Complex relative pronouns. • Presenting the selected French region. • Active and passive voice. • A film review. • Newspaper article - the use of the passive voice. • Job advertisement, CV, cover letter - documents analysis. • Vocabulary and expressions used in administrative correspondence - writing a cover letter. • A job interview. • Students' work, socializing and building a network of contacts. • The „subjonctif" mood - introduction. • Describing work experience. • Internet as the most popular medium. • Future tenses: le futur proche/ le futur simple; conditional „si+présent+futur simple". • Plans for the future. • Conditional « si+ imparfait+conditionnel présent ». • Expressing wishes. • Adverbs - the place in the sentence. • Private letter and reply to a private letter.

French (B)	K_U14, K_U16, K_U20

• Describing and reporting events in the past tense. • Paris - the center of fashion. • Pronouns COD/COI in various tenses. • Modern and dying professions. • A famous fashion designer - presentation. • Demonstrative and possessive substatival pronouns. • Simple and complex relative pronouns. • Jeans - a universal timeless outfit. • Complaints and solving problems, giving advice. • Expressing reason and result. • The „subjonctif" mood - expressing purpose. • Traffic regulations - obligations and prohibitions. • Reported questions. • Choosing profession, justyfiyng. • Expressing the reason. • Living in homeland and abroad, giving arguments. • National symbols of Poland and France. • „Le passé simple - literary tense". • Comparisons - various living styles, the comparative of irregular adjectives. • Real estate market in France and in Poland. • Expressing acquiescence. • Emigration and mobility, expressing opinions. • „Le savoir-vivre" - good manners. • What is proper and improper - similarities and differences concerning Polish and French customs. • Negatives - summary. • Expressing prohibition. • Expressing hypothesis. • Passive voice in a newspaper article. • Climate changes - vocabulary related to ecology. • People's eco-friendly habits. • Plans for the future - time expressions. • Pensioners nowadays and in the past; changes in perceiving elderly people. • Setting up a company - development plans. • Inventions which revolutionized people's lives. • Expressing hypothesis and condition. • Eco-firendly solutions for the city, region and country. • Ideal friend; superlatives. • Modern idols. • Presenting the favourite character. • Passions in our lives. • Tense concordance in a short story. • Globalisation, positive and negative consequences. • Verb patterns with an infinitive. • Expressing disagreement towards proposals. • The art of giving arguments in a presentation. • A mobile phone: hell or paradise? • Where does Europe end? - information about the European Union. • Verbs useful for giving arguments. • Arguments cohesion - coherence linkers. • Sentence transformations - expressing coherence. • Higher education - facts and expectations. • Presenting a selected company.

Fundamentals of economics	K_W10, K_W12, K_U01, K_U13, K_U20, K_K04

• Introduction to Economics (outline of economic thought, the basic concepts, principles and assumptions of microeconomic analysis, the place of economics in the system of social sciences and relationships with other disciplines). Introduction to microeconomics. • The model of the market economy (institutions, productivity, efficiency, actors, resources and streams in the economic system, market - classifications and functioning). • Demand (law of demand, exceptions, determinants, elasticity of demand), supply (the law of supply, exceptions, determinants, elasticity of demand), the balance of the market in the short, medium and long term, the impact of regulated prices on the market, model cobwebs. • Consumer choice (the functioning of households, usability, first and second Gossen law, pension consumer Marshall, the balance of the consumer). • The rules of the enterprise (introduction to the theory of enterprise, basic definitions, classifications and processes). • The short run and long run production function in the market, economies of scale, choice of optimal technology. • The instruments of cost management in the enterprise, cost function in the long and short term, costs and liquidity. • Perfect competition and monopolistic competition. • Various degrees of competitiveness in the marketplace: monopolies, oligopolies • Introduction to macroeconomics, the basic phenomena and macroeconomic problems. • The development of economic systems, economic growth - measuring and conditions of the product and national income and its determinants, economic conditions (cycles) and the role of investment in the economy, analysis of the situation in Europe and the world. • The importance of the public finance sector, the organization SFP (sub), the impact of fiscal policy on national income, the role of the state in the economy, the budget as a tool for influencing the economy, the issue of budget deficit and public debt, the impact of public support (including EU funds) for the development of entities the national economy, analysis of the situation in Europe. • The development of the monetary system, the role of money in the economy, money in the strict sense and broad sense, the demand for money, the money supply and the mechanisms of its creation, quantitative theory of money, monetary aggregates. • The banking system of the state, the role of the central bank and monetary policy tools of monetary policy, the interbank market and the activities of commercial banks. • The phenomenon of inflation and its effects on social and economic demand and supply-side causes of inflation, the measurement of inflation - inflation, analysis of the situation in Europe, anti-inflation policy. • The labor market, employment policy, the importance of competence and demographic processes, labor market flexibility, unemployment as a problem of economic and social development. • International economic relations, the foreign exchange market, balance of payments, the single market of the European Union and its importance for the development of Member States, including developing countries. The European Union in the global economy.

Fundamentals of management	K_W10, K_W11, K_W12, K_U13, K_U20, K_K04

• Management as an academic discipline • Company and its environment as an object of management • Management features • Conterporary management problems.

German (A)	K_U14, K_U16, K_U20

• Friendship, meetings, people relationships, relations. Declension - type 'n'. • Describing a person, introductions, characteristics of types of behaviour, features of character. • Presenting one's characteristic. Noun formation. • Reder's magazine - class reunions and locating classmates by internet. Working with a text. • Occupation and work, workplace, presenting one's flaws and strengths. • Talking about the past. Past tense (Präteritum) of regular, irregular and mixed nouns. • Report concerning the internship done. Presenting opinions regarding an employee. • Conditions and forms of work. Requirements and competences. • Working with a video material. Conducted activities and working conditions. • Presenting one's plans and professional plans. • Living conditions, an interview with a real estate agent. Relative pronouns and relative clauses. • Analysis of offers and notices, explaining abbrevations. Adverbials of time. • Living in Germany: informational text, statistics, graphs. • Customer service, phone conversations. Language reactions based on a given situation. • Oral and written complaint. Sentences with „obwohl" and „trotzdem" • Writing a formal letter with a set of fixed phrases. • Inviting to a company promotional meeting - working with a text. • Computerisation of everyday life. Functions of devices/appliances used nowadays and in the future. • Visions of technological progress of the future. Futur I tense. • Using electronic devices in private and professional life - presentation. • Working with a video material - history and development of an enterprise,

features of products and their distribution. • Formal and informal invitation. Conditional conjunction "falls". • Business meeting. Rules of participating in a meal and different professional and social situations. • Holiday plans, expressing wishes and intentions. Verbs: 'sollen'. • Media, Germany's press market. • Characteristics of a given magazine - presentation. • Shopping, slecting products, reacting to suggestions and propositions. Sentences with 'zu' before an infinitive. • Conversation between a client and consultant. Typical expressions. • Conversations between a client and consultant. Using typical professional expressions. Setting up a company and customer acquistion. • Choosing a profession. Determining one's own skills and abilities. Causative clauses. • Social competences and career choice test. Employment profiles. Time clauses with 'bevor' and 'während' conjunctions. • Describing personality and aptitudes, expressing opinions and presenting test results. • Miniproject - professional predispositions, weak and strong sides of a candidate, talking with a careers adviser. • Working with a video material - history and development of Hueber publishing house, as well as its products. • Working conditions and concept of an employee-friendly enterprise. Gradation and declension of an adjective. • European Union - employment opportunities in EU countries, its history, as well as inner labour market and main institutions. • Smoking prohibitions in a work place - formulating arguments in favour and against, expressing opinions. Imperative. • Presentation structure, template, typical expressions. • Conditions determining good employment and company's attractiveness. • Wasted chances and opportunities. Unreal clauses in the past. • Reporting experienced failures - a radio audition. Conditional clauses - Konjunktiv II. • Helpline - describing a given situation. 'Wäre / hätte' structures + Partizip II. • Describing controversial events - discussion and commentary. • Expressing disappointment and reacting to it - writing an e-mail, working with a text published on a blog. • Everyday situations that make you happy. Plusquamperfekt tense. • Expressing emotions - language means. • Summarizing the previous year and positive events. Time clauses with 'nachdem'. • Working with a video material - 'Our piece of happiness'. Family history. Important life areas, experiencing success and satisfaction. • Parties, celebrations, events happening in a workplace. • Beginnings of a career. Speed-dating. Employers' expectations. • Comparison of holidays and events. Written invitations for different occassions. • Writing an e-mail and letters - components. Writing invitations.

German(B)	K_U14, K_U16, K_U20

• New communication media. Establishing new contacts: Speed-dating. • Describing one's language skills - working with a video material. Declension of an adjective after definite, indefinite and no article. • Media competences, ability to creatively use internet assets in foreign language learning. Time adverbs. • Bisness meetings in a new environment, forms of greeting and introduction. • Strategies of learning language for special purposes. • Private and business meetings. Modal particles. • Planning and organizing official events. • Spoken and written invitations, establishing the date of the meeting. Rektion of the verb. Adverbial pronouns in questions and answers. • Working with a video material - 'Oktoberfest'. • Planning and preparation of a presentation. • Business lunch. Quiz about etiquette. • Features of a good presentation. • Preparing product presentation. • Planning a holiday, travel bureau's offers. Assumptions - 'werden + wohl' verbs + infinitive. • Accommodation - hotel rating, opinions on internet sites. Relative sentences, relative pronouns. • Public transport in German speaking countries. • Future vehicles and travels. Future tense 'Futur I'. • Working with a video material - dream travels. • Organizing a conference, choosing a hotel, business mail. • Flat market, different forms of accommodation. Complex nouns. • Living community, student's house. Looking for a flat - advertisements. Time prepositions. • A student room, flat appliances, description of functions of furniture and items of every day use. • Switching flats during holiday. Word order. • Multi generation house. • Office and its equipment, positive rapport. • Living business community, pros and cons. • Presenting a profession - working with a video material. • Ideal work place. Conditionals. • Job advertisements, writing a cv. • Different ways of job searching. Advice and tips for job applicants. Sentences with 'damit' and 'um...zu'. • Job applications, talking about your education and work experience. • Small-talk, expressing opinion about one's job - pros and cons. • Famous composers, a biography note. Negative sentences. • Music genres, music instruments, music bands. • Festivals and concerts in German speaking countries. A schedule of musical events. • Planning a shared evening, inviting to a concert, writing a private email. • 'Rammstein' band - presenting a band. Providing argument support one's choice. Sentences with „denn", „weil", „nämlich", „deshalb". • German rock music - working with a video material. • Creating a presentation about German rock music. • Board games, tele shows. Rules of favourite games. Passive voice. • E-commerce, internet shops. • Psychology of selling, interpreting the behaviour of the customer. Passive voice with modal verbs. • Consumers' typical behaviour during shopping. Identification of different behaviour. • Online shopping discussion - pros and cons. • Vocabulary related to finances. • Acquisition of new skills, upgrading one's qualifications, various course offers and certificates. Noun's genitive. • Advanced ways of information searching, remote ways of providing education, education platforms. • Facilities found in a moder language lab. Prepositions of place. • Education system in Germany - a discussion forum. • Technical occupations, handling and description of technical equipment, manuals. Prepositions with dative and accusative. • Malfunctions and technical faults. Imperative. • Complaints - exchaning emails.

Russian (A)	K_U14, K_U16, K_U20

• Healthy diet. • Wedding customs in Poland and Russia. • Family holidays. Sentences with а, и, но, или. • Leisure time. Writing a short play/movie review. • Mass media. Expressing opinion about mass media and their role. • Internet or newspapers. Demonstrative pronouns этот, эта, это, эти, тот, та, то, те. Using пользоваться (чем?) verb. • Disabled are among us. Vocabulary and constructios connected with the topic of disabled. • Popular occupations. Male and female noun forms of different occupations. Negative proniuns никто, ничто, некто, нечто, никогда, некогда, никуда, некуда. • Professional duties. Vocabulary related to activities coonducted in popular jobs. • Job interview. Giving advice concerning job selection and preparation for job interview. • Moscow labour market. Describing pros and cons of certain occupations. Writing a job application. • Working abroad - pros and cons. • Material revision. Talking about the plans after graduation. • Studying in Poland. Names of different universities; popular abbrevations. Vocabulary related to formalities and conditions that have to be met to study. • Studying in Russia. Abbrevations of universities and faculties,Supporting the choice of studies. Writing an email and private letter. • Student life. стать/быть/ работать (кем?) construction, быть по профессии/по образованию (кем?) construction and несмотря на то,что construction. • Excursions. Describing/planning and narrating excursions. Writing questions regarding holiday offers. • Summer camps. Tourist equipment. Travelling by train. путь noun. • Tourist office. Writing excursion advertising leaflets. Writing a letter of complaint. • Tourism in Poland. Accommodation base - vocabulary. Describing excusrions and sight-seeing. • Tiurism in Russia. Full meaning of турбюро, турбаза, ж/д abbrevations. заказать, забронировать verbs. • Renting a flat for summer. Vocabulary and constructions used in flat-renting advertisements. снимать, снять, сдать в аренду verbs. • Real estate agency. Describing appearance of rooms and their facilities based on illustrations. • House or flat? Where to live? Subjectless sentences. • Material review. Names of tourist equipment. vocabulary and constructions used when describing a flat. • Writing e-mails. Writing a private letter concerning an unfortunate journey. Vocabulary related to private letters. • Our neighbours. Participles: usage and creation. • Our planet Earth. Describing and proposing different ecological actions. Presenting data concerning biodegredation of different common-use products. • Protect nature. Conducting a survey related to pro-ecological behaviour. Writing an essay about environmental danges. • Natural disasters. Describing climate and weather. Vocabulary - natural disasters. • Ecological crisis. Describing climate and weather. Vocabulary - natural disasters. • Cataclisms. Describing activities related to acting in case of cataclisms. Superlative forms. • World of technologies. Talking about scientific inventions and technical novelties. Technical language. • 21st century inventions. Describing information technologies. Describing malfunctions. Vocabulary related to computer and internet. • Technology and us. Naming and describing inventions. Expressing opinions. • We are all equal. Creating utterances about the social roles of men and women. Expressing opinions about partnership. Vocabulary and constructions related to equality and social roles of men and women. • Generation gap. Expressing opinions about generation gap and discussion about the validity of some bans. • Juvenile subcultures. запрещать, запретить verbs. каждый, всякий, любой relative pronouns. • Important dates in our life. Describing dates and events. Complex quantifiers. • Products and services. Reading comprehension. Dialogues concerning malfunctions and repairs of every day objects. • Advertisement's effect on a human. Describing activites related to advertisements. Naming and describing services. • E-commerce. Talking about e-commerce. Accusative of plural living and non-living nouns. • War. Expressing opinions about war service and women participation: discussion. Vocabulary related to war service, conflicts and inner and international problems. • Citizen debt. Reading comprehension. Imperatives: Будь я президентом, не было бы такого!. • Social problems. Naming and describing selected social problems and proposing their solutions. Vocabulary related to selected social problems. • Human and society. Conducting a debate abour homelessness and means of fighting it. Time constructions with prepositions:за and через. • Master and Margaret. Discussing the text. Knowledge about Russia: life and work of Michael Bulhakow. • Slavian mythology. Read comprehension. • Russian painting. Reading comprehension: text about Russian painters. • Russian Federation. Vocabulary related to both the structure, as well as political ststem of Russian Federation. • Russia today. Reading comprehension concerning structure and political system of Russian Federation. • Poland in Europe. Reading comprehension concerning structure and political system of Poland. .

Russian (B)	K_U14, K_U16, K_U20

• Appearance. • Features of character. • Asking for personal details. Processing and transferring information. • Ethical problems. Personal prononus with or without preposition. • Home products. Present tense. • Real estate, Nouns. • House renovations. Adjectives. • School requirements. Verbs: учить, учиться, изучать. • Systems of educations in Poland and Russia. • School requirements. Prepositions в, на. • Occupations. Verbs related to different occupations. • Professional work. Temporary work. Labour market. Present tense. • Our portfolio. Writing a letter of motivation. Writing a CV. Nouns. • Family holidays. Naming holidays. Possesive pronouns. • Family members. Leisure time and reflexive

verbs. • People and relationships. Adverbs of place and direction. • Food and its names. • Restaurants. Numerals 1,2,3,4 in junction with nouns and adjectives. • Describing diets. Expressing opinions. Demonstrative pronouns. Imperative. • Services: buying and saling. Verbs: купить/покупать. • Bank (types of payment). Main numerals. Nouns: рубль. • Products. Advertisements. Adverbs of level and measurement. • Means of transport in Russia. Interesting places in Russia. • Travelling vocabulary. Naming and describing accommodation. Nouns ending -ий -ия, -ие. • Describing excursions and sight-seeing. Expressing opinions. Writing a blog. • Art genres (movies). Cinema genres. • Mass media. Present tenses. • Sport disciplines. Sport venues. • Sporstmen. Sport equipment. Comparatives. • Sport competitions. Nouns with adjectives. • Describing one's well-being. Ilnesses and means of curing them. • Curing and healing processes. Prepositions in constructions related to time and direction. • Addiction. Imperative. • Naming basic technical devices. Activities made with basic technical devices. • Computer and internet. Vocabulary. • Wildlife. Naming plants and animals. Describing landscape. • Catastrophies and natural disasters. Adjectives. • Catastrophies and natural disasters. Adjectives. • Ecology. Describing activities related to protecting natural environment. • Russia. Country's structures and offices. • Social and international organizations. Present tense. • Economics. Inner and international conflicts. • Social life. себя pronoun. друг друга expression. • Social problems. Vocabulary related to current social issues. • Master and Margaret. Reading comprehension. Life and work of Michael Bulhakow. • Mythology. Selected information concerning Slavian mythology. • Wasilij Kandinskij. Reading comprehension. • Iwan Szukszyn. Reading comprehension. • Russian fables. Nouns with adjectives. • Russian holidays. Naming and describing holidays. • Polish holidays. Naming and describing holidays.

4. Student work placement and internship

The basic aim of the professional practice is to acquire practical skills that complement and deepen the knowledge acquired by the student during the classes at the university. The implementation of the internship provides the opportunity to: confirm and develop the student"s professional competences within the chosen field of study and / or specialization, become familiar with advanced technical solutions as well as acquire professional knowledge and skills of their practical application, participate in the realization of specific projects and real problems solving. Apprenticeships give students the opportunity to learn about the specifics of the company"s operations and to shape the attitudes desired by employers and co-workers (proper work organization, conscientiousness and responsibility for entrusted tasks).

Apprenticeship is treated as a separate module of education and it is mandatory to pass. The way of organizing professional practice is defined in the Rector"s Regulation on the principles of organizing internships for students of the Rzeszów University of Technology. Students wanting to broaden their professional experience may also take additional internships at any time. Additional practices can be executed during the summer break.

The number of student work placements and internships is presented in Chapter 3 and may vary in different variants of the study plan for a given course Chemical and process engineering.