Study programme

Biotechnology
first degree study
The profile of studing: general academic

P R K VI

1. Basic information about the course

The name of the field of study	**Biotechnology**
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	**57 %**

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	**26 %**
biological sciences	**17 %**

Number of semesters	**7**
Specializations in the course of study	full time study: Applied biochemistry Purification and analysis of biotechnological products past time study: Applied biochemistry Purification and analysis of biotechnological products
Number of ECTS credit points required to complete the studies	**210**
Total number of class hours	full time study: Applied biochemistry: **2707** Purification and analysis of biotechnological products: **2707** past time study: Applied biochemistry: **1624** Purification and analysis of biotechnological products: **1624**
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 basic knowledge and engineering skills. He possess a general knowledge in the field of biotechnology, in particular on issues related to: biotechnology (including understanding of biochemical, molecular and cellular basis of organism functioning, the potential use of biological material in biotechnology - from single molecules through complexes and macromolecules to single-cell and multicellular organisms), general and inorganic chemistry, physical chemistry and organic chemistry, chemical analysis (including basic methods of instrumental analysis, apparatus and unit processes (operations) used in the biotechnology industry). He knows the basic methods, techniques, tools and materials used in simple engineering tasks solving in the field of biotechnology, in particular related to: information technologies, computational and simulation techniques, mastery of essential experimental techniques used in biological sciences, application of fundamental experimental and laboratory techniques used in molecular biology, computer programs that support modeling and designing biotechnological processes. The graduate is prepared to take a professional job in those branches of the economy in which biotechnological processes are applied, i.e. in the agro-food industry, pharmaceutical industry, in environmental protection and in analytical, medical, research and control laboratories - in positions related to running and organization of production processes and quality control. The graduate is especially well prepared to work in units in which modern methods of isolation, purification and analysis of biotechnological products are applied, especially in the pharmaceutical industry. 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 is aware of the necessity 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 in the field that allows the use of mathematical methods to describe chemical and physical processes in the field of technical engineering of chemical engineering and to perform calculations needed in engineering practice and research	P6S_WG
K_W02	Has knowledge of physics and biophysics that allows understanding and quantitative description of phenomena and processes occurring in living organisms and used in biotechnological processes	P6S_WG
K_W03	Has basic knowledge of information technologies and programmes useful in engineering activities characteristic of biotechnology	P6S_WG
K_W04	Has structured general knowledge of basic departments of chemistry including inorganic, organic, physical and analytical chemistry, including knowledge of instrumental analysis techniques	P6S_WG
K_W05	Knows the biochemical, molecular and cellular basis of the functioning of living organisms.	P6S_WG
K_W06	Knows the principles of expression and inheritance of genetic information and molecular techniques used to study genetic material	P6S_WG
K_W07	Has knowledge about microorganisms and their use in biotechnological processes	P6S_WG
K_W08	Has knowledge about the kinetics and properties of enzymes, their preparation and use to conduct biotechnological processes	P6S_WG
K_W09	Has basic knowledge of molecular biology techniques and immunology used in biotechnology	P6S_WG
K_W10	Knows the techniques and methods of obtaining, purifying, identifying and characterizing biotechnology products	P6S_WG
K_W11	Knows the structure, functions and use of bioreactors and other apparatus used in industrial biotechnology	P6S_WG
K_W12	Has a general orientation in current directions of development of biotechnology and biotechnology industry	P6S_WG
K_W13	has basic knowledge about the life cycle of products, equipment and installations in the biotechnology industry	P6S_WG
K_W14	Knows the basic methods, techniques, tools and materials used to solve basic engineering tasks related with biotechnology	P6S_WG
K_W15	Has the basic knowledge necessary to understand social, economic, legal, ethical and other non-technical aspects of biotechnology and genetic manipulation	P6S_WK
K_W16	Has basic knowledge of management, including quality management and biotechnology products	P6S_WK
K_W17	Knows the basic forms and procedures of protection of intellectual and industrial property	P6S_WK
K_W18	Knows the general principles of creating and running forms of individual entrepreneurship	P6S_WK
K_W19	Knows the mechanisms of bioprocess engineering processes and their methods of mathematical modeling and optimal guidance	P6S_WG
K_U01	Can find information in professional literature and databases related to chemistry and biotechnology, link the found content, interpret and draw conclusions	P6S_UW
K_U02	Can communicate using various techniques in a professional environment and in other environments	P6S_UK
K_U03	Uses biochemical and biotechnological terminology correctly	P6S_UK
K_U04	Demonstrates ability to prepare a well-documented study in the field of biotechnology in Polish and English	P6S_UW P6S_UK
K_U05	Demonstrates ability to prepare oral presentations of specific issues in the field of chemistry and biotechnology in Polish and English	P6S_UW P6S_UK
K_U06	Has the ability to self-educate	P6S_UU
K_U07	Has the ability to use a foreign language at B2 CEFR level in the field of biotechnology and the ability to use technical vocabulary in the field of the completed specialization	P6S_UK
K_U08	Demonstrates ability to support computer programmes supporting work in the field of chemical and biotechnological technologies	P6S_UW
K_U09	Can plan an experiment in the field of biochemistry, genetic engineering and biotechnology, correctly perform it, interpret results and draw conclusions	P6S_UW P6S_UO
K_U10	Can use the knowledge in the field of mathematics and computer science to solve engineering tasks in the field of biotechnology using analytical and computational methods	P6S_UW
K_U11	Demonstrates ability to perceive systemic and non-technical aspects of implemented engineering tasks	P6S_UW
K_U12	Obeys the principles of health and safety and demonstrates ability to assess the risks resulting from the use of biotechnological and chemical processes and their products and react in the event of their appearance	P6S_UW
K_U13	Can apply basic legal regulations in the field of biotechnology	P6S_UW
K_U14	Can pre-evaluate the economic effects of engineering activities in the field of biotechnology	P6S_UW
K_U15	Can use the acquired knowledge to critically analyze and evaluate the functioning of existing technical solutions used in biotechnology	P6S_UW
K_U16	Demonstrates ability to study physical and chemical properties, predict reactivity and synthesize simple compounds and materials used in biotechnology production	P6S_UW P6S_UO
K_U17	Demonstrates ability to apply basic laboratory techniques for the separation and purification of chemical compounds and biotechnology products as well as their qualitative and quantitative analysis	P6S_UW P6S_UO
K_U18	Demonstrates ability to apply basic laboratory techniques for the manipulation of genetic material	P6S_UW P6S_UO
K_U19	Demonstrates ability to design a simple biotechnology process and system using appropriate methods, techniques and tools	P6S_UW P6S_UO
K_K01	Understands the need for self-education and improvement of professional qualifications and update your directional knowledge	P6S_KK P6S_KR
K_K02	Is aware of the importance of engineering activities, its effects and impact on the natural environment and the responsibility arising from the decisions made	P6S_KO P6S_KR
K_K03	Demonstrates ability to work both individually and as a team, can make decisions and execute commands of his/her superiors	P6S_KR
K_K04	Demonstrates ability to properly define the priorities for the implementation of the task specified by himself/herself or other group members	P6S_KK P6S_KR
K_K05	Demonstrates ability to correctly identify and resolve dilemmas related to the profession	P6S_KK P6S_KR
K_K06	Can think and act in an entrepreneurial way	P6S_KO
K_K07	Understands the need to provide the public with information about beneficial and unfavorable aspects of activities related to the production and use of biotechnology products and demonstrates ability to provide such information in a generally understandable way	P6S_KO

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. Applied biochemistry, full time

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.	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.	124 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=H&TK=html&S=1491&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	CB	Cell biology	15	0	0	0	15	2	N	▪
1	CN	General and inorganic chemistry	30	30	0	0	60	6	T	▪
1	ZM	Academic savoir - vivre	10	0	0	0	10	1	N	
1	FF	Physics	30	30	0	0	60	6	T	▪
1	CB	Genetics	30	15	0	0	45	4	N	
1	ZM	Social competences	10	15	0	0	25	2	N	
1	FM	Mathematics	30	30	0	0	60	6	T	▪
1	ZE	Economic course	30	0	0	0	30	2	N	
Sums for the semester: 1			**200**	**120**	**0**	**0**	**320**	**30**	**3**	**4**
2	CB	Cell biology	15	0	30	0	45	4	T	▪
2	CN	General and inorganic chemistry	30	15	45	0	90	7	T	▪
2	FF	Physics	15	15	15	0	45	4	T	▪
2	CI	Engineering graphics	15	0	30	0	45	4	N	
2	FM	Mathematics	30	30	0	0	60	6	T	▪
2	CI	Packeges 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			**120**	**60**	**180**	**0**	**360**	**30**	**4**	**4**
3	CI	Chemical and biotechnological equipment	30	15	15	0	60	4	N	
3	CN	Biochemistry	15	0	30	0	45	3	T	▪
3	CD	Biophysics	15	0	0	0	15	1	N	
3	CB	Bioinformatics	15	0	15	0	30	2	N	
3	CN	Analytical chemistry	15	0	30	0	45	3	N	
3	CF	Physical chemistry	30	15	0	0	45	4	T	▪

Sem	Code	Module								
3	CD	Organic chemistry	30	15	0	0	45	4	T	🚩
3	DJ	Foreign language	0	30	0	0	30	2	N	🚩
3	CB	General microbiology	30	0	30	0	60	5	T	
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			**195**	**105**	**135**	**0**	**435**	**30**	**4**	**4**
4	CN	Biochemistry	30	0	30	0	60	5	T	🚩
4	CF	Physical chemistry	30	15	30	0	75	6	T	🚩
4	CD	Organic chemistry	30	15	30	0	75	6	T	🚩
4	CB	Scientific and technological information	0	0	2	0	2	0	N	
4	DJ	Foreign language	0	30	0	0	30	2	N	🚩
4	CB	In vitro cultures	15	0	15	0	30	2	N	
4	CN	Industrial microbiology	30	0	30	0	60	5	T	
4	CM	Biomaterials processing	30	0	30	0	60	4	N	
4	DL	Physical education	0	30	0	0	30	0	N	
Sums for the semester: 4			**165**	**90**	**167**	**0**	**422**	**30**	**4**	**4**
5	CF	Instrumental analysis	30	0	45	0	75	5	N	
5	CB	Plant biochemistry	15	0	15	0	30	2	N	
5	CB	Molecular biology	30	0	30	0	60	5	T	🚩
5	CN	Chemistry of cosmetics	15	0	15	0	30	2	N	
5	CI	Bioprocess engineering	30	15	0	0	45	3	N	🚩
5	DJ	Foreign language	0	30	0	0	30	2	N	🚩
5	CN	Analytical methods in biochemistry	15	0	15	0	30	3	T	
5	CF	Biomolecular process modeling	15	0	15	15	45	4	N	
5	CB	Immunological techniques in biotechnology	30	0	30	0	60	4	N	
Sums for the semester: 5			**180**	**45**	**165**	**15**	**405**	**30**	**2**	**3**
6	CN	Forensic biochemistry	15	0	15	0	30	2	N	
6	CB	Molecular biology	15	0	15	0	30	2	N	🚩
6	CS	Biodegradable biopolymers and polymers	15	0	15	0	30	2	N	
6	CI	Bioreactors	15	0	15	0	30	2	N	
6	CN	Chemistry and technology of biofuels	15	0	15	0	30	2	N	
6	CB	Enzymology	15	0	30	0	45	2	T	
6	CB	Protein engineering	30	0	0	15	45	4	N	
6	CI	Bioprocess engineering	15	15	15	0	45	3	T	🚩
6	CB	Genetic engineering	30	0	30	0	60	3	T	
6	DJ	Foreign language	0	30	0	0	30	3	T	🚩
6	CB	Computer-aided research	0	0	15	0	15	1	N	
6	CB	Toxicology	30	0	15	0	45	4	N	
Sums for the semester: 6			**195**	**45**	**180**	**15**	**435**	**30**	**4**	**3**
7	CN	Biocatalysis	15	0	15	0	30	2	N	
7	CF	Biosensors	15	0	15	0	30	2	N	
7	CN	Environmental protection and biotechnology	15	0	15	0	30	3	T	
7	CI	Purification of biotechnology products	30	0	15	0	45	2	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	0	0	0	30	30	2	N	
7	CM	Drug design and synthesis	15	0	15	15	45	4	N	
Sums for the semester: 7			**90**	**0**	**75**	**165**	**330**	**30**	**1**	**0**
TOTALS FOR ALL SEMESTERS:			**1145**	**465**	**902**	**195**	**2707**	**210**	**22**	**22**

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 (A)	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 (A)	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 (A)	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 (A)	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=H&TK=html&S=1491&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=H&TK=html&S=1491&C=2020, which are an integral part of the study programme.

Academic savoir - vivre	K_W15, K_U06, K_K03
• 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_W04, K_U06, K_K01, K_K03
• 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.	
Analytical methods in biochemistry	K_W04, K_W05, K_W10, K_U03, K_U09, K_K03
• basics of MS, NMR and FTIR • fluorescent methods, electrophoresis, X-ray diffraction • biomolecule separation methods - chromatography, electrophoresis etc. advanced microsopic methods	

Biocatalysis	K_W08, K_W10, K_W14, K_U03, K_U19, K_K01, K_K03

• Enzyme composition • Enzymatic mechanisms • Enzyme kinetics; • Enzyme immobilisation • Industrial enzymatic processes; samples of enzymatic processes

Biochemistry	K_W05, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• Biochemistry - the molecular logic of living organisms. • Structure and properties of amino acids. Proteins: a hierarchical organization of structure. Basic aspects of the protein structure and function. Myoglobin and hemoglobin. • Introduction to enzymes. Factors affecting enzyme activity. Enzyme kinetics and inhibition. Control of enzyme activity. • Carbohydrates: monosaccharide, oligosaccharide and polysaccharides structures. Glycoproteins. • Lipids. Structure of cell membranes. Mechanisms of transport across cell membranes. • Membrane receptors and sygnal transduction in cell. • Transduction of genetic information in cell. DNA structure and replication. RNA synthesis and splicing. Protein synthesis. • Identification of amino acids and proteins by specific colour reactions and TLC method. • Determination of protein concentration. • Identification of simple sugars and polisaccharides by colour reactions. Hydrolysis of sucrose. • Separation of amylose and amylopectin from potato starch. Hydrolysis of starch. • Isolation of cholesterol from a chicken egg yolk. Identification of cholesterol by Salkowski method. • Determination of nitrate(III) levels in meat products with the Grieass reagent. • Metabolism: organisation and basic ideas. • Carbohydrate metabolism: glycolysis and gluconeogenesis. • Cellular respiration and energetics: citric acid cycle, oxidative phosphorylation, photosynthesis. • Isolation and determination of superoxide dismutase (SOD) activity from the yeast Saccharomyces cerevisiae. • Identification of superoxide dismutase by native gel electrophoresis and negative staining. • Native gel electrophoresis and identification of LDH isoenzymes. • Isolation of macromolecules by gel filtration. • Separation of lysozyme from chicken egg by ion-exchange chromatography. • Identification of lysozyme by SDS-PAGE electrophoresis.

Biodegradable biopolymers and polymers	K_W04, K_W12, K_U16, K_K03

• Mechanisms of the polymerization and their relationships with the real process of synthesis. • Types of polymers in terms of their chemical and supermolecular structure and physicmechanical properties • Factors determining the chemical and biological resistance of polymers. Depolymerization processes, degradation and destruction of biodegradable polymers. Use of these processes in technology and industry. • Synthetic polymers susceptible to biodegradation processes. Polymeric biomaterials. • Natural polymers and their importance in the art of pharmacy and medicine. Biodegradation of natural polymers. • Synthesis of poly (caprolactone) and evaluation of its properties. Preparation of high-molecular blood products based on gelatin. Evaluation of the properties of selected biopolymers used as packaging.

Bioinformatics	K_W01, K_W03, K_W14, K_U01, K_U02, K_U06, K_U08, K_U09, K_U10, K_K01

• Introduction to bioinformatics. Basic concepts. E-learning in biotechnology. • Data mining methods in bioinformatics • Sequence alignment • Computer representation and visualisation of biopolymer structures • Bioinformatic databases. Computer representation of structural and sequential information • PCA and cluster analysis methods in bioinformatics • Integrated sequence search system • 3D visualisation and analysis of protein in PDB database

Biomaterials processing	K_W04, K_W10, K_U16, K_K01

• Classification of polymers. Basic definitions for polymer chemistry:molecular mass, polymerization degree, space building. Polyreactions types. Polymerization classifications • Technological metods of polymerization: mass, solvent, suspensions and emulsion. Polyurethanes, polyamides, polyolefins. Hydrogels - fabrication and properties. • Ceramic biomaterials - introduction. Classification of ceramic biomaterials. Outline of ceramic biomaterials technology • Alumina in bone surgery and dentals. Manufacturing of alumina biomaterials.. Manufacturing and properties of hydroxyapatite. • Methods for the preparation and properties of porous ceramic biomaterials • Technology and properties of carbon biomaterials . Technology and properties of metallic biomaterials . Technology and properties of the composite biomaterials • Preparation and characterization of selected polymeric biomaterials. • Preparation and characterization of selected ceramic biomaterials.

Biomolecular process modeling	K_W03, K_W14, K_U01, K_U08, K_U19, K_K01, K_K03

• Fundamentals of molecular modeling methods: molecular mechanics, molecular dynamics, Monte Carlo method. Molecular forces. Basics of molecular quantum mechanics: ab initio methods, semi-empirical methods, methods exploiting density functionals (DFT). Biomolecular geometry optimization. Biomolecular structure data bases (Protein Data Bank PDB, PDBe, PDBj), ligand data bases (PubChem, ZINC, BindingDB), enzyme data bases, others). Information downloading from biological data bases. Elements of homological analysis. Basics of spatial protein structure modeling. Modeling of quantities describing physicochemical properties of biological and chemical systems. Ligand conformation analysis. Application of molecular modeling methods in studies of biochemical system reactivities. Study of thermodynamics and transition states of chemical reactions. Molecular docking: docking methods, scored functions of assessment of ligand–receptor interaction. Examination of structure-biological activity relation (2D-QSAR, 3D-QSAR, 4D-QSAR, 5D-QSAR, 6D-QSAR). Kinds of structural indexes and techniques of their calculation. CoMFA and CoMSIA methods. • 1. Biomolecular structure data bases (Protein Data Bank PDB, PDBe, PDBj), ligand data bases (PubChem, ZINC, BindingDB), enzyme data bases, Entrez and ExPASy services, others). Information downloading from biological data bases. 2. Visualization of the structure and physicochemical properties of biomolecules. Adjustment of protein and ligand structures. 3. Modeling of quantities describing physicochemical properties of biological and chemical systems. Conformational analysis of ligands. 4. Modeling of protein structure. 5. Modeling of chemical reaction (thermodynamics, transition states) using en example of a reaction of a drug with a specific receptor. 6. Calculation of QSAR descriptors. 7. Examination of structure-biological activity relationships (QSAR). 8. Molecular docking processes. Investigation of ligand-receptor (i.e. drug-protein) interaction.

Biophysics	K_W02, K_U06, K_K01

• The bases of the biophysics. Classification of biomolecules. Classification of biomacromolecules (biopolymers). Chemical structures. Super-molecules structure. Interactions of molecules and macromolecules. • Methods of the determination of molecular masses and their distribution for biopolymers:- the method of light scattering statistically (Rayleigh), dynamics (quasi-elastic) - the viscometery, osmometery, bulio- and cryoscopy, method of sedimentation, MALDI-TOF, Gel Permeation Chromatography (GPC) or Self-Exclusion Chromatography (SEC). • Biothermodynamic systems and processes. Phase transitions. Entropy , enthalpy, free energy, heat capacity biopolymers. The phenomena of thermo conductivity mass transportation, viscosity of polymers. Thermal analysis methods for examination the thermal proprieties of biopolymers: TGA, DSC, temperature-modulated DSC, TMA, thermal conductivity. • The chosen physical methods for the investigations of the structure of biopolymers: spectroscopic (IR, spectroscopy Raman, NMR), X-ray spectroscopy (SAXS, WAXS), degree amorphous and crystalline phases. Microscopic techniques: optical microscopy, electron microscopy, atomic force microscopy (AFM). Static and dynamic methods to determine the mechanical proprieties of polymers (dynamic mechanical analysis -DMA). Mechanical modules. • The elements of the biophysics of organs: the sense of the hearing system; visual system, respiration system, the circulation blood system. The influence of physical factors on alive organisms (mechanical, temperatures and moisture, the electric and magnetic field; the radiation ionizing and non-ionizing). Spectroscopy and scanning, topography NMR.

Bioprocess engineering	K_W10, K_W19, K_U12, K_K01

• Heat Transfer: (Fixed) Stationary Heat Transfer, Heat Transfer Driving Force, Kinds of the Heat Transfer: Thermal Conduction, I-St Fourier Law, Thermal Conduction Coefficient, Heat Non- And Conductors, Thermal Conduction Across Wall, Heat Transfer Resistance, Heat Convection – Newton Equation, Heat Transfer Cases, Criterial Numbers And Equations, Heat Radiation, Heat Screen Meaning, Heat Losses to Environment, Overall Heat Transfer, Newton Equation for Overall Heat Transfer, Overall Heat Transfer Coefficient, Some Cases of Transient Heat Transfer, Basis Of Heat Exchanger Design. Mass Transfer: (Fixed) Stationary Mass Transfer, Driving Force, Mass Diffusion, I-St Fick Law, Mass Diffusion Coefficients, Mass Transfer Resistance, Kinds of the Mass Diffusion, Mass Diffusion, Mass Convection, Newton Kinetic Equation, Mass Transfer Cases, Criterial Numbers And Equations, Overall Mass Transfer, Newton Equation for Overall Mass Transfer, Overall Mass Transfer Coefficient, Disappearance of Mass Transfer Resistance, Overall Mass Transfer Driving Force, Basis Of Mass Exchanger Design. Concurrent Heat and Mass Transfer – Basic Knowledge Absorption; A) Process Definition, B) Static's of the Process – Absorption Equilibrium, Kinds of the Equilibrium Line Notations, C) Process Kinetics, Mass and Overall Mass Transport in the Absorption, D) Mass Balance of the Absorption, Operation Line of the Absorption, Minimum of the Spraying Liquid Mass and Velocity, E) Overall Mass Transfer Driving Force int Absorption, F) Dynamic Model of the Absorption,Chemisorption. • Distillation And Rectification: Points A) to F) Analogous to the Same Above with the Following Differences: Distillation Equilibrium for Binary Component System, Kinds of the Equilibrium Line Notations - for Ideal System – Raoult Law, Nonideal Systems – Aberrations From Raoult Law, Azeotropes, Differential Distillation, Equilibrium Distillation, Mass and Overall Mass Transport in the Rectification, Batch Rectification, Continuous Rectification, Heat and Mass Balances of the Rectification, Heat and Mass Balances of the Operated Plate,

Operation Lines of the Rectification, Minimum and Maximum Minimum of the Column Reflux, Column Efficiency Measured by Theoretical Plate Amount. Exstraction: Points A) to F) Analogous to the Same Above with the Following Differences: Extraction Equilibrium for Ternary Component System, Ideal System – Nernst Law, Nonideal Systems – Aberrations From Nernst Law, Stepping Extraction Parallel-Current and Counter-Current Extraction, Minimum and Maximum of the Extrahent Mass, Kinds of the Mathematics Solution of the Mentioned Above Extraction Cases, Column Extraction, Dynamic Model of the Column Extraction.

Bioreactors	K_W07, K_W11, K_U15, K_U19, K_K01

• Definition of bioprocess engineering. Stoichiometry of microbial growth, oxygen balance. Kinetics of cells growth, product formation, kinetics of enzymatic reactions. Bioreactors: batch reactor, chemostat, chemostat with recycle, multistage chemostat systems, plug flow reactor, bubble-column reactors, fluidization reactors, membrane reactors. Designing of bioreactors. Scaling-up and scaling-down.

Biosensors	K_W10, K_U06, K_K01

• Classification of chemical sensors. Theoretical basics of chemical recognition. • Electrochemical sensors - potentiometric, amperometric and conductometric sensors. • Optical sensor, physics of optical fibers, optical fiber sensors – design, operation and examples. • Mass sensors, basics of piezo- and pyroelectricity, chemical layers of mass sensors. • Thermal sensors - pyroelectric sensors, gas catalytic sensors. • Applications of chemical sensors in industrial analytical control, clinical chemistry and environment protection. Prospects of development of chemical sensors.

Cell biology	K_W05, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• Similarities and differences in structure of prokaryotic and eukaryotic cells. • Basic research methods applied in studies of cell and its components. • Evolution and function of subcellular structures. • Mechanisms of cell membrane transport. • Signal transduction in the cell. • Cell cycle and course of mitosis and meiosis. • Basic laboratory methods and safety rules and regulations. • Microscopic observations of cells and tissues. • Isolation of chloroplasts and mitochondria from the plant cells. • Separation of chlorophylls and carotenoids be thin layer chromatography.

Chemical and biotechnological equipment	K_W11, K_W13, K_U17, K_K01

• Classification of chemical apparatus. Fundamentals of transport phenomena of heat and mass momentum. The nature of the fluid flow. Fluid flow resistance. Liquid outflow from the tank • Apparatus for mixing, aeration and disintegration of biomass. Demand for mixing power. • Bioreactors and fermenters - construction solutions and the principle of operation. Bioprocesses in fluidised bed. • Characteristics of comminuted materials. • Slurry separation by deposition, sedimentation, flotation, classification. • Filtration and spinning of biological suspensions, process rules and apparatus. • Heat exchangers, evaporators and sterilizers. • Apparatus for absorption and adsorption. • Apparatus for distillation and rectification. • Apparatus for extraction and crystallization

Chemistry and technology of biofuels	K_W05, K_U15, K_U19, K_K05

• 1. Introduction to the course. Requirements for the completion of the course. The role of fossil liquid fuels and biofuels. • Biomass and wastes (organic raw materials) as feedstocks for biofuels production. First- and next-generation biofuels. Fermentation in production of biofuels. Methods of analysis of biofuels • Conversion of cellulose and lignocellulosie. Algae biomass in biofuels. • Gaseous bio-fuels - properties, applications, production • Future trends in biofuels, directions of research • Methods of analysis of biofuels • Biodiesel synthesis • Production of bioethanol

Chemistry of cosmetics	K_W05, K_W10, K_U02, K_U16, K_K02

• Inorganic compounds with therapeutic action. An overview of the most important organic compounds used in cosmetics. Physical chemistry of cosmetics: Structure-activity correlations. Anatomy and physiology of the skin. Anatomy and physiology of the hair. Cosmetic ingredients and their functions: antimicrobial agents, colorants, UV filters, antioxidants, surfactants, fragrances, vitamins, liposomes, proteins, peptides, lipids, ceramides, vegetable raw materials, elixirs youth, immunostimulants in cosmetics. Chemistry of specific product categories such as hair, skin and oral care, colour cosmetics, aerosols and perfumes. Manufacture and Control: packaging, production, quality assurance, product stability, safety assessment, legislation, microbial preservation, performance evaluation and market research. Laying the cosmetic formulations. International Nomenclature of Cosmetic Ingredients. Threats to the environment and human health posed by some of the ingredients of cosmetics. • Hands-on experience creating and evaluating hair and skin products. Emulsions including creams and lotions; surfactant systems including shampoos and gels.

Computer science	K_W03, K_W14, K_U02, K_U08, K_K01

• 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, 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 and units in C++. Data types defined in C++. • Main control statements in C++. Static and dynamic variables. Computer memory management. Programming of branches and loops. The definition of functions. Program testing according to principles of software engineering. • The Windows operating system. Networks. Internet-based education. • Text editor. Development of laboratory data. Preparing of presentation. • Chemical structure editors. • Basics of programming in C++ language. Preparation of the project, the development of the algorithm, implementation of procedures, running & testing program and passing the subject. • Creating of process and technological diagrams. • Practical test covering skills acquired on L01-L05.

Computer-aided research	K_W03, K_U01, K_U06, K_U08

• Strategies of searching chemical structures and metabolic databases • Chemical structure formats. 3D visualization of chemical structures • CAOS - computer prediction of biodegradation pathways for chemical compounds and generation of combinatorial libraries • Computer design of new drugs • Chemical similarity

Drug design and synthesis	K_W10, K_W12, K_U16, K_U17, K_K03

• Drug from the idea for the implementation: Leading Structure - search; relation between the structure and the activity of the drug; Pharmacokinetics; QSAR; Combinatorial Synthesis. Laboratory: chosen methods of synthesis of drugs. • Definition of the medicine/drug, stages of seeking the medicine, choice of the site of action of the medicine, choice of the biological assay, seeking the leading structure. • Synthesis on the solid phase - bases and assumptions. • Combinatorial synthesis - idea, methods. • Isolation and purification of the active ingredient, elucidation the structure of the active compound. • Pharmacophore, isostere - definition, examples. • Synthesis of the most populardrugs e.g. prazole, antibiotics, betablockers and statins. • Elements of strategy of planning the synthesis of new potential drugs. The most popular types of the reaction used in the synthesis of medicines/drugs in including analysis of the applied synthesis in the pharmaceutical industry. • Written passing the subject. • Performing five laboratory exercises from the area of the isolation, the synthesis and analysis of medical products during of 5 lesson according to instructions placed on sd of the coordinator, before beginning of the cycle classes.

Engineering graphics	K_W03, K_W14, K_U02, K_U06, K_K01

• Technical letter • Rectangular projections, axonometric views, views and sections. • Technical charts. • Rules for dimensioning. • Assembly drawings. • Processes, apparatus and devices used in chemical technology and biotechnology and their standardized graphic symbols. • Preliminary information, start AutoCAD and basic settings. • Exercises for features and commands of AutoCAD. • Application of AutoCAD specific functions. • Creating a simple technical drawing - projection and dimensioning of a complex geometric solid. • Making production and assembly drawings of machines parts and chemical apparatus

Engineering project	K_U01, K_U03, K_U04, K_U06, K_U08, K_U09, K_U10, K_K01, K_K04

• 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.

Environmental protection and biotechnology	K_W14, K_U03, K_U19, K_K02, K_K05
• Pigments removal from sewage – sludge with the application of biodegradability adsorbents. • Microbiological degradation of cellulose. • Biodegradation of organic compounds. • Biotechnological methods of waste processing from the food industry.	
Enzymology	K_W08, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03
• Enzyme structure and function. • Factors influencing enzyme activity. • Methods used in enzyme activity studies. • Enzyme reaction kinetics. • Enzymes in biotechnology. • Enzyme activity measurements methodology. • Enzyme activity analysis in biotechnological products.	
Forensic biochemistry	K_W12, K_W14, K_U02, K_U16, K_K03
• Metabolites - structures, applications, biological function • Elements of toxicology, harmful compounds - classification, effects on human organism, • Basics of chemical and biochemical analysis in forensic sciences, application of these methods, instrumental methods in forensic analysis • Introduction to analysis of analytical results, basics of interpretation of MS, NMR, FTIR spectra • Serology, DNA profiling, inorganic and oragnic material analysis, analysis of dyes, paints, microscopic analyses. • analysis of structures of harmful compounds with spectroscopic methods • Detection of blood stains • Fingerprint analysis methods • Quantification of heavy metals in urine • LCMS analysis of narcotics in physiological fluids	
General and inorganic chemistry	K_W04, K_U06, K_K01, K_K03
• 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. 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. 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. 4-7. Properties of elements. Inorganic compounds, preparation methods end properties. Main group metals (1, 2, 13). Elements of group 15-18. 8. D-block elements. Crystal field theory. Spectroscopic and magnetic properties. 9. F-block elements. 10. 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.	
General microbiology	K_W07, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03
• The structure and function of prokaryotic cells • Metabolic diversity of microorganisms • Bacterial secondary metabolites and their importance in the environment • The role of microorganisms in biogeochemical cycles • Interaction of microorganisms • The basic microbiological techniques • Isolation and preliminary identification of microorganisms	
Genetic engineering	K_W06, K_W09, K_W12, K_W14, K_U06, K_U09, K_U15, K_U19, K_K01, K_K03, K_K07
• Methods for obtaining DNA fragments: cutting the genomic DNA with restriction enzymes, chemical synthesis, reverse transcription, polymerase chain reaction (PCR). The use of these fragments for various purposes in molecular genetics. Molecular cloning of genes in prokaryotic and eukaryotic cells. Plasmid vectors, cosmids, phage vectors, shuttle vectors, YAC (yeast artificial chromosome). Construction of vectors: restriction enzymes, ligation. Mechanisms for obtaining transgenic organisms: transformation, transduction, transfection. Techniques for analysis and identification of transformants. Expression systems in bacteria and eukaryotic cells. Manipulation of gene expression. Controlled in-vitro mutagenesis. Techniques for transgenic plants and animals. Purification and identification of the recombinant proteins obtained by different methods of analysis: affinity chromatography, electrophoresis and immunoblotting, mass spectrometry. • Evolution of NCBI model. Understanding the diversity of DNA sequences deposited in the databases. Finding and selective use of information in planning experiments. Designing PCR primers for the selected sequence and in any orientation, with attached restriction sites occurring at the start and stop codons for protein domains. The construction of restriction map, characterization of restriction enzymes. Cloning without the use of restriction enzymes. Codon optimization. Designing SNP detection methods (PCR-RFLP, minisequencing) • Application of the techniques of genetic transformation for cloning, sequencing and overexpression. Transformation of transgenic E. coli with pET expression vector or pGlo coding GFP protein. Cultivation of bacteria on the discriminating medium. The chemical transformation and electrotransformation. Isolation of colonies containing cloned gene. Preparation of competent bacteria and plasmids for transformation.	
Genetics	K_W06, K_W14, K_U03, K_U06, K_U09, K_K01, K_K03
• Rules of inheritance, discoveries of Mendel, Morgan, basis of the quantitative and population genetics • The structure of DNA and organization of genetic material • Mutations, chromosomal aberrations, aneuploidy, polyploidy • Genetic crosses, determining the phenotype of offspring and parents, including prediction of Blood type and genetic diseases in humans and prediction of the outcomes of breeding procedures in plants and animals	
Immunological techniques in biotechnology	K_W05, K_W09, K_W14, K_U06, K_U09, K_U15, K_U17, K_K01, K_K03
• Structure of animal and human immune system, lymphoid organs – primary and secondary, cytokine receptors and their properties, complement system • Antigens and the mechanisms of their identification. Characteristics of innate and acquired immunological response mechanisms. Mechanism of receptor activation in B and T cells by an antigen: antigen processing and presentation • Signal transmission between the components of immune system, structure of the immune system T cell receptors • In vivo production of monoclonal and polyclonal antibodies. Obtaining monoclonal antibodies using the method of in vivo and in vitro immunization, and the method of genetic engineering • Methods of the qualitative and quantitative evaluation of detectable macromolecules, using the ELISA method, immunoprecipitation, immunobloting, flow cytometry • The use of recombinant antibodies in a diagnosis and therapy. Classic and recombinant vaccines	
In vitro cultures	K_W14, K_U06, K_U09, K_U19, K_K03
• Definition of plant in vitro culture. Application of plant in vitro culture • Organisation of in vitro culture laboratory: equipment, rules of sterile work, • Methods of terilization for glasware, media, tool. • Media used in plant in vitro culture: types of media, ingredients (macro- microelemets, vitamins, plant hormones, aminoacids, sugars, geling agents). Composition and preparation of Murashige nad Skoog medium 1962. • Primary and secondary explants. Sources of primary explants. Methods of primary expalnts harvesting. • Organogenesis in in vitro culture. Micropropagation as technological application of in vitro culture. • Kallus culture: induction, maintenance, application. • Suspension culture: induction maintenance, application. • Root culture. • Application of in vitro culture in obtainig virus free plants. • Anther culture. Microspore culture and production of dihaploids. • Isolation, culture and fusion of plant protoplasts. • Work safety • Rools of sterile work in plant in vitro culture laboratory. Operetion of equipment. • Preparation of medium for carrot callus induction. • Induction of calli from primary explants of carrot • Preparation of medium for micropropafation of wild strawberry • Transpantation of wild strawberry microplants • Isolation of mature rye embryos.	
Industrial microbiology	K_W07, K_W10, K_W12, K_U18, K_U19, K_K01
• Biological and technological criteria for the classification of microorganisms used in the industry • Methods for the isolation of microorganisms for industrial use from environmental samples and optimization of conditions in laboratory culture • The correct use of terminology in the field of naming microbiological • Secondary metabolites as precursors and products of specific biosynthesis • Fermentation processes and their implementation on an industrial scale • Mechanisms of xenobiotics biodegradation • Microbiology of food • Techniques for isolating microorganisms for industrial use from the environmental samples • Screening tests of proteolytic microorganisms in a laboratory • Methods for improving production characteristics of industrial microorganisms	

Instrumental analysis	K_W04, K_W10, K_U16, K_U17, K_K01

• Analytical process, its elements and statistical evaluation of each step. Analysis of elements and compounds by spectroscopic methods. Atomic Emission Spectroscopy - basis of the method, methods of sample atomization and excitation, applications. Atomic absorption spectroscopy. Molecular spectroscopy in the ultraviolet and visible light. Infrared spectroscopy. Spectra recording techniques, methods of quantitative and qualitative analysis. Fundamentals of nuclear magnetic resonance spectroscopy. The quantitative and structural analysis based on the NMR spectra. Fundamentals of mass spectrometry. Interpretation and application of analytical mass spectra for organic compounds. Chromatographic methods for separation of mixtures. Basic principles and classification. Theoreticasl basis of separation process. Retention mechanisms and parameters. Separation efficiency. Definition and determination of resolution index, theoretical plate number, selectivity factor. Separation techniques in liquid chromatography - adsorption chromatography, partition - normal/reverse chromatography, ion-exchange chromatography , gel filtration chromatography. Selection of the chromatographic conditions - rules for the selection of the stationary and mobile phases. High Performance Liquid Chromatography HPLC and thin-layer HPTLC. Isocratic and gradient techniques, instrumentation. Gas chromatography. The rate theory of chromatography - band broadening, column efficiency. Optimization of column performance. Chromatographic methods of qualitative and quantitative analysis. Potentiometric methods. Design, operation and application of the selected ion-selective electrodes. Conductometry and its analytical application. Voltammetric methods - linear-sweep LSV, cyclic CV, and stripplng CSV, ASV techniques. Quantitative and qualitative analysis. Selected applications in analytical laboratory and industrial applications, criteria for the method selection. • Identification of components in the mixture of hydrocarbons and their determination by gas chromatography GC. Determination of hydrocarbons and their derivatives using HPLC. Analysis of the composition of mixtures of organic compounds using a GC-MS. Identification and a quantitative analysis by IR spectroscopy. Determination of the concentration of substances bythe UV-VIS spectroscopy. Structural analysis on the base of 1H-NMR spectra. Determination of the element content in the solutions by atomic absorption spectroscopy (AAS). Polarimetric determination of sucrose in aqueous solution. Quantitative determination of elements by cyclic voltammetry CV. Determination of iodide and chloride by potentiometric precipitation titration. Determination of the concentration of the phenol by conductrometric titration method.

Mathematics	K_W01, K_U06, K_K01

• 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 • Ordinary differential equations: notions of general solution and particular solution, initial-value problem, ordinary differential equations of first-order, ordinary differential equations of second-order. • 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. Double and triple integrals.

Molecular biology	K_W05, K_W06, K_W14, K_U06, K_U09, K_K01, K_K03

• Basic terminology in the field of molecular biology. Differences in the structure of genetic information between pro and eucariots. Introduction to labolatory procedures - isolation of nucleic acids. • Plasmids: structure, replication, biological function, transfer of information between cells, resiatance to unfavorable environmental conditions like antibitics, heave metal ions, sulfonamids, phenol and its derivatives. Virulence towards host, elimination of competitors from environment. Systematcs of pasmids. Application of plasmids in genetic ingeniering; Ti, Ri, E. coli plasmids.Introduction to laboratorie; restriction enzymes, restriction mappiong • Structure of the bacterial chromosome. Recplication of the bacterial chromosome. Hetthylation of bacteroal chromosome. RCR. • Transcription in procariots • Structure and function of bacterial ribosoms. Translation in procariotic cells. Posttranslational modification of proteins. • Sources of diversity in microorganisms. • Compartmentalization of eucariotic cells and its influence on structure of eucariotic genomes. • Structure of eucariotic chromosom: centromer, telomers, eucgromatin, heterochromatin, nucleosom, histones. Replication of eucariotic chromosom. • E. coli plasmids isolation. • DNA electroforeis in agarose gel. • Digestion of DNA with restriction enzymes. • PCR • Restriction mapping , aanalizys of PCR products. • DNA ligation

Organic chemistry	K_W04, K_W10, K_U16, K_U17, K_K03

• Structure and isomerism of organic compounds. Efects of electronic displacements versus explanation of properties of organic compounds. Classification of organic compounds. Type of organic reactions and kinds of mechanisms. Chemical individuals. • Saturated and unsaturated hydrocarbons (alkene, alkadiene, alkyne, isoprenoids, steroids). Aromatic hydrocarbons. • Nomenclature of saturated, unsaturated and aromatic hydrocarbons. Reactions of saturated, unsaturated and aromatic hydrocarbons. • Halogen derivatives of hydrocarbons, metalorganic compounds. Alcohols and phenols. Ethers. Aldehyde and ketones (aldol condensation). Mono- and polycarboxylic acids, halogen, hydroxy and oxo acids. Derivatives of carboxylic acid (halogens, anhydrides, amides). Esters (lactides, lactones, fats, soap, ester condensation). Nitrogen organic compounds: nitro compounds, amines, amino acids, peptides, proteins. Carbohydrates. Selected heterocyclic compounds. • Techniques and methods relayed to separation and purification of organic compounds and determination of basic physical properties. Synthesis and characterization of selected organic compounds.

Packeges of application software	K_W03, K_U02, K_U08

• Application of MS Excel to tabelarize 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 or Maple. Creation of simple programs for solving selected mathematical problems.

Physical chemistry	K_W04, K_U06, K_K01, K_K03

• 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. Colloidal solutions, micelles. 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 equilibria, 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. The transition state theory. Complex

reactions. Kinetics of enzymatic reaction. Basics of katalysis. Adsorption. Adsorption theories. Electrolyte solutions. Debye-Hückel theory. Specific and molar conductance of strong and weak electrolytes. Transport numbers. Ionic mobility. Thermodynamics of electrolyte solutions. Electrochemistry. Semicells and electrochemical cells. Chemical reactions in an electrochemical cell. Electromotive force of electrochemical cells. Thermodynamics of electrochemical cell. Physicochemical applications of semicells and electrochemical cells. • Physicochemical calculations connected with chemical equilibrium, chemical kinetics, simple, complex and enzymatic reactions, theory of electrolyte solutions, ionic conductance and electrodics. • Determination of molar refraction of organic liquids. Determination of surface tension of liquids. Determination of critical micelle concentration. Determination of reaction order and rate. Determination of thermical activation of a chemical reaction. Determination of phase equilibrium in three - component system. Determination of adsorption isotherm. Determination of limiting molar conductivity of electrolyte solution. Determination of ΔG, ΔH and ΔS of chemical reaction. Electrochemical determination of solubility constant.

Physical education	K_K01, K_K03, K_K04

• 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_W01, K_W02, K_K03

• Measurements and physical units. 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.

Plant biochemistry	K_W05, K_W06, K_W14, K_U09, K_U18, K_K03

• Familiarization with biochemical specificity of plant cell • Identifying and obtaining gene of desired function.

Process design	K_W03, K_W13, K_W14, K_W19, K_U02, K_U08, K_U14, K_U15, K_U19, K_K01, K_K02, K_K03

• Introduction to simulation programs. Basic rules for the selection of thermodynamic models • An introduction to computing simulation processes (flow of information, analysis of degrees of freedom, the classification of simulation methods). The calculation of chemical reaction processes and reactors. • The criteria for evaluation of the project - "pure" chemical technology. Hierarchical method, an example application. Calculation of the heat exchangers. • 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). • 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.

Professional training	K_U02, K_K01, K_K02, K_K03

• 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.

Protein engineering	K_W03, K_W05, K_W12, K_W14, K_U03, K_U08, K_U09, K_U19, K_K02

• Molecular aspects of enzymatic activity • Selected aspects of design and protein structural modifications • Selected examples of protein engineering • Protein engineering in-silico for the improvement of its biotechnological properties

Purification of biotechnology products	K_W10, K_U17, K_K03

• Strategies to recover and purify product. The permeate techniques of the mixtures separation: ultrafiltration, osmosis, reverse osmosis, microfiltration, dialysis, electrodialysis. Mathematical models of the processes. The examples of applications for species separation in biotechnology. Chromatographic and adsorptive technique of species separation. Thin layer chromatography, column periodical chromatography and continuous chromatography (SMB). Expanded bed adsorption chromatography. The normal and reversed phase chromatography. Ion exchange and gel chromatography. Theory of chromatographic separation: basic mathematical models of adsorption and mass transfer. The influence of process parameters: temperature, composition of mobile phase, solid phase, pH, ion strength of mobile phase on the mixtures separation. The optimization of periodical and continuous process. Principles of selections of chromatographic systems. Capillary electrophoresis and electrochromatography. Drying methods, crystallization methods.

Scientific and technological information	K_W03, K_U01

• 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_W15, K_U06, K_K04

• 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_W01, K_W03, K_W14, K_U10, K_K01

• 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_W13, K_W14, K_U12, K_K01, K_K02, K_K04
• 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).	

Toxicology	K_W14, K_U03, K_U19, K_K02, K_K05
• Introduction on the toxicology, definition of poison, intoxication, intoxication types, toxicity of chemical compounds, accumulation, persistence, way of introduction of poisons in the organisms. • Factors which influence of toxicity of poisons, synergisms and antagonisms. • Biotransformation of poisons in the organisms and degradation process of the poisons in the environment, elimination of poisons from organisms (pathway and biochemical mechanisms of elimination), etiology of intoxication, definition of abbreviation which will be used in the toxicology. • Prevention of the intoxication and basic therapy of intoxication REACH process – legislative in the European Union. • Risk assessment, definition of RA, identification of harmful substance, dose – response, exposition, risk characteristic, calculation of ADI (or RfD) and LD50, definition of abbreviation NOEL, NOAEL, NOEC, NOAEC, SF, UF, MF, ADI, TI • Practical presentation of risk assessment of use of herbicide in the aquatic environment. • IDevelopmental toxicology, toxicology versus spermatogenesis, oogenesis and fertilization. Evaluation of toxic compounds on the embryo and developmental organism after birth to adulthood. • Toxicology of choice inorganic compounds (CO, CN-, NO2-, NH3, H2S, Cl2, PH3 …). Toxicology of acids and hydroxide. • Toxicology of selected organic compounds. • Toxicology of selected heavy metals (Pb, Cd, Hg, Cu, As, Ba, Mg ....) • Toxicology of pesticides – divide of pesticides according to use in the agricultural practice, toxicology of selected pesticides according to chemical groups • Intoxications of selected drugs • Mycotoxins - characterization, toxicity, risk, divide by effect of the living organism • Poison plants – chemical compounds of toxic plants, divide toxic plants by effect of the living organism (by effect on the bodily organs) • Poisonous animals – chemical compounds of animal toxins, representative animal species. • General information about toxicology, diagnose of intoxication, sampling, packing and sending for chemical toxicology analysis • Determination of noxa in biological material without samples adjustment • Determination of toxicologically important chemical compounds separable by water steam distillation • Determination of warfarine (kumarine) in the biological material • Determination of alkaloids in biological material by TLC method • Determination of drugs in the biological material by TLC method (salinomycín, monenzin, paracetamol) • Determination of herbicides MCPA and DNOK in the biological material	

programme content of elective modules

English (A)	K_U02, K_U06, K_U07
• 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. • Speaking practice - preparation for the oral examination.	

English (B)	K_U02, K_U06, K_U07
• 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: conditionals. • 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 questionnaire. • Writing a questionnaire. 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 - preparation for the oral examination. • Speaking practice - preparation for the oral examination.

French (A)	K_U02, K_U06, K_U07

• 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_U02, K_U06, K_U07

• 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_W15, K_W16, K_W18, K_U11, K_U14, K_K06

• 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_W15, K_W16, K_W18, K_U11, K_U14, K_K06

• Management as an academic discipline • Company and its environment as an object of management • Management features • Conterporary management problems. • State security management, internal and external security, ecological safety, microbiological safety, management of state security structures.

German (A)	K_U02, K_U06, K_U07

• 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.

German A	K_U02, K_U06, K_U07

• 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 abbreviations. 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.

Russian (A)	K_U02, K_U06, K_U07

• 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 excursions and sight-seeing. • Tiurism in Russia. Full meaning of турбюро, турбаза, ж/д abbreviations. • 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 noveltis. 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

<table>
<tr><td>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. .</td></tr>
</table>

Russian (B)	K_U02, K_U06, K_U07

• 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. Purification and analysis of biotechnological products, full time

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.	123 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.	126 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=H&TK=html&S=1490&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/ Seminar	Sum of hours	ECTS	Exam	Mand.
1	ZB	Technical safety and ergonomics	15	0	0	0	15	1	N	
1	CB	Cell biology	15	0	0	0	15	2	N	🚩
1	CN	General and inorganic chemistry	30	30	0	0	60	6	T	🚩
1	ZM	Academic savoir - vivre	10	0	0	0	10	1	N	
1	FF	Physics	30	30	0	0	60	6	T	🚩
1	CB	Genetics	30	15	0	0	45	4	N	
1	ZM	Social competences	10	15	0	0	25	2	N	
1	FM	Mathematics	30	30	0	0	60	6	T	🚩
1	ZE	Economic course	30	0	0	0	30	2	N	
Sums for the semester: 1			**200**	**120**	**0**	**0**	**320**	**30**	**3**	**4**
2	CB	Cell biology	15	0	30	0	45	4	T	🚩

2	CN	General and inorganic chemistry	30	15	45	0	90	7	T	▮
2	FF	Physics	15	15	15	0	45	4	T	▮
2	CI	Engineering graphics	15	0	30	0	45	4	N	
2	FM	Mathematics	30	30	0	0	60	6	T	▮
2	CI	Packeges 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			**120**	**60**	**180**	**0**	**360**	**30**	**4**	**4**
3	CI	Chemical and biotechnological equipment	30	15	15	0	60	4	N	
3	CN	Biochemistry	15	0	30	0	45	3	T	▮
3	CD	Biophysics	15	0	0	0	15	1	N	
3	CB	Bioinformatics	15	0	15	0	30	2	N	
3	CN	Analytical chemistry	15	0	30	0	45	3	N	
3	CF	Physical chemistry	30	15	0	0	45	4	T	▮
3	CD	Organic chemistry	30	15	0	0	45	4	T	▮
3	DJ	Foreign language	0	30	0	0	30	2	N	▮
3	CB	General microbiology	30	0	30	0	60	5	T	
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			**195**	**105**	**135**	**0**	**435**	**30**	**4**	**4**
4	CN	Biochemistry	30	0	30	0	60	5	T	▮
4	CF	Physical chemistry	30	15	30	0	75	6	T	▮
4	CD	Organic chemistry	30	15	30	0	75	6	T	▮
4	CB	Scientific and technological information	0	0	2	0	2	0	N	
4	DJ	Foreign language	0	30	0	0	30	2	N	▮
4	CB	In vitro cultures	15	0	15	0	30	2	N	
4	CN	Industrial microbiology	30	0	30	0	60	5	T	
4	CM	Biomaterials processing	30	0	30	0	60	4	N	
4	DL	Physical education	0	30	0	0	30	0	N	
Sums for the semester: 4			**165**	**90**	**167**	**0**	**422**	**30**	**4**	**4**
5	CF	Instrumental analysis	30	0	45	0	75	5	N	
5	CN	Biocatalysis	15	0	15	0	30	2	N	
5	CB	Molecular biology	30	0	30	0	60	5	T	▮
5	CN	Environmental protection and biotechnology	30	0	15	0	45	4	T	
5	CB	Plant biotechnology	30	0	15	0	45	4	T	
5	CI	Bioprocess engineering	30	15	0	0	45	3	N	▮
5	DJ	Foreign language	0	30	0	0	30	2	N	▮
5	CB	Computer-aided research	0	0	15	0	15	1	N	
5	CB	Immunological techniques in biotechnology	30	0	30	0	60	4	N	
Sums for the semester: 5			**195**	**45**	**165**	**0**	**405**	**30**	**3**	**3**
6	CB	Molecular biology	15	0	15	0	30	2	N	▮
6	CI	Bioreactors	15	0	15	0	30	2	N	
6	CX	Bioreactors II	0	0	15	0	15	1	N	
6	CB	Enzymology	15	0	30	0	45	2	T	
6	CI	Bioprocess engineering	15	15	15	0	45	3	T	▮
6	CB	Genetic engineering	30	0	30	0	60	3	T	
6	DJ	Foreign language	0	30	0	0	30	3	T	▮
6	CF	Biomolecular processes modeling	30	0	15	30	75	6	N	
6	CM	Drug design and synthesis	30	0	30	0	60	5	N	
6	CB	Toxicology	30	0	15	0	45	3	N	
Sums for the semester: 6			**180**	**45**	**180**	**30**	**435**	**30**	**4**	**3**
7	CI	Process safety	15	0	0	15	30	2	N	
7	CF	Biosensors	15	0	15	0	30	2	N	
7	CX	Chosen subject OA	15	0	0	0	15	1	N	
7	CI	Purification of biotechnology products	30	0	15	0	45	2	N	

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/Seminar	Sum of hours	ECTS	Exam	Mand.
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	CB	Proteomics and protein engineering	30	0	15	0	45	4	N	
Sums for the semester: 7			**120**	**0**	**45**	**165**	**330**	**30**	**0**	**0**
TOTALS FOR ALL SEMESTERS:			**1175**	**465**	**872**	**195**	**2707**	**210**	**22**	**22**

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 (A)	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 (A)	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 (A)	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 (A)	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	
7	CF	Bioinorganic chemistry	15	0	0	0	15	2	N	
7	CB	Cell signalling	15	0	0	0	15	2	N	
7	CN	Remediation of toxic substances in environmental material	15	0	0	0	15	2	N	
7	CB	Molecular taxonomy	15	0	0	0	15	2	N	
7	CN	Application of biotechnology in modern therapy	15	0	0	0	15	2	N	

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=H&TK=html&S=1490&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=H&TK=html&S=1490&C=2020, which are an integral part of the study programme.

Academic savoir - vivre	K_W15, K_U06, K_K03
• 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_W04, K_U06, K_K01, K_K03
• 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.	
Biocatalysis	K_W08, K_W10, K_W14, K_U03, K_U19, K_K01, K_K03
• Enzyme composition • Enzymatic mechanisms • Enzyme kinetics; • Enzyme immobilisation • Industrial enzymatic processes; samples of enzymatic processes	
Biochemistry	K_W05, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03
• Biochemistry - the molecular logic of living organisms. • Structure and properties of amino acids. Proteins: a hierarchical organization of structure. Basic aspects of the protein structure and function. Myoglobin and hemoglobin. • Introduction to enzymes. Factors affecting enzyme activity. Enzyme kinetics and inhibition. Control of enzyme activity. • Carbohydrates: monosaccharide, oligosaccharide and polysaccharides structures. Glycoproteins. • Lipids. Structure of cell membranes. Mechanisms of transport across cell membranes. • Membrane receptors and sygnal transduction in cell. • Transduction of genetic information in cell. DNA structure and replication. RNA synthesis and splicing. Protein synthesis. • Identification of amino acids and proteins by specific colour reactions and TLC method. • Determination of protein concentration. • Identification of simple sugars and polisaccharides by colour reactions. Hydrolysis of sucrose. • Separation of amylose and amylopectin from potato starch. Hydrolysis of starch. • Isolation of cholesterol from a chicken egg yolk. Identification of cholesterol by Salkowski method. • Determination of nitrate(III) levels in meat products with the Grieass reagent. • Metabolism: organisation and basic ideas. • Carbohydrate metabolism: glycolysis and gluconeogenesis. • Cellular respiration and energetics: citric acid cycle, oxidative phosphorylation, photosynthesis. • Isolation and determination of superoxide dismutase (SOD) activity from the yeast Saccharomyces cerevisiae. • Identification of superoxide dismutase by native gel electrophoresis and negative staining. • Native gel electrophoresis and identification of LDH isoenzymes. • Isolation of macromolecules by gel filtration. • Separation of lysozyme from chicken egg by ion-exchange chromatography. • Identification of lysozyme by SDS-PAGE electrophoresis.	
Bioinformatics	K_W01, K_W03, K_W14, K_U01, K_U02, K_U06, K_U08, K_U09, K_U10, K_K01
• Introduction to bioinformatics. Basic concepts. E-learning in biotechnology. • Data mining methods in bioinformatics • Sequence alignment • Computer representation and visualisation of biopolymer structures • Bioinformatic databases. Computer representation of structural and sequential information • PCA and cluster analysis methods in bioinformatics • Integrated sequence search system • 3D visualisation and analysis of protein in PDB database	
Biomaterials processing	K_W04, K_W10, K_U16, K_K01
• Classification of polymers. Basic definitions for polymer chemistry:molecular mass, polymerization degree, space building. Polyreactions types. Polymerization classifications • Technological metods of polymerization: mass, solvent, suspensions and emulsion. Polyurethanes, polyamides, polyolefins. Hydrogels - fabrication and properties. • Ceramic biomaterials - introduction. Classification of ceramic biomaterials. Outline of ceramic biomaterials technology • Alumina in bone surgery and dentals. Manufacturing of alumina biomaterials.. Manufacturing and properties of hydroxyapatite. • Methods for the preparation and properties of porous ceramic biomaterials • Technology and properties of carbon biomaterials . Technology and properties of metallic biomaterials . Technology and properties of the composite biomaterials • Preparation and characterization of selected polymeric biomaterials. • Preparation and characterization of selected ceramic biomaterials.	
Biomolecular processes modeling	K_W03, K_W14, K_U01, K_U08, K_U19, K_K01, K_K03
• Main conceptions of biomolecular modeling. Fundamentals of molecular modeling methods: molecular mechanics, molecular dynamics, Monte Carlo method. Molecular forces: covalent, electrostatic, hydrogen and hydrophobic interactions. Basics of molecular quantum mechanics: ab initio methods, semi-empirical methods, DFT method, hybrid methods. Methods of optimization of molecular geometry. Biotechnological bases, other biomolecular bases. Elements of homological analysis . Phylogenetic analysis in proteins. Protein modeling: amino acids, peptides, proteins – modeling of protein structure (primary, secondary, tertiary and quaternary structure). Application of molecular modeling methods in conformational analysis of biological systems. Study of reactivity by quantum chemistry methods. Computer modeling and study of reaction kinetics and thermodynamics. Application of molecular modeling methods in studies of active site reactivities of biochemical (enzymatic) systems, modeling of chemical reactions and transition states, spectroscopic spectra. Molecular docking: docking methods and algorithms, scoring functions of ligand-receptor interaction. Biomolecular modeling in the design of pharmacophores. Quantitative structure-activity relation QSAR methods (2D-QSAR, 3D-QSAR, 4D-QSAR, 5D-QSAR, 6D-QSAR). Kinds of structural indexes and techniques of their calculation. CoMFA and CoMSIA methods and their applications in biotechnology. • Data bases of structural proteins in biomolelular modelling. Homology and phylogenetic analysis of proteins. Minimization energy in peptides and proteins. Modeling of protein structure. Conformational analysis. Electrostatic properties of biomolecules. Examination of structure-activity relation (QSAR) Quantum chemistry investigation of antioxidative properties of flavonoids. Computer modeling of sun filters. Study of reactivity of enzyme systems, modeling of chemical reaction and its transition states. Molecular docking. • Carrying out of the assigned computational design.	
Biophysics	K_W02, K_U06, K_K01
• The bases of the biophysics. Classification of biomolecules. Classification of biomacromolecules (biopolymers). Chemical structures. Super-molecules structure. Interactions of molecules and macromolecules. • Methods of the determination of molecular masses and their distribution for biopolymers:- the method of light scattering statistically (Rayleigh), dynamics (quasi-elastic) - the viscometery, osmometery, bulio- and cryoscopy, method of sedimentation, MALDI-TOF, Gel Permeation Chromatography (GPC) or Self-Exclusion Chromatography (SEC). • Biothermodynamic systems and processes. Phase transitions. Entropy , enthalpy, free energy, heat capacity biopolymers. The phenomena of thermo conductivity mass transportation, viscosity of polymers. Thermal analysis methods for examination the thermal proprieties of biopolymers: TGA, DSC, temperature-modulated DSC, TMA, thermal conductivity. • The chosen physical methods for the investigations of the structure of biopolymers: spectroscopic (IR, spectroscopy Raman, NMR), X-ray spectroscopy (SAXS, WAXS), degree amorphous and crystalline phases. Microscopic techniques: optical microscopy, electron microscopy, atomic force microscopy (AFM). Static and dynamic methods to determine the mechanical proprieties of polymers (dynamic mechanical analysis -DMA). Mechanical modules. • The elements of the biophysics of organs: the sense of the hearing system; visual system, respiration system, the circulation blood system. The influence of physical factors on alive organisms (mechanical, temperatures and moisture, the electric and magnetic field; the radiation ionizing and non-ionizing). Spectroscopy and scanning, topography NMR.	

Bioprocess engineering	K_W10, K_W19, K_U12, K_K01
• Heat Transfer: (Fixed) Stationary Heat Transfer, Heat Transfer Driving Force, Kinds of the Heat Transfer: Thermal Conduction, I-St Fourier Law, Thermal Conduction Coefficient, Heat Non- And Conductors, Thermal Conduction Across Wall, Heat Transfer Resistance, Heat Convection – Newton Equation, Heat Transfer Cases, Criterial Numbers And Equations, Heat Radiation, Heat Screen Meaning, Heat Losses to Environment, Overall Heat Transfer, Newton Equation for Overall Heat Transfer, Overall Heat Transfer Coefficient, Some Cases of Transient Heat Transfer, Basis Of Heat Exchanger Design. Mass Transfer: (Fixed) Stationary Mass Transfer, Driving Force, Mass Diffusion, I-St Fick Law, Mass Diffusion Coefficients, Mass Transfer Resistance, Kinds of the Mass Diffusion, Mass Diffusion, Mass Convection, Newton Kinetic Equation, Mass Transfer Cases, Criterial Numbers And Equations, Overall Mass Transfer, Newton Equation for Overall Mass Transfer, Overall Mass Transfer Coefficient, Disappearance of Mass Transfer Resistance, Overall Mass Transfer Driving Force, Basis Of Mass Exchanger Design. Concurrent Heat and Mass Transfer – Basic Knowledge Absorption; A) Process Definition, B) Static's of the Process – Absorption Equilibrium, Kinds of the Equilibrium Line Notations, C) Process Kinetics, Mass and Overall Mass Transport in the Absorption, D) Mass Balance of the Absorption, Operation Line of the Absorption, Minimum of the Spraying Liquid Mass and Velocity, E) Overall Mass Transfer Driving Force int Absorption, F) Dynamic Model of the Absorption,Chemisorption. • Distillation And Rectification: Points A) to F) Analogous to the Same Above with the Following Differences: Distillation Equilibrium for Binary Component System, Kinds of the Equilibrium Line Notations - for Ideal System – Raoult Law, Nonideal Systems – Aberrations From Raoult Law, Azeotropes, Differential Distillation, Equilibrium Distillation, Mass and Overall Mass Transport in the Rectification, Batch Rectification, Continuous Rectification, Heat and Mass Balances of the Rectification, Heat and Mass Balances of the Operated Plate, Operation Lines of the Rectification, Minimum and Maximum Minimum of the Column Reflux, Column Efficiency Measured by Theoretical Plate Amount. Exstraction: Points A) to F) Analogous to the Same Above with the Following Differences: Extraction Equilibrium for Ternary Component System, Ideal System – Nernst Law, Nonideal Systems – Aberrations From Nernst Law, Stepping Extraction Parallel-Current and Counter-Current Extraction, Minimum and Maximum of the Extrahent Mass, Kinds of the Mathematics Solution of the Mentioned Above Extraction Cases, Column Extraction, Dynamic Model of the Column Extraction.	
Bioreactors	K_W07, K_W11, K_U15, K_U19, K_K01
• Definition of bioprocess engineering. Stoichiometry of microbial growth, oxygen balance. Kinetics of cells growth, product formation, kinetics of enzymatic reactions. Bioreactors: batch reactor, chemostat, chemostat with recycle, multistage chemostat systems, plug flow reactor, bubble-column reactors, fluidization reactors, membrane reactors. Designing of bioreactors. Scaling-up and scaling-down.	
Bioreactors II	K_W07, K_W11, K_U09, K_K02
• Designing of real bioreactors of different types with taking into account the kinetics of bioreaction and mass and heat transfer.	
Biosensors	K_W10, K_U06, K_K01
• Classification of chemical sensors. Theoretical basics of chemical recognition. • Electrochemical sensors - potentiometric, amperometric and conductometric sensors. • Optical sensor, physics of optical fibers, optical fiber sensors – design, operation and examples. • Mass sensors, basics of piezo- and pyroelectricity, chemical layers of mass sensors. • Thermal sensors - pyroelectric sensors, gas catalytic sensors. • Applications of chemical sensors in industrial analytical control, clinical chemistry and environment protection. Prospects of development of chemical sensors.	
Cell biology	K_W05, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03
• Similarities and differences in structure of prokaryotic and eukaryotic cells. • Basic research methods applied in studies of cell and its components. • Evolution and function of subcellular structures. • Mechanisms of cell membrane transport. • Signal transduction in the cell. • Cell cycle and course of mitosis and meiosis. • Basic laboratory methods and safety rules and regulations. • Microscopic observations of cells and tissues. • Isolation of chloroplasts and mitochondria from the plant cells. • Separation of chlorophylls and carotenoids be thin layer chromatography.	
Chemical and biotechnological equipment	K_W11, K_W13, K_U17, K_K01
• Classification of chemical apparatus. Fundamentals of transport phenomena of heat and mass momentum. The nature of the fluid flow. Fluid flow resistance. Liquid outflow from the tank • Apparatus for mixing, aeration and disintegration of biomass. Demand for mixing power. • Bioreactors and fermenters - construction solutions and the principle of operation. Bioprocesses in fluidised bed. • Characteristics of comminuted materials. • Slurry separation by deposition, sedimentation, flotation, classification. • Filtration and spinning of biological suspensions, process rules and apparatus. • Heat exchangers, evaporators and sterilizers. • Apparatus for absorption and adsorption. • Apparatus for distillation and rectification. • Apparatus for extraction and crystallization	
Computer science	K_W03, K_W14, K_U02, K_U08, K_K01
• 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, 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 and units in C++. Data types defined in C++. • Main control statements in C++. Static and dynamic variables. Computer memory management. Programming of branches and loops. The definition of functions. Program testing according to principles of software engineering. • The Windows operating system. Networks. Internet-based education. • Text editor. Development of laboratory data. Preparing of presentation. • Chemical structure editors. • Basics of programming in C++ language. Preparation of the project, the development of the algorithm, implementation of procedures, running & testing program and passing the subject. • Creating of process and technological diagrams. • Practical test covering skills acquired on L01-L05.	
Computer-aided research	K_W03, K_U01, K_U06, K_U08
• Strategies of searching chemical structures and metabolic databases • Chemical structure formats. 3D visualization of chemical structures • CAOS - computer prediction of biodegradation pathways for chemical compounds and generation of combinatorial libraries • Computer design of new drugs • Chemical similarity	
Drug design and synthesis	K_W10, K_W12, K_W16, K_U17, K_K03
• Drug from the idea for the implementation: Leading Structure - search; relation between the structure and the activity of the drug; Pharmacokinetics; QSAR; Combinatorial Synthesis. Laboratory: chosen methods of synthesis of drugs. • Definition of the medicine/drug, stages of seeking the medicine, choice of the site of action of the medicine, choice of the biological assay, seeking the leading structure. • Synthesis on the solid phase - bases and assumptions. • Combinatorial synthesis - idea, methods. • Isolation and purification of the active ingredient, elucidation the structure of the active compound. • Pharmacophore, isostere - definition, examples. • Synthesis of the most populardrugs e.g. prazole, antibiotics, betablockers and statins. • Elements of strategy of planning the synthesis of new potential drugs. The most popular types of the reaction used in the synthesis of medicines/drugs in including analysis of the applied synthesis in the pharmaceutical industry. • Written passing the subject. • Performing five laboratory exercises from the area of the isolation, the synthesis and analysis of medical products during of 5 lesson according to instructions placed on sd of the coordinator, before beginning of the cycle classes.	
Engineering graphics	K_W03, K_W14, K_U02, K_U06, K_K01
• Technical letter • Rectangular projections, axonometric views, views and sections. • Technical charts. • Rules for dimensioning. • Assembly drawings. • Processes, apparatus and devices used in chemical technology and biotechnology and their standardized graphic symbols. • Preliminary information, start AutoCAD and basic settings. • Exercises for features and commands of AutoCAD. • Application of AutoCAD specific functions. • Creating a simple technical drawing - projection and dimensioning of a complex geometric solid. • Making production and assembly drawings of machines parts and chemical apparatus	
Engineering project	K_U01, K_U03, K_U04, K_U06, K_U08, K_U09, K_U10, K_K01, K_K04

• 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.

Environmental protection and biotechnology	K_W14, K_U03, K_U19, K_K02, K_K05

• Definitions and fundamental phrases. Environment, environment protection, ecology, ecological impact, system, ecosystem, paradigm, civilization. Elements of theory of systems. Reductionism versus holism in reality description and understanding. Micro- and macro-explanation concept. Soft and hard technologies. • Ecological equilibrium. Elements of ecological equilibrium of Earth. Energy balance of Earth. Cycles of chemicals in the environment. Circulation of matter (H_2O, CO_2, N_2, O_2, heavy metals) and energy. Populations and their features. Agglomeration process, dissipative structures. Agriculture and ecology. Contamination caused by farm plant and animal production. Soil components and their transformation. Degradation and protection of soils. Biological sewage and waste water purification. Importance of fuels and energy in agriculture economy. • Chemical inorganic and organic pollutants in environment and their biological and medical action. Chemical inorganic and organic pollutants in environment and their biological and medical action. Classifications and systematics of pollutants. Inorganic and organic persistent pollutants, their scattering, bioaccumulation, toxicology (enzyme dysfunction, heme biosynnthesis disfunction, oxidative phosphorylation inhibition, narcosis, DNA modification), and hormone-like activity.Tobacco smoke as a pollution agent. Purification of liquid waste by means of defined bacteria cultures. Ecological validation of marketable washing powders. • Toxic metals and organic pollutants level in air, water, soil and food as an indicator of environment quality. System approach to calculation and conversion of different solution concentration expressions and units especially for applied in ecology and in medical analytical chemistry. Determination of toxic metals as Hg, Cd and Pb in biological and environment samples. Determination of soil quality parameters. Tests and ecological validation of common plastics. • Energy production and ecology in XXI age. Ecological valuation and economy of applied energy sources. Renewable sources of energy. Biomass and bio-fuels. Soft technologies rising up on the basis of solar energy as wind, solar collectors, heat pumps etc. Solar economy and possibility of solar age. Thermal and photovoltaic technology applications of solar energy. The passage to the Solar Age and its political, legislative and tax limitations. Geothermic energy as a large scale energy source of growing importance. Ecological validation of marketable sources of light. Analysis of thermal solar energy home set with solar collector. Analysis of photovoltaic solar energy home set. • Wastes disposal. Wastes in nature technologies in comparison to that in man's technologies. Characteristics of wastes generated by power industry and other kinds of industry. Environmentally hazardous products. The life cycle assessment approach and ISO standards.. Waste management in local communes. An overview of waste utilization methods. Waste combustion. Ecological and ethical aspects of chemical production. • Current ecological problems. The current ecological problems of Poland and UE. Look over of environment friendly technologies and biological methods of environment protection. Environment legislation in Poland and UE. The problem of ecological taxes.

Enzymology	K_W08, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• Enzyme structure and function. • Factors influencing enzyme activity. • Methods used in enzyme activity studies. • Enzyme reaction kinetics. • Enzymes in biotechnology. • Enzyme activity measurements methodology. • Enzyme activity analysis in biotechnological products.

General and inorganic chemistry	K_W04, K_U06, K_K01, K_K03

• 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. 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. 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. 4-7. Properties of elements. Inorganic compounds, preparation methods end properties. Main group metals (1, 2, 13). Elements of group 15-18. 8. D-block elements. Crystal field theory. Spectroscopic and magnetic properties. 9. F-block elements. 10. 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.

General microbiology	K_W07, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• The structure and function of prokaryotic cells • Metabolic diversity of microorganisms • Bacterial secondary metabolites and their importance in the environment • The role of microorganisms in biogeochemical cycles • Interaction of microorganisms • The basic microbiological techniques • Isolation and preliminary identification of microorganisms

Genetic engineering	K_W06, K_W09, K_W12, K_W14, K_U06, K_U09, K_U15, K_U19, K_K01, K_K03, K_K07

• Methods for obtaining DNA fragments: cutting the genomic DNA with restriction enzymes, chemical synthesis, reverse transcription, polymerase chain reaction (PCR). The use of these fragments for various purposes in molecular genetics. Molecular cloning of genes in prokaryotic and eukaryotic cells. Plasmid vectors, cosmids, phage vectors, shuttle vectors, YAC (yeast artificial chromosome). Construction of vectors: restriction enzymes, ligation. Mechanisms for obtaining transgenic organisms: transformation, transduction, transfection. Techniques for analysis and identification of transformants. Expression systems in bacteria and eukaryotic cells. Manipulation of gene expression. Controlled in-vitro mutagenesis. Techniques for transgenic plants and animals. Purification and identification of the recombinant proteins obtained by different methods of analysis: affinity chromatography, electrophoresis and immunoblotting, mass spectrometry. • Evolution of NCBI model. Understanding the diversity of DNA sequences deposited in the databases. Finding and selective use of information in planning experiments. Designing PCR primers for the selected sequence and in any orientation, with attached restriction sites occurring at the start and stop codons for protein domains. The construction of restriction map, characterization of restriction enzymes. Cloning without the use of restriction enzymes. Codon optimization. Designing SNP detection methods (PCR-RFLP, minisequencing) • Application of the techniques of genetic transformation for cloning, sequencing and overexpression. Transformation of transgenic E. coli with pET expression vector or pGlo coding GFP protein. Cultivation of bacteria on the discriminating medium. The chemical transformation and electrotransformation. Isolation of colonies containing cloned gene. Preparation of competent bacteria and plasmids for transformation.

Genetics	K_W06, K_W14, K_U03, K_U06, K_U09, K_K01, K_K03

• Rules of inheritance, discoveries of Mendel, Morgan, basis of the quantitative and population genetics • The structure of DNA and organization of genetic material • Mutations, chromosomal aberrations, aneuploidy, polyploidy • Genetic crosses, determining the phenotype of offspring and parents, including prediction of Blood type and genetic diseases in humans and prediction of the outcomes of breeding procedures in plants and animals

Immunological techniques in biotechnology	K_W05, K_W09, K_W14, K_U06, K_U09, K_U15, K_U17, K_K01, K_K03

• Structure of animal and human immune system, lymphoid organs – primary and secondary, cytokine receptors and their properties, complement system • Antigens and the mechanisms of their identification. Characteristics of innate and acquired immunological response mechanisms. Mechanism of receptor activation in B and T cells by an antigen: antigen processing and presentation • Signal transmission between the components of immune system, structure of the immune system T cell receptors • In vivo production of monoclonal and polyclonal antibodies. Obtaining monoclonal antibodies using the method of in vivo and in vitro immunization, and the method of genetic engineering • Methods of the qualitative and quantitative evaluation of detectable macromolecules, using the ELISA method, immunoprecipitation, immunobloting, flow cytometry • The use of recombinant antibodies in a diagnosis and therapy. Classic and recombinant vaccines

In vitro cultures	K_W14, K_U06, K_U09, K_U19, K_K03

• Definition of plant in vitro culture. Application of plant in vitro culture • Organisation of in vitro culture laboratory: equipment, rules of sterile work, • Methods of terilization for glasware, media, tool. • Media used in plant in vitro culture: types of media, ingredients (macro- microelemets, vitamins, plant hormones, aminoacids, sugars, geling agents). Composition and preparation of Murashige nad Skoog medium 1962. • Primary and secondary explants. Sources of primary explants. Methods of primary expalnts harvesting. • Organogenesis in in vitro culture. Micropropagation as technological application of in vitro culture. • Kallus culture: induction, maintenance, application. • Suspension culture: induction maintenance, application. • Root culture. • Application of in vitro culture in obtainig virus free plants. • Anther culture. Microspore culture and production of dihaploids. • Isolation, culture and fusion of plant protoplasts. • Work safety • Rools of sterile work in plant in vitro culture laboratory. Operetion of equipment. • Preparation of medium for carrot callus induction. • Induction of calli from primary explants of carrot • Preparation of medium for micropropafation of wild strawberry • Transpantation of wild strawberry microplants • Isolation of mature rye embryos.

Industrial microbiology	K_W07, K_W10, K_U12, K_U18, K_U19, K_K01

• Biological and technological criteria for the classification of microorganisms used in the industry • Methods for the isolation of microorganisms for industrial use from environmental samples and optimization of conditions in laboratory culture • The correct use of terminology in the field of naming microbiological • Secondary metabolites as precursors and products of specific biosynthesis • Fermentation processes and their implementation on an industrial scale • Mechanisms of xenobiotics biodegradation • Microbiology of food • Techniques for isolating microorganisms for industrial use from the environmental samples • Screening tests of proteolytic microorganisms in a laboratory • Methods for improving production characteristics of industrial microorganisms

Instrumental analysis	K_W04, K_W10, K_U16, K_U17, K_K01

• Analytical process, its elements and statistical evaluation of each step. Analysis of elements and compounds by spectroscopic methods. Atomic Emission Spectroscopy - basis of the method, methods of sample atomization and excitation, applications. Atomic absorption spectroscopy. Molecular spectroscopy in the ultraviolet and visible light. Infrared spectroscopy. Spectra recording techniques, methods of quantitative and qualitative analysis. Fundamentals of nuclear magnetic resonance spectroscopy. The quantitative and structural analysis based on the NMR spectra. Fundamentals of mass spectrometry. Interpretation and application of analytical mass spectra for organic compounds. Chromatographic methods for separation of mixtures. Basic principles and classification. Theoreticasl basis of separation process. Retention mechanisms and parameters. Separation efficiency. Definition and determination of resolution index, theoretical plate number, selectivity factor. Separation techniques in liquid chromatography - adsorption chromatography, partition - normal/reverse chromatography, ion-exchange chromatography , gel filtration chromatography. Selection of the chromatographic conditions - rules for the selection of the stationary and mobile phases. High Performance Liquid Chromatography HPLC and thin-layer HPTLC. Isocratic and gradient techniques, instrumentation. Gas chromatography. The rate theory of chromatography - band broadening, column efficiency. Optimization of column performance. Chromatographic methods of qualitative and quantitative analysis. Potentiometric methods. Design, operation and application of the selected ion-selective electrodes. Conductometry and its analytical application. Voltammetric methods - linear-sweep LSV, cyclic CV, and stripplng CSV, ASV techniques. Quantitative and qualitative analysis. Selected applications in analytical laboratory and industrial applications, criteria for the method selection. • Identification of components in the mixture of hydrocarbons and their determination by gas chromatography GC. Determination of hydrocarbons and their derivatives using HPLC. Analysis of the composition of mixtures of organic compounds using a GC-MS. Identification and a quantitative analysis by IR spectroscopy. Determination of the concentration of substances bythe UV-VIS spectroscopy. Structural analysis on the base of 1H-NMR spectra. Determination of the element content in the solutions by atomic absorption spectroscopy (AAS). Polarimetric determination of sucrose in aqueous solution. Quantitative determination of elements by cyclic voltammetry CV. Determination of iodide and chloride by potentiometric precipitation titration. Determination of the concentration of the phenol by conductrometric titration method.

Mathematics	K_W01, K_U06, K_K01

• 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 • Ordinary differential equations: notions of general solution and particular solution, initial-value problem, ordinary differential equations of first-order, ordinary differential equations of second-order. • 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. Double and triple integrals.

Molecular biology	K_W05, K_W06, K_W14, K_U06, K_U09, K_K01, K_K03

• Basic terminology in the field of molecular biology. Differences in the structure of genetic information between pro and eucariots. Introduction to labolatory procedures - isolation of nucleic acids. • Plasmids: structure, replication, biological function, transfer of information between cells, resiatance to unfavorable environmental conditions like antibitics, heave metal ions, sulfonamids, phenol and its derivatives. Virulence towards host, elimination of competitors from environment. Systematcs of pasmids. Application of plasmids in genetic ingeniering; Ti, Ri, E. coli plasmids.Introduction to laboratorie; restriction enzymes, restriction mappiong • Structure of the bacterial chromosome. Recplication of the bacterial chromosome. Hetthylation of bacteroal chromosome. RCR. • Transcription in procariots • Structure and function of bacterial ribosoms. Translation in procariotic cells. Posttranslational modification of proteins. • Sources of diversity in microorganisms. • Compartmentalization of eucariotic cells and its influence on structure of eucariotic genomes. • Structure of eucariotic chromosom: centromer, telomers, eucgromatin, heterochromatin, nucleosom, histones. Replication of eucariotic chromosom. • E. coli plasmids isolation. • DNA electroforeis in agarose gel. • Digestion of DNA with restriction enzymes. • PCR • Restriction mapping , aanalizys of PCR products. • DNA ligation

Organic chemistry	K_W04, K_W10, K_U16, K_U17, K_K03

• Structure and isomerism of organic compounds. Efects of electronic displacements versus explanation of properties of organic compounds. Classification of organic compounds. Type of organic reactions and kinds of mechanisms. Chemical individuals. • Saturated and unsaturated hydrocarbons (alkene, alkadiene, alkyne, isoprenoids, steroids). Aromatic hydrocarbons. • Nomenclature of saturated, unsaturated and aromatic hydrocarbons. Reactions of saturated, unsaturated and aromatic hydrocarbons. • Halogen derivatives of hydrocarbons, metalorganic compounds. Alcohols and phenols. Ethers. Aldehyde and ketones (aldol condensation). Mono- and polycarboxylic acids, halogen, hydroxy and oxo acids. Derivatives of carboxylic acid (halogens, anhydrides, amides). Esters (lactides, lactones, fats, soap, ester condensation). Nitrogen organic compounds: nitro compounds, amines, amino acids, peptides, proteins. Carbohydrates. Selected heterocyclic compounds. • Techniques and methods relayed to separation and purification of organic compounds and determination of basic physical properties. Synthesis and characterization of selected organic compounds.

Packeges of application software	K_W03, K_U02, K_U08

• Application of MS Excel to tabelarize 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 or Maple. Creation of simple programs for solving selected mathematical problems.	
Physical chemistry	K_W04, K_U06, K_K01, K_K03
• 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. Colloidal solutions, micelles. 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 equilibria, 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. The transition state theory. Complex reactions. Kinetics of enzymatic reaction. Basics of katalysis. Adsorption. Adsorption theories. Electrolyte solutions. Debye-Hückel theory. Specific and molar conductance of strong and weak electrolytes. Transport numbers. Ionic mobility. Thermodynamics of electrolyte solutions. Electrochemistry. Semicells and electrochemical cells. Chemical reactions in an electrochemical cell. Electromotive force of electrochemical cells. Thermodynamics of electrochemical cell. Physicochemical applications of semicells and electrochemical cells. • Physicochemical calculations connected with chemical equilibrium, chemical kinetics, simple, complex and enzymatic reactions, theory of electrolyte solutions, ionic conductance and electrodics. • Determination of molar refraction of organic liquids. Determination of surface tension of liquids. Determination of critical micelle concentration. Determination of reaction order and rate. Determination of thermical activation of a chemical reaction. Determination of phase equilibrium in three - component system. Determination of adsorption isotherm. Determination of limiting molar conductivity of electrolyte solution. Determination of ΔG, ΔH and ΔS of chemical reaction. Electrochemical determination of solubility constant.	
Physical education	K_K01, K_K03, K_K04
• 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_W01, K_W02, K_K03
• Measurements and physical units. 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.	
Plant biotechnology	K_W06, K_W09, K_W12, K_W14, K_U03, K_U09, K_U18, K_U19, K_K02, K_K07
• Genetics and Biotechnology. Elements of population genetics, genetics and plant breeding. Cytogenetics in plant biotechnology. Molecular diagnosis of plant and pathogen. Genomics research plants. Feedback and gene mapping. Isolation and characterization of genes. Transgenic plants - methods of transformation, identification and breeding. The cell wall - structure and improve biotechnology. • The concept of biotechnology. Biomass feedstock biotechnology. Biotransformation of selected chemicals. Plant biotechnology to improve the quality of food, modified starch and other carbohydrates. The transgenic plants as a source of modified oils of storage proteins with improved functional properties. Use of bioreactor cultures of plant cells and tissue. Production of immunotherapeutic agents and biopharmaceuticals in plants. Production of bio fuel. • Regulation of physiological processes, plant growth and development by endogenous and exogenous factors. Creating a structure gene in plant transformation. Industrial strategies for detection of bioactive compounds in plants. Transgenic plants in improving resistance to biotic, abiotic and herbicides. Transformations and functions of lipids (waxes, cutin and suberin).	
Process design	K_W03, K_W13, K_W13, K_W14, K_W19, K_W19, K_U02, K_U08, K_U14, K_U14, K_U15, K_U19, K_U19, K_K01, K_K02, K_K03
• Introduction to methods of designing integrated systems technology. Characteristics of simulation programs. Basic rules for the selection of thermodynamic models • An introduction to computing simulation processes (flow of information, analysis of degrees of freedom, the classification of simulation methods). The calculation of chemical reaction processes and reactors. • The criteria for evaluation of the project - "pure" chemical technology. Hierarchical method, an example application. Calculation of the heat exchangers. • 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). • 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.	
Process safety	K_W12, K_W19, K_U12, K_U15, K_U19, K_K02
• Basic terminology and applicable legal regulations in the field of process safety • Impact of chemicals hazards on the human body and the environment. • Mathematical description of selected types of failure • Models for dispersing substances • Failure risk analysis methods	
Professional training	K_U02, K_K01, K_K02, K_K03
• 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.	
Proteomics and protein engineering	K_W05, K_W10, K_W12, K_W14, K_U03, K_U09, K_U18, K_U19, K_K02

	• Goal and importance of protein engineering • Bioinformatic methods in analysis and characterisation of proteins and its recombinant derivatives • Selected aspects of biophysical and biochemical protein characterisation (i) in-silico (ii) by experimental methods • Design and production of recombinant proteins • Selected aspects of natural and non-natural protein modifications and their importance

Purification of biotechnology products	K_W10, K_U17, K_K03

• Strategies to recover and purify product. The permeate techniques of the mixtures separation: ultrafiltration, osmosis, reverse osmosis, microfiltration, dialysis, electrodialysis. Mathematical models of the processes. The examples of applications for species separation in biotechnology. Chromatographic and adsorptive technique of species separation. Thin layer chromatography, column periodical chromatography and continuous chromatography (SMB). Expanded bed adsorption chromatography. The normal and reversed phase chromatography. Ion exchange and gel chromatography. Theory of chromatographic separation: basic mathematical models of adsorption and mass transfer. The influence of process parameters: temperature, composition of mobile phase, solid phase, pH, ion strength of mobile phase on the mixtures separation. The optimization of periodical and continuous process. Principles of selections of chromatographic systems. Capillary electrophoresis and electrochromatography. Drying methods, crystallization methods.

Scientific and technological information	K_W03, K_U01

• 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_W15, K_U06, K_K04

• 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_W01, K_W03, K_W14, K_U10, K_K01

• 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_W13, K_W14, K_U12, K_K01, K_K02, K_K04

• 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).

Toxicology	K_W14, K_U03, K_U19, K_K02, K_K05

• Introduction on the toxicology, definition of poison, intoxication, intoxication types, toxicity of chemical compounds, accumulation, persistence, way of introduction of poisons in the organisms. • Factors which influence of toxicity of poisons, synergisms and antagonisms. • Biotransformation of poisons in the organisms and degradation process of the poisons in the environment, elimination of poisons from organisms (pathway and biochemical mechanisms of elimination), etiology of intoxication, definition of abbreviation which will be used in the toxicology. • Prevention of the intoxication and basic therapy of intoxication REACH process – legislative in the European Union. • Risk assessment, definition of RA, identification of harmful substance, dose – response, exposition, risk characteristic, calculation of ADI (or RfD) and LD50, definition of abbreviation NOEL, NOAEL, NOEC, NOAEC, SF, UF, MF, ADI • Practical presentation of risk assessment of use of herbicide in the aquatic environment. • Developmental toxicology, toxicology versus spermatogenesis, oogenesis and fertilization. Evaluation of toxic compounds on the embryo and developmental organism after birth to adulthood. • Toxicology of choice inorganic compounds (CO, CN-, NO2-, NH3, H2S, Cl2, PH3 …). Toxicology of acids and hydroxide. • Toxicology of selected organic compounds. • Toxicology of selected heavy metals (Pb, Cd, Hg, Cu, As, Ba, Mg ....) • Toxicology of pesticides – divide of pesticides according to use in the agricultural practice, toxicology of selected pesticides according to chemical groups • Intoxications of selected drugs • Mycotoxins - characterization, toxicity, risk, divide by effect of the living organism • Poison plants – chemical compounds of toxic plants, divide toxic plants by effect of the living organism (by effect on the bodily organs) • Poisonous animals – chemical compounds of animal toxins, representative animal species. • General information about toxicology, diagnose of intoxication, sampling, packing and sending for chemical toxicology analysis • Determination of noxa in biological material without samples adjustment • Determination of toxicologically important chemical compounds separable by water steam distillation • Determination of warfarine (kumarine) in the biological material • Determination of alkaloids in biological material by TLC method • Determination of drugs in the biological material by TLC method (salinomycín, monenzin, paracetamol) • Determination of herbicides MCPA and DNOK in the biological material

programme content of elective modules

Application of biotechnology in modern therapy	K_W05, K_W12, K_U06, K_K01, K_K07

• Biotechnology-derived drugs (biopharmaceuticals) and conventional medicines. • Animals as a living bioreactors. • Biotechnological methods for the production of human hormones. • Monoclonal antibodies - the use in the treatment of immunological diseases and cancer, and diagnostics. • Vaccines - types, potential for development. • Xenotransplantation - the directions of development. • Induced pluripotent stem cells. • Immunosuppressive drugs: modifications and applications. • Artificial skin. • Angiogenesis in vitro. • Diagnostic tests - RIA and ELISA • Nanoparticles in biomedical sciences. • Lecture credit.

Bioinorganic chemistry	K_W04, K_W05, K_U06, K_K01

• Metal coordination sites - their role in bioprocesses in biological systems. Porphyrin ligands and other macrocyclic systems. Transport and storage of transition metal ions. The formation constants of transition metals complexes and methods of their determination. Factors influencing for the potential of the metal complexes. Biological and synthetic molecular oxygen carriers. The transfer of electrons in biochemical reactions. The reactions of reactive oxygen species in biological systems. Heme proteins and copper proteins in redox reactions. Medical elements of inorganic chemistry, metals and their compounds in medicine (prevention, diagnostics)

Cell signalling	K_W05, K_U06, K_K01

• Introduction to the subject. Structure and function of membrane proteins. • General description of signal reception by cell membrane receptors. • Seven-helix receptors. • Receptor tyrosine kinases. • Cytokine receptors. • Receptor serine/threonine kinases. • Guanylyl cyclase receptors. • Tumor necrosis factor receptor family. • Notch receptors. • Hedgehog receptors. • Toll-like receptors. • Apoptosis and necrosis. • Genetic control of apoptosis. • Written qualification

English (A)	K_U02, K_U06, K_U07

• 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 anecdots. • 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. • Speaking practice - preparation for the oral examination.

English (B)	K_U02, K_U06, K_U07

• 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 - preparation for the oral examination. • Speaking practice - preparation for the oral examination.

French (A)	K_U02, K_U06, K_U07

• 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_U02, K_U06, K_U07

• 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 substantival 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_W15, K_W16, K_W18, K_U11, K_U14, K_K06

• 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_W15, K_W16, K_W18, K_U11, K_U14, K_K06

• Management as an academic discipline • Company and its environment as an object of management • Management features • Conterporary management problems. • State security management, internal and external security, ecological safety, microbiological safety, management of state security structures.

German (A)	K_U02, K_U06, K_U07

• 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 - exchanging emails.

German A	K_U02, K_U06, K_U07

• 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.

Molecular taxonomy	K_W12, K_U06, K_K01

• Evolutionary biology. Classification and phylogeny. Mechanisms and the way of evolution. The formation of genetic variation. Genetic variation in natural populations. The evolution of phenotypic traits. Species and speciation. • The evolution of proteins, genes and genomes. Applications of molecular phylogenetics

Remediation of toxic substances in environmental material	K_W07

• Geochemical cycle. Soil as the ecological environment. Emission of industrial pollution to the environment. Pollution of geochemical cycle (asbestos, chromium(VI), lead, mercury, cadmium, synthetic organic compounds, dioxins, DDT and derivative of compounds, PCB, PAH. Protecting the environment from production of biotech and chemical industries. Basics of post-production waste and biotechnological aspects of environmental protection. Physical and chemical properties of soils. Soil organic matter. The content of organic carbon (humus) in the soil. Macro and micro-organisms in the soil environment. Oxidation-reduction properties of the soil. Sorption capacity of the soil. Distribution of soils in Poland, according to the state of emergency. Protection of soil. Remediation and bioremediation. Physicochemical methods of remediation. Biological methods of remediation. Microorganisms and their use in the process of rehabilitation of degraded soils. Biodegradation as a method of purifying contaminated soil petroleum products. Phytoremediation. Landfarming. Reclamation of degraded soils. Degradation of soils and their resistance to degradation. Eco-technical tasks in the field of protection and restoration of soil.

Russian (A)	K_U02, K_U06, K_U07

• 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 excursrions 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_U02, K_U06, K_U07

• Appearance. • Features of character. • Asking for personal details. Processing and transferring information. • Ethical problems. Personal pronouns 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.

3.3. Applied biochemistry, past time

3.3.1. 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.	80 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.	124 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.	36 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=H&TK=html&S=1538&C=2020, which are an integral part of the study programme.

3.3.2. Plan of study

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/ Seminar	Sum of hours	ECTS	Exam	Mand.
1	ZH	Technical safety and ergonomics	9	0	0	0	9	1	N	
1	CB	Cell biology	9	0	0	0	9	2	N	🚩
1	CN	General and inorganic chemistry	18	18	0	0	36	6	T	🚩
1	ZM	Academic savoir-vivre	6	0	0	0	6	1	N	
1	FF	Physics	18	18	0	0	36	6	T	🚩
1	CB	Genetics	18	9	0	0	27	4	N	
1	ZM	Social competences	6	9	0	0	15	2	N	
1	FM	Mathematics	18	18	0	0	36	6	T	🚩
1	ZE	Economic course	18	0	0	0	18	2	N	
Sums for the semester: 1			**120**	**72**	**0**	**0**	**192**	**30**	**3**	**4**
2	CB	Cell biology	9	0	18	0	27	4	T	🚩
2	CN	General and inorganic chemistry	18	9	27	0	54	7	T	🚩
2	FF	Physics	9	9	9	0	27	4	T	🚩
2	CI	Engineering graphics	9	0	18	0	27	4	N	
2	FM	Mathematics	18	18	0	0	36	6	T	🚩
2	CX	Packages of application software	0	0	18	0	18	2	N	
2	CB	Computer science	9	0	18	0	27	3	N	
Sums for the semester: 2			**72**	**36**	**108**	**0**	**216**	**30**	**4**	**4**
3	CI	Chemical and biotechnological equipment	18	9	9	0	36	4	N	
3	CS	Biochemistry	9	0	18	0	27	3	T	🚩
3	CM	Biophysics	9	0	0	0	9	1	N	
3	CC	Bioinformatics	9	0	9	0	18	2	N	
3	CN	Analytical chemistry	9	0	18	0	27	3	N	
3	CF	Physical chemistry	18	9	0	0	27	4	T	🚩
3	CM	Organic Chemistry	18	9	0	0	27	4	T	🚩

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/	Sum of	ECTS	Exam	Mand.
3	DJ	Foreign language	0	18	0	0	18	2	N	🚩
3	CB	General microbiology	18	0	18	0	36	5	T	
3	CB	Statistics and results elaboration	9	0	9	0	18	2	N	
3	DL	Physical education	0	18	0	0	18	0	N	
Sums for the semester: 3			**117**	**63**	**81**	**0**	**261**	**30**	**4**	**4**
4	CS	Biochemistry	18	0	18	0	36	5	T	🚩
4	CF	Physical chemistry	18	9	18	0	45	6	T	🚩
4	CM	Organic Chemistry	18	9	18	0	45	6	T	🚩
4	CB	Scientific and technological information	0	0	1	0	1	0	N	
4	DJ	Foreign language	0	18	0	0	18	2	N	🚩
4	CB	In vitro cultures	9	0	9	0	18	2	N	
4	CS	Industrial microbiology	18	0	18	0	36	5	T	
4	CM	Biomaterials processing	18	0	18	0	36	4	N	
4	DL	Physical education	0	18	0	0	18	0	N	
Sums for the semester: 4			**99**	**54**	**100**	**0**	**253**	**30**	**4**	**4**
5	CF	Instrumental analysis	18	0	27	0	45	5	N	
5	CB	Plant biochemistry	9	0	9	0	18	2	N	
5	CB	Molecular biology	18	0	18	0	36	5	T	🚩
5	CS	Chemistry of cosmetics	9	0	9	0	18	2	N	
5	CI	Bioprocess Engineering	18	9	0	0	27	3	N	🚩
5	DJ	Foreign language	0	18	0	0	18	2	N	🚩
5	CS	Analytical methods in biochemistry	9	0	9	0	18	3	T	
5	CF	Biomolecular process modeling	9	0	9	9	27	4	N	
5	CB	Immunological techniques in biotechnology	18	0	18	0	36	4	N	
Sums for the semester: 5			**108**	**27**	**99**	**9**	**243**	**30**	**2**	**3**
6	CS	Forensic biochemistry	9	0	9	0	18	2	N	
6	CB	Molecular biology	9	0	9	0	18	2	N	🚩
6	CS	Biodegradable biopolymers and polymers	9	0	9	0	18	2	N	
6	CI	Bioreactors	9	0	9	0	18	2	N	
6	CS	Chemistry and technology of biofuels	9	0	9	0	18	2	N	
6	CB	Enzymology	9	0	18	0	27	2	T	
6	CB	Protein engineering	18	0	0	9	27	4	N	
6	CI	Bioprocess Engineering	9	9	9	0	27	3	T	🚩
6	CB	Genetic engineering	18	0	18	0	36	3	T	
6	DJ	Foreign language	0	18	0	0	18	3	T	🚩
6	CB	Computer-aided research	0	0	9	0	9	1	N	
6	CB	Toxicology	18	0	9	0	27	4	N	
Sums for the semester: 6			**117**	**27**	**108**	**9**	**261**	**30**	**4**	**3**
7	CS	Biocatalysis	9	0	9	0	18	2	N	
7	CF	Biosensors	9	0	9	0	18	2	N	
7	CN	Environmental protection and biotechnology	9	0	9	0	18	3	T	
7	CI	Purification of biotechnology products	18	0	9	0	27	2	N	
7	CX	Professional training	0	0	0	0	0	4	N	
7	CX	Engineering project	0	0	0	72	72	11	N	
7	CI	Process design	0	0	0	18	18	2	N	
7	CM	Drug design and synthesis	9	0	9	9	27	4	N	
Sums for the semester: 7			**54**	**0**	**45**	**99**	**198**	**30**	**1**	**0**
TOTALS FOR ALL SEMESTERS:			**687**	**279**	**541**	**117**	**1624**	**210**	**22**	**22**

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

3.3.3. Elective modules

The following modules are an extension of the table from the chapter 3.3.2. They can be chosen by students regardless of their specialisation / education path.

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

							Seminar	hours			
2	ZE	Fundamentals of economics	18	0	0	0	18	2	N	
2	ZO	Fundamentals of management	18	0	0	0	18	2	N	
3	DJ	English (A)	0	18	0	0	18	2	N	
3	DJ	English (B)	0	18	0	0	18	2	N	
3	DJ	French (A)	0	18	0	0	18	2	N	
3	DJ	French (B)	0	18	0	0	18	2	N	
3	DJ	German A	0	18	0	0	18	2	N	
3	DJ	German (A)	0	18	0	0	18	2	N	
3	DJ	Russian (A)	0	18	0	0	18	2	N	
3	DJ	Russian (B)	0	18	0	0	18	2	N	
4	DJ	English (A)	0	18	0	0	18	2	N	
4	DJ	English (B)	0	18	0	0	18	2	N	
4	DJ	French (A)	0	18	0	0	18	2	N	
4	DJ	French (B)	0	18	0	0	18	2	N	
4	DJ	German A	0	18	0	0	18	2	N	
4	DJ	German (A)	0	18	0	0	18	2	N	
4	DJ	Russian (A)	0	18	0	0	18	2	N	
4	DJ	Russian (B)	0	18	0	0	18	2	N	
5	DJ	English (A)	0	18	0	0	18	2	N	
5	DJ	English (B)	0	18	0	0	18	2	N	
5	DJ	French (A)	0	18	0	0	18	2	N	
5	DJ	French (B)	0	18	0	0	18	2	N	
5	DJ	German A	0	18	0	0	18	2	N	
5	DJ	German (A)	0	18	0	0	18	2	N	
5	DJ	Russian (A)	0	18	0	0	18	2	N	
5	DJ	Russian (B)	0	18	0	0	18	2	N	
6	DJ	English (A)	0	18	0	0	18	3	T	
6	DJ	English (B)	0	18	0	0	18	3	T	
6	DJ	French (A)	0	18	0	0	18	3	T	
6	DJ	French (B)	0	18	0	0	18	3	T	
6	DJ	German A	0	18	0	0	18	3	T	
6	DJ	German (A)	0	18	0	0	18	3	T	
6	DJ	Russian (A)	0	18	0	0	18	3	T	
6	DJ	Russian (B)	0	18	0	0	18	3	T	

3.3.4. 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=H&TK=html&S=1538&C=2020

3.3.5. 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=H&TK=html&S=1538&C=2020, which are an integral part of the study programme.

Academic savoir-vivre	K_W15, K_U06, K_K03
• 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_W04, K_U06, K_K01, K_K03
• 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.	
Analytical methods in biochemistry	K_W04, K_W05, K_W10, K_U03, K_U09, K_K03
• basics of MS, NMR and FTIR • fluorescent methods, electrophoresis, X-ray diffraction • biomolecule separation methods - chromatography, electrophoresis etc. advanced microsopic methods	
Biocatalysis	K_W08, K_W10, K_W14, K_U03, K_U19, K_K01, K_K03

• enzyme composition • enzymatic mechanisms • enzyme kinetics; • enzyme immobilisation • industrial enzymatic processes; samples of enzymatic processes	
Biochemistry	K_W05, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• Biochemistry - the molecular logic of living organisms. • Structure and properties of amino acids. Proteins: a hierarchical organization of structure. Basic aspects of the protein structure and function. Myoglobin and hemoglobin. • Introduction to enzymes. Factors affecting enzyme activity. Enzyme kinetics and inhibition. Control of enzyme activity. • Carbohydrates: monosaccharide, oligosaccharide and polysaccharides structures. Glycoproteins. • Lipids. Structure of cell membranes. Mechanisms of transport across cell membranes. • Membrane receptors and sygnal transduction in cell. • Transduction of genetic information in cell. DNA structure and replication. RNA synthesis and splicing. Protein synthesis. • Identification of amino acids and proteins by specific colour reactions and TLC method. • Determination of protein concentration. • Identification of simple sugars and polisaccharides by colour reactions. Hydrolysis of sucrose. • Separation of amylose and amylopectin from potato starch. Hydrolysis of starch. • Isolation of cholesterol from a chicken egg yolk. Identification of cholesterol by Salkowski method. • Determination of nitrate(III) levels in meat products with the Grieass reagent. • Metabolism: organisation and basic ideas. • Carbohydrate metabolism: glycolysis and gluconeogenesis. • Cellular respiration and energetics: citric acid cycle, oxidative phosphorylation, photosynthesis. • Isolation and determination of superoxide dismutase (SOD) activity from the yeast Saccharomyces cerevisiae. • Identification of superoxide dismutase by native gel electrophoresis and negative staining. • Native gel electrophoresis and identification of LDH isoenzymes. • Isolation of macromolecules by gel filtration. • Separation of lysozyme from chicken egg by ion-exchange chromatography. • Identification of lysozyme by SDS-PAGE electrophoresis.

Biodegradable biopolymers and polymers	K_W04, K_W12, K_U16, K_K03

• Mechanisms of the polymerization and their relationships with the real process of synthesis. • Types of polymers in terms of their chemical and supermolecular structure and physicmechanical properties • Factors determining the chemical and biological resistance of polymers. Depolymerization processes, degradation and destruction of biodegradable polymers. Use of these processes in technology and industry. • Synthetic polymers susceptible to biodegradation processes. Polymeric biomaterials. • Natural polymers and their importance in the art of pharmacy and medicine. Biodegradation of natural polymers. • Synthesis of poly (caprolactone) and evaluation of its properties. Preparation of high-molecular blood products based on gelatin. Evaluation of the properties of selected biopolymers used as packaging.

Bioinformatics	K_W01, K_W03, K_W14, K_U01, K_U02, K_U06, K_U08, K_U09, K_U10, K_K01

• Introduction to bioinformatics. Basic concepts. E-learning in biotechnology. • Data mining methods in bioinformatics • Sequence alignment • Computer representation and visualisation of biopolymer structures • Bioinformatic databases • PCA and cluster analysis methods in bioinformatics • Integrated sequence search system • 3D visualisation and analysis of protein in PDB database

Biomaterials processing	K_W04, K_W10, K_U16, K_K01

• Classification of polymers. Basic definitions for polymer chemistry:molecular mass, polymerization degree, space building. Polyreactions types. Polymerization classifications • Technological metods of polymerization: mass, solvent, suspensions and emulsion. Polyurethanes, polyamides, polyolefins. Hydrogels - fabrication and properties. • Ceramic biomaterials - introduction. Classification of ceramic biomaterials. Outline of ceramic biomaterials technology • Alumina in bone surgery and dentals. Manufacturing of alumina biomaterials.. Manufacturing and properties of hydroxyapatite. • Methods for the preparation and properties of porous ceramic biomaterials • Technology and properties of carbon biomaterials . Technology and properties of metallic biomaterials . Technology and properties of the composite biomaterials • Preparation and characterization of selected polymeric biomaterials. • Preparation and characterization of selected ceramic biomaterials.

Biomolecular process modeling	K_W03, K_W14, K_U01, K_U08, K_U19, K_K01, K_K03

• Fundamentals of molecular modeling methods: molecular mechanics, molecular dynamics, Monte Carlo method. Molecular forces. Basics of molecular quantum mechanics: ab initio methods, semi-empirical methods, methods exploiting density functionals (DFT). Biomolecular geometry optimization. Biomolecular structure data bases (Protein Data Bank PDB, PDBe, PDBj), ligand data bases (PubChem, ZINC, BindingDB), enzyme data bases, others). Information downloading from biological data bases. Elements of homological analysis. Basics of spatial protein structure modeling. Modeling of quantities describing physicochemical properties of biological and chemical systems. Ligand conformation analysis. Application of molecular modeling methods in studies of biochemical system reactivities. Study of thermodynamics and transition states of chemical reactions. Molecular docking: docking methods, scored functions of assessment of ligand–receptor interaction. Examination of structure-biological activity relation (2D-QSAR, 3D-QSAR, 4D-QSAR, 5D-QSAR, 6D-QSAR). Kinds of structural indexes and techniques of their calculation. CoMFA and CoMSIA methods. • 1. Biomolecular structure data bases (Protein Data Bank PDB, PDBe, PDBj), ligand data bases (PubChem, ZINC, BindingDB), enzyme data bases, Entrez and ExPASy services, others). Information downloading from biological data bases. 2. Visualization of the structure and physicochemical properties of biomolecules. Adjustment of protein and ligand structures. 3. Modeling of quantities describing physicochemical properties of biological and chemical systems. Conformational analysis of ligands. 4. Modeling of protein structure. 5. Modeling of chemical reaction (thermodynamics, transition states) using en example of a reaction of a drug with a specific receptor. 6. Calculation of QSAR descriptors. 7. Examination of structure-biological activity relationships (QSAR). 8. Molecular docking processes. Investigation of ligand-receptor (i.e. drug-protein) interaction.

Biophysics	K_W02, K_U06, K_K01

• The bases of the biophysics. Classification of biomolecules. Classification of biomacromolecules (biopolymers). Chemical structures. Super-molecules structure. Interactions of molecules and macromolecules. • Methods of the determination of molecular masses and their distribution for biopolymers:- the method of light scattering statistically (Rayleigh), dynamics (quasi-elastic) - the viscometery, osmometery, bulio- and cryoscopy, method of sedimentation, MALDI-TOF, Gel Permeation Chromatography (GPC) or Self-Exclusion Chromatography (SEC). • Biothermodynamic systems and processes. Phase transitions. Entropy , enthalpy, free energy, heat capacity biopolymers. The phenomena of thermo conductivity mass transportation, viscosity of polymers. Thermal analysis methods for examination the thermal proprieties of biopolymers: TGA, DSC, temperature-modulated DSC, TMA, thermal conductivity. • The chosen physical methods for the investigations of the structure of biopolymers: spectroscopic (IR, spectroscopy Raman, NMR), X-ray spectroscopy (SAXS, WAXS), degree amorphous and crystalline phases. Microscopic techniques: optical microscopy, electron microscopy, atomic force microscopy (AFM). Static and dynamic methods to determine the mechanical proprieties of polymers (dynamic mechanical analysis -DMA). Mechanical modules. • The elements of the biophysics of organs: the sense of the hearing system; visual system, respiration system, the circulation blood system. The influence of physical factors on alive organisms (mechanical, temperatures and moisture, the electric and magnetic field; the radiation ionizing and non-ionizing). Spectroscopy and scanning, topography NMR.

Bioprocess Engineering	K_W10, K_W19, K_U12, K_K01

• Heat Transfer: (Fixed) Stationary Heat Transfer, Heat Transfer Driving Force, Kinds of the Heat Transfer: Thermal Conduction, I-St Fourier Law, Thermal Conduction Coefficient, Heat Non- And Conductors, Thermal Conduction Across Wall, Heat Transfer Resistance, Heat Convection – Newton Equation, Heat Transfer Cases, Criterial Numbers And Equations, Heat Radiation, Heat Screen Meaning, Heat Losses to Environment, Overall Heat Transfer, Newton Equation for Overall Heat Transfer, Overall Heat Transfer Coefficient, Some Cases of Transient Heat Transfer, Basis Of Heat Exchanger Design. Mass Transfer: (Fixed) Stationary Mass Transfer, Driving Force, Mass Diffusion, l-St Fick Law, Mass Diffusion Coefficients, Mass Transfer Resistance, Kinds of the Mass Diffusion, Mass Diffusion, Mass Convection, Newton Kinetic Equation, Mass Transfer Cases, Criterial Numbers And Equations, Overall Mass Transfer, Newton Equation for Overall Mass Transfer, Overall Mass Transfer Coefficient, Disappearance of Mass Transfer Resistance, Overall Mass Transfer Driving Force, Basis Of Mass Exchanger Design. Concurrent Heat and Mass Transfer – Basic Knowledge Absorption; A) Process Definition, B) Static's of the Process – Absorption Equilibrium, Kinds of the Equilibrium Line Notations, C) Process Kinetics, Mass and Overall Mass Transport in the Absorption, D) Mass Balance of the Absorption, Operation Line of the Absorption, Minimum of the Spraying Liquid Mass and Velocity, E) Overall Mass Transfer Driving Force int Absorption, F) Dynamic Model of the Absorption,Chemisorption. • Distillation And Rectification: Points A) to F) Analogous to the Same Above with the Following Differences: Distillation Equilibrium for Binary Component System, Kinds of the Equilibrium Line Notations - for Ideal System – Raoult Law, Nonideal Systems – Aberrations From Raoult Law, Azeotropes, Differential Distillation, Equilibrium Distillation, Mass and Overall Mass Transport in the Rectification, Batch Rectification, Continuous Rectification, Heat and Mass Balances of the Rectification, Heat and Mass Balances of the Operated Plate, Operation Lines of the Rectification, Minimum and Maximum Minimum of the Column Reflux, Column Efficiency Measured by Theoretical Plate Amount. Exstraction: Points A) to F) Analogous to the Same Above with the Following Differences: Extraction Equilibrium for Ternary Component

System, Ideal System – Nernst Law, Nonideal Systems – Aberrations From Nernst Law, Stepping Extraction Parallel-Current and Counter-Current Extraction, Minimum and Maximum of the Extrahent Mass, Kinds of the Mathematics Solution of the Mentioned Above Extraction Cases, Column Extraction, Dynamic Model of the Column Extraction.	
Bioreactors	K_W07, K_W11, K_U15, K_U19, K_K01
• Definition of bioprocess engineering. Stoichiometry of microbial growth, oxygen balance. Kinetics of cells growth, product formation, kinetics of enzymatic reactions. Bioreactors: batch reactor, chemostat, chemostat with recycle, multistage chemostat systems, plug flow reactor, bubble-column reactors, fluidization reactors, membrane reactors. Designing of bioreactors. Scaling-up and scaling-down.	
Biosensors	K_W10, K_U06, K_K01
• Classification of chemical sensors. Theoretical basics of chemical recognition. • Electrochemical sensors - potentiometric, amperometric and conductometric sensors. • Optical sensor, physics of optical fibers, optical fiber sensors – design, operation and examples. • Mass sensors, basics of piezo- and pyroelectricity, chemical layers of mass sensors. • Thermal sensors - pyroelectric sensors, gas catalytic sensors. • Applications of chemical sensors in industrial analytical control, clinical chemistry and environment protection. Prospects of development of chemical sensors.	
Cell biology	K_W05, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03
• Similarities and differences in structure of prokaryotic and eukaryotic cells. • Basic research methods applied in studies of cell and its components. • Evolution and function of subcellular structures. • Mechanisms of cell membrane transport. • Signal transduction in the cell. • Cell cycle and course of mitosis and meiosis. • Basic laboratory methods and safety rules and regulations. • Microscopic observations of cells and tissues. • Isolation of chloroplasts and mitochondria from the plant cells. • Separation of chlorophylls and carotenoids be thin layer chromatography.	
Chemical and biotechnological equipment	K_W11, K_W13, K_U17, K_K01
• Classification of chemical apparatus. Fundamentals of transport phenomena of heat and mass momentum. The nature of the fluid flow. Fluid flow resistance. Liquid outflow from the tank • Apparatus for mixing, aeration and disintegration of biomass. Demand for mixing power. • Bioreactors and fermenters - construction solutions and the principle of operation. Bioprocesses in fluidised bed. • Characteristics of comminuted materials. • Slurry separation by deposition, sedimentation, flotation, classification. • Filtration and spinning of biological suspensions, process rules and apparatus. • Heat exchangers, evaporators and sterilizers. • Apparatus for absorption and adsorption. • Apparatus for distillation and rectification. • Apparatus for extraction and crystallization	
Chemistry and technology of biofuels	K_W05, K_U15, K_U19, K_K05
• 1. Introduction to the course. Requirements for the completion of the course. The role of fossil liquid fuels and biofuels. • Biomass and wastes (organic raw materials) as feedstocks for biofuels production. First- and next-generation biofuels. Fermentation in production of biofuels. Methods of analysis of biofuels • Conversion of cellulose and lignocellulosie. Algae biomass in biofuels. • Gaseous bio-fuels - properties, applications, production • Future trends in biofuels, directions of research • Methods of analysis of biofuels • Biodiesel synthesis • Production of bioethanol	
Chemistry of cosmetics	K_W05, K_W10, K_U02, K_U16, K_K02
• Inorganic compounds with therapeutic action. An overview of the most important organic compounds used in cosmetics. Physical chemistry of cosmetics: Structure-activity correlations. Anatomy and physiology of the skin. Anatomy and physiology of the hair. Cosmetic ingredients and their functions: antimicrobial agents, colorants, UV filters, antioxidants, surfactants, fragrances, vitamins, liposomes, proteins, peptides, lipids, ceramides, vegetable raw materials, elixirs youth, immunostimulants in cosmetics. Chemistry of specific product categories such as hair, skin and oral care, colour cosmetics, aerosols and perfumes. Manufacture and Control: packaging, production, quality assurance, product stability, safety assessment, legislation, microbial preservation, performance evaluation and market research. Laying the cosmetic formulations. International Nomenclature of Cosmetic Ingredients. Threats to the environment and human health posed by some of the ingredients of cosmetics. • Hands-on experience creating and evaluating hair and skin products. Emulsions including creams and lotions; surfactant systems including shampoos and gels.	
Computer science	K_W03, K_W14, K_U02, K_U08, K_K01
• 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 Turbo Pascal v. 7.0. Construction of programs and units in Pascal. Declaration and implementation section of the unit. Data types defined in Pascal. • Main control statements in Pascal. 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. • The Windows operating system. Searching for information on the Internet. Internet-based education. • Microsoft Office package: Word, Excel, PowerPoint. Development of laboratory data. Preparing of presentation. • Chemical structure editors. • Getting to know the skeletal program TEST.PAS. Preparation of the project, the development of the algorithm, implementation of procedures, running and testing program.Development of project documentation. Acceptation of the student's project.	
Computer-aided research	K_W03, K_U01, K_U06, K_U08
• Strategies of searching chemical structures and metabolic databases • Computer database of protein families • CAOS - computer prediction of biodegradation pathways for chemical compounds and generation of combinatorial libraries • Computer design of new drugs • Chemical similarity	
Drug design and synthesis	K_W10, K_W12, K_U16, K_U17, K_K03
• Drug from the idea for the implementation: Leading Structure - search; relation between the structure and the activity of the drug; Pharmacokinetics; QSAR; Combinatorial Synthesis. Laboratory: chosen methods of synthesis of drugs. • Definition of the medicine/drug, stages of seeking the medicine, choice of the site of action of the medicine, choice of the biological assay, seeking the leading structure. • Synthesis on the solid phase - bases and assumptions. • Combinatorial synthesis - idea, methods. • Isolation and purification of the active ingredient, elucidation the structure of the active compound. • Pharmacophore, isostere - definition, examples. • Synthesis of the most populardrugs e.g. prazole, antibiotics, betablockers and statins. • Elements of strategy of planning the synthesis of new potential drugs. The most popular types of the reaction used in the synthesis of medicines/drugs in including analysis of the applied synthesis in the pharmaceutical industry. • Written passing the subject. • Performing five laboratory exercises from the area of the isolation, the synthesis and analysis of medical products during of 5 lesson according to instructions placed on sd of the coordinator, before beginning of the cycle classes.	
Engineering graphics	K_W03, K_W14, K_U02, K_U06, K_K01
• Technical charts, project views with Monge's method, perspective pictoriali • sections. • Dimensioning • Drawing of various joints. • Tolerances, fits in mechanical engineering. Description of microstructure on machine element surfaces. Assemble drawing and drawing of elements. • Standardized graphical symbols apparatus and equipment used in the processes of chemical technology • Reading the documentation.	
Engineering project	K_U01, K_U03, K_U04, K_U06, K_U08, K_U09, K_U10, K_K01, K_K04
• 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.	
Environmental protection and biotechnology	K_W14, K_U03, K_U19, K_K02, K_K05
• Determination and removal of phosphorus compounds in the volume coagulation process. • Microbiological degradation of cellulose. • Biodegradation of organic compounds. • Biotechnological methods of waste processing from the food industry.	

Enzymology	K_W08, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03
• Construction of enzymes, mechanism of action, reaction kinetics • Techniques for enzyme analysis • The use of enzymes in biotechnology	
Forensic biochemistry	K_W12, K_W14, K_U02, K_U16, K_K03
• metabolites - structures, applications, biological function • Elements of toxicology, harmful compounds - classification, effects on human organism, • Basics of chemical and biochemical analysis in forensic sciences, application of these methods, instrumental methods in forensic analysis • Introduction to analysis of analytical results, basics of interpretation of MS, NMR, FTIR spectra • Serology, DNA profiling, inorganic and oragnic material analysis, analysis of dyes, paints, microscopic analyses. • analysis of structures of harmful compounds with spectroscopic methods • Detection of blood stains • Fingerprint analysis methods • Quantification of heavy metals in urine • LCMS analysis of narcotics in physiological fluids	
General and inorganic chemistry	K_W04, K_U06, K_K01, K_K03
• 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. 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. 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. 4-7. Properties of elements. Inorganic compounds, preparation methods end properties. Main group metals (1, 2, 13). Elements of group 15-18. 8. D-block elements. Crystal field theory. Spectroscopic and magnetic properties. 9. F-block elements. 10. 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.	
General microbiology	K_W07, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03
• The structure and function of prokaryotic cells • Metabolic diversity of microorganisms • Bacterial secondary metabolites and their importance in the environment • The role of microorganisms in biogeochemical cycles • Interaction of microorganisms • The basic microbiological techniques • Isolation and preliminary identification of microorganisms	
Genetic engineering	K_W06, K_W09, K_W12, K_W14, K_U06, K_U09, K_U15, K_U19, K_K01, K_K03, K_K07
• Methods for obtaining DNA fragments: cutting the genomic DNA with restriction enzymes, chemical synthesis, reverse transcription, polymerase chain reaction (PCR). The use of these fragments for various purposes in molecular genetics. Molecular cloning of genes in prokaryotic and eukaryotic cells. Plasmid vectors, cosmids, phage vectors, shuttle vectors, YAC (yeast artificial chromosome). Construction of vectors: restriction enzymes, ligation. Mechanisms for obtaining transgenic organisms: transformation, transduction, transfection. Techniques for analysis and identification of transformants. Expression systems in bacteria and eukaryotic cells. Manipulation of gene expression. Controlled in-vitro mutagenesis. Techniques for transgenic plants and animals. Purification and identification of the recombinant proteins obtained by different methods of analysis: affinity chromatography, electrophoresis and immunoblotting, mass spectrometry. • Evolution of NCBI model. Understanding the diversity of DNA sequences deposited in the databases. Finding and selective use of information in planning experiments. Designing PCR primers for the selected sequence and in any orientation, with attached restriction sites occurring at the start and stop codons for protein domains. The construction of restriction map, characterization of restriction enzymes. Cloning without the use of restriction enzymes. Codon optimization. Designing SNP detection methods (PCR-RFLP, minisequencing) • Application of the techniques of genetic transformation for cloning, sequencing and overexpression. Transformation of transgenic E. coli with pET expression vector or pGlo coding GFP protein. Cultivation of bacteria on the discriminating medium. The chemical transformation and electrotransformation. Isolation of colonies containing cloned gene. Preparation of competent bacteria and plasmids for transformation.	
Genetics	K_W06, K_W14, K_U03, K_U06, K_U09, K_K01, K_K03
• Rules of inheritance, discoveries of Mendel, Morgan, basis of the quantitative and population genetics • The structure of DNA and organization of genetic material • Mutations, chromosomal aberrations, aneuploidy, polyploidy • Genetic crosses, determining the phenotype of offspring and parents, including prediction of Blood type and genetic diseases in humans and prediction of the outcomes of breeding procedures in plants and animals	
Immunological techniques in biotechnology	K_W05, K_W09, K_W14, K_U06, K_U09, K_U15, K_U17, K_K01, K_K03
• Structure of animal and human immune system, lymphoid organs – primary and secondary, cytokine receptors and their properties, complement system • Antigens and the mechanisms of their identification. Characteristics of innate and acquired immunological response mechanisms. Mechanism of receptor activation in B and T cells by an antigen: antigen processing and presentation • Signal transmission between the components of immune system, structure of the immune system T cell receptors • In vivo production of monoclonal and polyclonal antibodies. Obtaining monoclonal antibodies using the method of in vivo and in vitro immunization, and the method of genetic engineering • Methods of the qualitative and quantitative evaluation of detectable macromolecules, using the ELISA method, immunoprecipitation, immunobloting, flow cytometry • The use of recombinant antibodies in a diagnosis and therapy. Classic and recombinant vaccines	
In vitro cultures	K_W14, K_U06, K_U09, K_U19, K_K03
• Definition of plant in vitro culture. Application of plant in vitro culture • Organisation of in vitro culture laboratory: equipment, rules of sterile work, • Methods of terilization for glasware, media, tool. • Media used in plant in vitro culture: types of media, ingredients (macro- microelemets, vitamins, plant hormones, aminoacids, sugars, geling agents). Composition and preparation of Murashige nad Skoog medium 1962. • Primary and secondary explants. Sources of primary explants. Methods of primary expalnts harvesting. • Organogenesis in in vitro culture. Micropropagation as technological application of in vitro culture. • Kallus culture: induction, maintenance, application. • Suspension culture: induction maintenance, application. • Root culture. • Application of in vitro culture in obtainig virus free plants. • Anther culture. Microspore culture and production of dihaploids. • Isolation, culture and fusion of plant protoplasts. • Work safety • Rools of sterile work in plant in vitro culture laboratory. Operetion of equipment. • Preparation of medium for carrot callus induction. • Induction of calli from primary explants of carrot • Preparation of medium for micropropafation of wild strawberry • Transpantation of wild strawberry microplants • Isolation of mature rye embryos.	
Industrial microbiology	K_W07, K_W10, K_U12, K_U18, K_U19, K_K01
• Biological and technological criteria for the classification of microorganisms used in the industry • Methods for the isolation of microorganisms for industrial use from environmental samples and optimization of conditions in laboratory culture • The correct use of terminology in the field of naming microbiological • Secondary metabolites as precursors and products of specific biosynthesis • Fermentation processes and their implementation on an industrial scale • Mechanisms of xenobiotics biodegradation • Microbiology of food • Techniques for isolating microorganisms for industrial use from the environmental samples • Screening tests of proteolytic microorganisms in a laboratory • Methods for improving production characteristics of industrial microorganisms	
Instrumental analysis	K_W04, K_W10, K_U16, K_U17, K_K01
• Analytical process, its elements and statistical evaluation of each step. Analysis of elements and compounds by spectroscopic methods. Atomic Emission Spectroscopy - basis of the method, methods of sample atomization and excitation, applications. Atomic absorption spectroscopy. Molecular spectroscopy in the ultraviolet and visible light. Infrared spectroscopy. Spectra recording techniques, methods of quantitative and qualitative analysis. Fundamentals of nuclear magnetic resonance spectroscopy. The quantitative and structural analysis based on the NMR	

spectra. Fundamentals of mass spectrometry. Interpretation and application of analytical mass spectra for organic compounds. Chromatographic methods for separation of mixtures. Basic principles and classification. Theoreticasl basis of separation process. Retention mechanisms and parameters. Separation efficiency. Definition and determination of resolution index, theoretical plate number, selectivity factor. Separation techniques in liquid chromatography - adsorption chromatography, partition - normal/reverse chromatography, ion-exchange chromatography , gel filtration chromatography. Selection of the chromatographic conditions - rules for the selection of the stationary and mobile phases. High Performance Liquid Chromatography HPLC and thin-layer HPTLC. Isocratic and gradient techniques, instrumentation. Gas chromatography. The rate theory of chromatography - band broadening, column efficiency. Optimization of column performance. Chromatographic methods of qualitative and quantitative analysis. Potentiometric methods. Design, operation and application of the selected ion-selective electrodes. Conductometry and its analytical application. Voltammetric methods - linear-sweep LSV, cyclic CV, and stripplng CSV, ASV techniques. Quantitative and qualitative analysis. Selected applications in analytical laboratory and industrial applications, criteria for the method selection. • Identification of components in the mixture of hydrocarbons and their determination by gas chromatography GC. Determination of hydrocarbons and their derivatives using HPLC. Analysis of the composition of mixtures of organic compounds using a GC-MS. Identification and a quantitative analysis by IR spectroscopy. Determination of the concentration of substances bythe UV-VIS spectroscopy. Structural analysis on the base of 1H-NMR spectra. Determination of the element content in the solutions by atomic absorption spectroscopy (AAS). Polarimetric determination of sucrose in aqueous solution. Quantitative determination of elements by cyclic voltammetry CV. Determination of iodide and chloride by potentiometric precipitation titration. Determination of the concentration of the phenol by conductrometric titration method.

Mathematics	K_W01, K_U06, K_K01

• 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. • Test based on the materials covered during lectures and tutorials. • 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. • Test based on the materials covered during lectures and tutorials. • 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.

Molecular biology	K_W05, K_W06, K_W14, K_U06, K_U09, K_K01, K_K03

• Basic terminology in the field of molecular biology. Differences in the structure of genetic information between pro and eucariots. Introduction to labolatory procedures - isolation of nucleic acids. • Plasmids: structure, replication, biological function, transfer of information between cells, resiatance to unfavorable environmental conditions like antibitics, heave metal ions, sulfonamids, phenol and its derivatives. Virulence towards host, elimination of competitors from environment. Systematcs of pasmids. Application of plasmids in genetic ingeniering; Ti, Ri, E. coli plasmids.Introduction to laboratorie; restriction enzymes, restriction mappiong • Structure of the bacterial chromosome. Recplication of the bacterial chromosome. Hetthylation of bacteroal chromosome. RCR. • Transcription in procariots • Structure and function of bacterial ribosoms. Translation in procariotic cells. Posttranslational modification of proteins. • Sources of diversity in microorganisms. • Compartmentalization of eucariotic cells and its influence on structure of eucariotic genomes. • Structure of eucariotic chromosom: centromer, telomers, eucgromatin, heterochromatin, nucleosom, histones. Replication of eucariotic chromosom. • E. coli plasmids isolation. • DNA electroforeis in agarose gel. • Digestion of DNA with restriction enzymes. • PCR • Restriction mapping , aanalizys of PCR products. • DNA ligation

Organic Chemistry	K_W04, K_W10, K_W16, K_U17, K_K03

• Includes messages from the scope of the structure and the property of organic compounds, onomastics, the stereochemistry of both mechanisms of the reaction and elements of the organic synthesis. Notions of the organic chemistry, patterns of organic compounds, structure of particles, functional groups, reactions in the organic chemistry, marking of structures of organic compounds. Classification of organic compounds. Types of trusses, polarization, inductive effect, free radicals, karbokationy, karboaniony. Notion elektrofila and nukleofila. Phenomenon of the resonance. Isomerism. The acidity and the alkalinity of organic compounds. Alkanes, cycloalkanes, olefines alkynes, dieny, arenas, fluoro derivatives, organometallic. compounds. • Basic concepts: patterns of organic compounds, drawing, functional groups, level of oxidizing, nomenclature. Types of bonds, hybridization. • Alkanes, cycloalkanes, olefines, dieny, alkynes - characteristics of these groups, physical and chemical characteristics, isomerism. • Aromatic hydrocarbons - characteristics, physical and chemical properties, basic reactions. • Isomerism-kind of, examples. • The nucleophilic substitution and the elimination. • Fluoro-derivatives. • Organometallic compounds. • Revision of lecture material. • Continuation of lecture contents of the previous semester and includes messages about groups of such connections as: alcohol, phenols, ethers, sulfur-compounds, nitro-compounds, amines. Aldehydes, ketones, carboxylic acids and derivatives. Lipides, carbohydrates, amino acids, proteins. Heterocyclic compounds. • Alcohol and phenols - properties, reactions. • Ethers, compounds of sulphur. • Aldehydes and ketones - characteristics, reactions and property. • Carboxylic acids, derivatives, reactions, properties. • Amines-obtaining, properties, reactions. • Amino acids and peptides. • Carbohydrates - characteristics, reactions. • Chemistry of the life. • Revision of lecture material. • Obtaining and structure elucidation product from different class of organic compounds.

Packages of application software	K_W03, K_U02, K_U08

• Application of MS Excel to tabelarize 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 or Maple. Creation of simple programs for solving selected mathematical problems.

Physical chemistry	K_W04, K_U06, K_K01, K_K03

• 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. Colloidal solutions, micelles. 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 equilibria, 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. The transition state theory. Complex reactions. Kinetics of enzymatic reaction. Basics of katalysis. Adsorption. Adsorption theories. Electrolyte solutions. Debye-Hückel theory. Specific and molar conductance of strong and weak electrolytes. Transport numbers. Ionic mobility. Thermodynamics of electrolyte solutions. Electrochemistry. Semicells and electrochemical cells. Chemical reactions in an electrochemical cell. Electromotive force of electrochemical cells. Thermodynamics of electrochemical cell. Physicochemical applications of semicells and electrochemical cells. • Physicochemical calculations connected with chemical equilibrium, chemical kinetics, simple, complex and enzymatic reactions, theory of electrolyte solutions, ionic conductance and electrodics. • Determination of molar refraction of organic liquids. Determination of surface tension of liquids. Determination of critical micelle concentration. Determination of reaction order and rate. Determination of thermical activation of a chemical reaction. Determination of phase equilibrium in three - component system. Determination of adsorption isotherm. Determination of limiting molar conductivity of electrolyte solution. Determination of ΔG, ΔH and ΔS of chemical reaction. Electrochemical determination of solubility constant.

Physical education	K_K01, K_K03, K_K04

• 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). • 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).

Physics	K_W01, K_W02, K_K03

• 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

Plant biochemistry	K_W05, K_W06, K_W14, K_U09, K_U18, K_K03

• Familiarization with biochemical specificity of plant cell • Identifying and obtaining gene of desired function.

Process design	K_W03, K_W13, K_W14, K_W19, K_U02, K_U08, K_U14, K_U15, K_U19, K_K01, K_K02, K_K03

• Introduction to simulation programs. Basic rules for the selection of thermodynamic models • An introduction to computing simulation processes (flow of information, analysis of degrees of freedom, the classification of simulation methods). The calculation of chemical reaction processes and reactors. • The criteria for evaluation of the project - "pure" chemical technology. Hierarchical method, an example application. Calculation of the heat exchangers. • 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). • 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.

Professional training	K_U02, K_K01, K_K02, K_K03

• 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.

Protein engineering	K_W03, K_W05, K_W12, K_W14, K_U03, K_U08, K_U09, K_U19, K_K02

• Molecular aspects of enzymatic activity • Selected aspects of design and protein structural modifications • Selected examples of protein engineering • Protein engineering in-silico for the improvement of its biotechnological properties

Purification of biotechnology products	K_W10, K_U17, K_K03

• Strategies to recover and purify product. The permeate techniques of the mixtures separation: ultrafiltration, osmosis, reverse osmosis, microfiltration, dialysis, electrodialysis. Mathematical models of the processes. The examples of applications for species separation in biotechnology. Chromatographic and adsorptive technique of species separation. Thin layer chromatography, column periodical chromatography and continuous chromatography (SMB). Expanded bed adsorption chromatography. The normal and reversed phase chromatography. Ion exchange and gel chromatography. Theory of chromatographic separation: basic mathematical models of adsorption and mass transfer. The influence of process parameters: temperature, composition of mobile phase, solid phase, pH, ion strength of mobile phase on the mixtures separation. The optimization of periodical and continuous process. Principles of selections of chromatographic systems. Capillary electrophoresis and electrochromatography. Drying methods, crystallization methods.

Scientific and technological information	K_W03, K_U01

• 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_W15, K_U06, K_K04

• 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_W01, K_W03, K_W14, K_U10, K_K01

• 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_W13, K_W14, K_U12, K_K01, K_K02, K_K04

• 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).

Toxicology	K_W14, K_U03, K_U19, K_K02, K_K05

• Introduction on the toxicology, definition of poison, intoxication, intoxication types, toxicity of chemical compounds, accumulation, persistence, way of introduction of poisons in the organisms. • Factors which influence of toxicity of poisons, synergisms and antagonisms. • Biotransformation of poisons in the organisms and degradation process of the poisons in the environment, elimination of poisons from organisms (pathway and biochemical mechanisms of elimination), etiology of intoxication, definition of abbreviation which will be used in the toxicology. • Prevention of the intoxication and basic therapy of intoxication REACH process – legislative in the European Union. • Risk assessment, definition of RA, identification of harmful substance, dose – response, exposition, risk characteristic, calculation of ADI (or RfD) and LD50, definition of abbreviation NOEL, NOAEL, NOEC, NOAEC, SF, UF, MF, ADI • Practical presentation of risk assessment of use of herbicide in the aquatic environment. • IDevelopmental toxicology, toxicology versus spermatogenesis, oogenesis and fertilization. Evaluation of toxic compounds on the embryo and developmental organism after birth to adulthood. • Toxicology of choice inorganic compounds (CO, CN-, NO2-, NH3, H2S, Cl2, PH3 …). Toxicology of acids and hydroxide. • Toxicology of selected organic compounds. • Toxicology of selected heavy metals (Pb, Cd, Hg, Cu, As, Ba, Mg ....) • Toxicology of pesticides – divide of pesticides according to use in the agricultural practice, toxicology of selected pesticides according to chemical groups • Intoxications of selected drugs • Mycotoxins - characterization, toxicity, risk, divide by effect of the living organism • Poison plants – chemical compounds of toxic plants, divide toxic plants by effect of the living organism (by effect on the bodily organs) • Poisonous animals – chemical compounds of animal toxins, representative animal species. • General information about toxicology, diagnose of intoxication, sampling, packing and sending for chemical toxicology analysis • Determination of noxa in biological material without samples adjustment • Determination of toxicologically important chemical compounds separable by water steam distillation • Determination of warfarine (kumarine) in the biological material • Determination of alkaloids in biological material by TLC method • Determination of drugs in the biological material by TLC method (salinomycín, monenzin, paracetamol) • Determination of herbicides MCPA and DNOK in the biological material

programme content of elective modules

English (A)	K_U02, K_U06, K_U07

• 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. • Speaking practice - preparation for the oral examination.

English (B)	K_U02, K_U06, K_U07

• 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 - preparation for the oral examination. • Speaking practice - preparation for the oral examination.

French (A)	K_U02, K_U06, K_U07

• 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_U02, K_U06, K_U07

• 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_W15, K_W16, K_W18, K_U11, K_U14, K_K06

• 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_W15, K_W16, K_W18, K_U11, K_U14, K_K06

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

German (A)	K_U02, K_U06, K_U07

• 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.

| German A | K_U02, K_U06, K_U07 |

• 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.

| Russian (A) | K_U02, K_U06, K_U07 |

• Healthy lifestyle - reading comprehension, discussion. • Family celebrations - getting married and traditions connected with it. Reading comprehension and speaking activities. The use of pronouns друг друга. • State and church holidays - preparations; describing holiday customs. Coordinate clauses. • Evening at the theatre - a play review writing. Grammar: subordinate relative clauses; use of the который pronoun. • Mass media - the role in daily life of modern society. Speaking: giving opinion on radio and TV programmes. • "Абитура на ура" - reading comprehension tasks. • Popular professions and workplaces. Speaking: expressions of opinion about workconditions. Grammar: negative pronauns: никто, ничто. • Workactions connected with the professions. Speaking, grammar. Use of verbs:стать, работать (кем). • Writing of formal letters: CV and motivation letter. Grammatical constructions:несмотря на то, что • Work advertising - writing. Lexical exercises. • Universities in Russia - rules and reasons for studying - discussion. Reading comprehension tasks. • Talking about working abroad - pro and contra arguments - discussion. • Interview for a job - dialogs. Grammar exercises: use of pronauns: сам, самый. • School trip - oferts - offers of travel agencies. Giving information. Grammar exercises: verbs: посетить/посещать • At the camp - main ewents. writing exercises. • Travel with train - announcement at the station. Grammar: noun путь - declination. • Meanse of transport - underground - positive and negative sites. Discussion. Reading comprehension • Visit in travel agency - negotiations about travel destination. Grammar: verbs - заказать/забронировать - use; forms. • Writing of the formal letters to travels organizer. Lexical exercises. • Renting a flet - discription of the rooms. Reading comprehension tasks. • Houses to rent - advertisements, writing exercises. Short forms of adjectives. • Accidents during the travel, reading text, lexical exercises. • Daily routines and obligations in household - discussion, comprehensive tasks. • Speaking: partnership, woman and man in modern society. Writing exercises. • Generation gap - reasons. typical conflikts, sozial norms - discussion. Grammar - irregular verbs. • The history of life of famous writer M. Bulhakov - problems in his novels. Lexical exercises. • Our holydays. Writing of postcards.Verbs forms - grammar exercises. • Free time - organization. Work with text " Отдых в современном обществе" - comprehension tasks. • Sport - emotion, sport spectacles. Lexical exercises. • Speaking: sportly life style - positive and negative aspects. • Natural environments destruction - reasons and consequences. Reading comprehension tasks. • Greenhouse effect and his consequences. How to protect our enwironment - discussion. • Speaking: visit at a restaurant - ordering, menu analysis. Writing recipies. Grammar: imperative forms of verbs. • Speaking: Problems of school leavers in modern socjety. Work with text "Трудоустройство" • Job offers - loan and workconditions. Graduating of adjectives - grammar exercises. • Documents connected with the job - writing applications for a job. • Use of business idiom - examples. • Taxes - kinds. Lexical exercises. • Advertisements - discription, visualisation of information. • Contract of employment - a model analysis; employees' duties. Contract of employment - writing exercises. • Economy - definition, main ideas. Lexical and grammar exercises. • Economy reforms in Russia in the 1990s. "Рынок - не рынок" - reading comprehension. • The Russian Federation - administrative division, state institutions. Lexical exercises. • Russian economy policy. "Российский экспорт - импрт" - reading comprehension. • Enterprises - types and organization. Functions of enterprises - main branches, finances. Verb "заниматься" with gerunds. • Enterprise - legal status and general shaleholders meeting. • Profitability indicators - vocabulary. Grammar exercises. • International companies on the Russian market. "Окно на восток российского бизнеса" - reading comprehension, analysis, presentation, discussion. • Speaking: presenting companies - branches. • Advertisements - types, structure. Writing exercises. • Commercial documentation - orders, confirmation, simple covering letters. • Speaking activities

Russian (B)	K_U02, K_U06, K_U07

• 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.

3.4. Purification and analysis of biotechnological products, past time

3.4.1. 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.	79 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.	126 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.	36 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=H&TK=html&S=1537&C=2020, which are an integral part of the study programme.

3.4.2. Plan of study

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/ Seminar	Sum of hours	ECTS	Exam	Mand.
1	ZH	Technical safety and ergonomics	9	0	0	0	9	1	N	
1	CB	Cell biology	9	0	0	0	9	2	N	🚩
1	CN	General and inorganic chemistry	18	18	0	0	36	6	T	🚩
1	ZM	Academic savoir-vivre	6	0	0	0	6	1	N	
1	FF	Physics	18	18	0	0	36	6	T	🚩
1	CB	Genetics	18	9	0	0	27	4	N	
1	ZM	Social competences	6	9	0	0	15	2	N	
1	FM	Mathematics	18	18	0	0	36	6	T	🚩
1	ZE	Economic course	18	0	0	0	18	2	N	
Sums for the semester: 1			**120**	**72**	**0**	**0**	**192**	**30**	**3**	**4**
2	CB	Cell biology	9	0	18	0	27	4	T	🚩
2	CN	General and inorganic chemistry	18	9	27	0	54	7	T	🚩
2	FF	Physics	9	9	9	0	27	4	T	🚩
2	CI	Engineering graphics	9	0	18	0	27	4	N	
2	FM	Mathematics	18	18	0	0	36	6	T	🚩

Sem	Code	Subject								
2	CX	Packages of application software	0	0	18	0	18	2	N	
2	CB	Computer science	9	0	18	0	27	3	N	
Sums for the semester: 2			**72**	**36**	**108**	**0**	**216**	**30**	**4**	**4**
3	CI	Chemical and biotechnological equipment	18	9	9	0	36	4	N	
3	CS	Biochemistry	9	0	18	0	27	3	T	🚩
3	CM	Biophysics	9	0	0	0	9	1	N	
3	CC	Bioinformatics	9	0	9	0	18	2	N	
3	CN	Analytical chemistry	9	0	18	0	27	3	N	
3	CF	Physical chemistry	18	9	0	0	27	4	T	🚩
3	CM	Organic Chemistry	18	9	0	0	27	4	T	🚩
3	DJ	Foreign language	0	18	0	0	18	2	N	🚩
3	CB	General microbiology	18	0	18	0	36	5	T	
3	CB	Statistics and results elaboration	9	0	9	0	18	2	N	
3	DL	Physical education	0	18	0	0	18	0	N	
Sums for the semester: 3			**117**	**63**	**81**	**0**	**261**	**30**	**4**	**4**
4	CS	Biochemistry	18	0	18	0	36	5	T	🚩
4	CF	Physical chemistry	18	9	18	0	45	6	T	🚩
4	CM	Organic Chemistry	18	9	18	0	45	6	T	🚩
4	CB	Scientific and technological information	0	0	1	0	1	0	N	
4	DJ	Foreign language	0	18	0	0	18	2	N	🚩
4	CB	In vitro cultures	9	0	9	0	18	2	N	
4	CS	Industrial microbiology	18	0	18	0	36	5	T	
4	CM	Biomaterials processing	18	0	18	0	36	4	N	
4	DL	Physical education	0	18	0	0	18	0	N	
Sums for the semester: 4			**99**	**54**	**100**	**0**	**253**	**30**	**4**	**4**
5	CF	Instrumental analysis	18	0	27	0	45	5	N	
5	CS	Biocatalysis	9	0	9	0	18	2	N	
5	CB	Molecular biology	18	0	18	0	36	5	T	🚩
5	CN	Environmental protection and biotechnology	18	0	9	0	27	4	T	
5	CB	Plant biotechnology	18	0	9	0	27	4	T	
5	CI	Bioprocess Engineering	18	9	0	0	27	3	N	🚩
5	DJ	Foreign language	0	18	0	0	18	2	N	🚩
5	CB	Computer-aided research	0	0	9	0	9	1	N	
5	CB	Immunological techniques in biotechnology	18	0	18	0	36	4	N	
Sums for the semester: 5			**117**	**27**	**99**	**0**	**243**	**30**	**3**	**3**
6	CB	Molecular biology	9	0	9	0	18	2	N	🚩
6	CI	Bioreactors	9	0	9	0	18	2	N	
6	CI	Bioreactors II	0	0	9	0	9	1	N	
6	CB	Enzymology	9	0	18	0	27	2	T	
6	CI	Bioprocess Engineering	9	9	9	0	27	3	T	🚩
6	CB	Genetic engineering	18	0	18	0	36	3	T	
6	DJ	Foreign language	0	18	0	0	18	3	T	🚩
6	CF	Biomolecular processes modeling	18	0	9	18	45	6	N	
6	CM	Drug design and synthesis	18	0	18	0	36	5	N	
6	CB	Toxicology	18	0	9	0	27	3	N	
Sums for the semester: 6			**108**	**27**	**108**	**18**	**261**	**30**	**4**	**3**
7	CI	Process safety	9	0	0	9	18	2	N	
7	CF	Biosensors	9	0	9	0	18	2	N	
7	CX	Chosen subject OA	9	0	0	0	9	1	N	
7	CI	Purification of biotechnology products	18	0	9	0	27	2	N	
7	CX	Professional training	0	0	0	0	0	4	N	
7	CX	Engineering project	0	0	0	72	72	11	N	
7	CI	Process design	9	0	0	18	27	4	N	
7	CB	Proteomics and protein engineering	18	0	9	0	27	4	N	

Sums for the semester: 7			72	0	27	99	198	30	0	0
TOTALS FOR ALL SEMESTERS:			705	279	523	117	1624	210	22	22

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

3.4.3. Elective modules

The following modules are an extension of the table from the chapter 3.4.2. 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	18	0	0	0	18	2	N	
2	ZO	Fundamentals of management	18	0	0	0	18	2	N	
3	DJ	English (A)	0	18	0	0	18	2	N	
3	DJ	English (B)	0	18	0	0	18	2	N	
3	DJ	French (A)	0	18	0	0	18	2	N	
3	DJ	French (B)	0	18	0	0	18	2	N	
3	DJ	German A	0	18	0	0	18	2	N	
3	DJ	German (A)	0	18	0	0	18	2	N	
3	DJ	Russian (A)	0	18	0	0	18	2	N	
3	DJ	Russian (B)	0	18	0	0	18	2	N	
4	DJ	English (A)	0	18	0	0	18	2	N	
4	DJ	English (B)	0	18	0	0	18	2	N	
4	DJ	French (A)	0	18	0	0	18	2	N	
4	DJ	French (B)	0	18	0	0	18	2	N	
4	DJ	German A	0	18	0	0	18	2	N	
4	DJ	German (A)	0	18	0	0	18	2	N	
4	DJ	Russian (A)	0	18	0	0	18	2	N	
4	DJ	Russian (B)	0	18	0	0	18	2	N	
5	DJ	English (A)	0	18	0	0	18	2	N	
5	DJ	English (B)	0	18	0	0	18	2	N	
5	DJ	French (A)	0	18	0	0	18	2	N	
5	DJ	French (B)	0	18	0	0	18	2	N	
5	DJ	German A	0	18	0	0	18	2	N	
5	DJ	German (A)	0	18	0	0	18	2	N	
5	DJ	Russian (A)	0	18	0	0	18	2	N	
5	DJ	Russian (B)	0	18	0	0	18	2	N	
6	DJ	English (A)	0	18	0	0	18	3	T	
6	DJ	English (B)	0	18	0	0	18	3	T	
6	DJ	French (A)	0	18	0	0	18	3	T	
6	DJ	French (B)	0	18	0	0	18	3	T	
6	DJ	German A	0	18	0	0	18	3	T	
6	DJ	German (A)	0	18	0	0	18	3	T	
6	DJ	Russian (A)	0	18	0	0	18	3	T	
6	DJ	Russian (B)	0	18	0	0	18	3	T	
7	CF	Bioinorganic chemistry	9	0	0	0	9	2	N	
7	CB	Cell signalling	9	0	0	0	9	2	N	
7	CN	Remediation of toxic substances in environmental material	9	0	0	0	9	2	N	
7	CB	Molecular taxonomy	9	0	0	0	9	2	N	
7	CS	Application of biotechnology in modern therapy	9	0	0	0	9	2	N	

3.4.4. 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=H&TK=html&S=1537&C=2020

3.4.5. 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=H&TK=html&S=1537&C=2020, which are an integral part of the study programme.

Academic savoir-vivre	K_W15, K_U06, K_K03

• 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_W04, K_U06, K_K01, K_K03

• 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.

Biocatalysis	K_W08, K_W10, K_W14, K_U03, K_U19, K_K01, K_K03

• enzyme composition • enzymatic mechanisms • enzyme kinetics; • enzyme immobilisation • industrial enzymatic processes; samples of enzymatic processes

Biochemistry	K_W05, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• Biochemistry - the molecular logic of living organisms. • Structure and properties of amino acids. Proteins: a hierarchical organization of structure. Basic aspects of the protein structure and function. Myoglobin and hemoglobin. • Introduction to enzymes. Factors affecting enzyme activity. Enzyme kinetics and inhibition. Control of enzyme activity. • Carbohydrates: monosaccharide, oligosaccharide and polysaccharides structures. Glycoproteins. • Lipids. Structure of cell membranes. Mechanisms of transport across cell membranes. • Membrane receptors and sygnal transduction in cell. • Transduction of genetic information in cell. DNA structure and replication. RNA synthesis and splicing. Protein synthesis. • Identification of amino acids and proteins by specific colour reactions and TLC method. • Determination of protein concentration. • Identification of simple sugars and polisaccharides by colour reactions. Hydrolysis of sucrose. • Separation of amylose and amylopectin from potato starch. Hydrolysis of starch. • Isolation of cholesterol from a chicken egg yolk. Identification of cholesterol by Salkowski method. • Determination of nitrate(III) levels in meat products with the Grieass reagent. • Metabolism: organisation and basic ideas. • Carbohydrate metabolism: glycolysis and gluconeogenesis. • Cellular respiration and energetics: citric acid cycle, oxidative phosphorylation, photosynthesis. • Isolation and determination of superoxide dismutase (SOD) activity from the yeast Saccharomyces cerevisiae. • Identification of superoxide dismutase by native gel electrophoresis and negative staining. • Native gel electrophoresis and identification of LDH isoenzymes. • Isolation of macromolecules by gel filtration. • Separation of lysozyme from chicken egg by ion-exchange chromatography. • Identification of lysozyme by SDS-PAGE electrophoresis.

Bioinformatics	K_W01, K_W03, K_W14, K_U01, K_U02, K_U06, K_U08, K_U09, K_U10, K_K01

• Introduction to bioinformatics. Basic concepts. E-learning in biotechnology. • Data mining methods in bioinformatics • Sequence alignment • Computer representation and visualisation of biopolymer structures • Bioinformatic databases • PCA and cluster analysis methods in bioinformatics • Integrated sequence search system • 3D visualisation and analysis of protein in PDB database

Biomaterials processing	K_W04, K_W10, K_U16, K_K01

• Classification of polymers. Basic definitions for polymer chemistry:molecular mass, polymerization degree, space building. Polyreactions types. Polymerization classifications • Technological metods of polymerization: mass, solvent, suspensions and emulsion. Polyurethanes, polyamides, polyolefins. Hydrogels - fabrication and properties. • Ceramic biomaterials - introduction. Classification of ceramic biomaterials. Outline of ceramic biomaterials technology. • Alumina in bone surgery and dentals. Manufacturing of alumina biomaterials.. Manufacturing and properties of hydroxyapatite. • Methods for the preparation and properties of porous ceramic biomaterials • Technology and properties of carbon biomaterials . Technology and properties of metallic biomaterials . Technology and properties of the composite biomaterials • Preparation and characterization of selected polymeric biomaterials. • Preparation and characterization of selected ceramic biomaterials.

Biomolecular processes modeling	K_W03, K_W14, K_U01, K_U08, K_U19, K_K01, K_K03

• Main conceptions of biomolecular modeling. Fundamentals of molecular modeling methods: molecular mechanics, molecular dynamics, Monte Carlo method. Molecular forces: covalent, electrostatic, hydrogen and hydrophobic interactions. Basics of molecular quantum mechanics: ab initio methods, semi-empirical methods, DFT method, hybrid methods. Methods of optimization of molecular geometry. Biotechnological bases, other biomolecular bases. Elements of homological analysis . Phylogenetic analysis in proteins. Protein modeling: amino acids, peptides, proteins – modeling of protein structure (primary, secondary, tertiary and quaternary structure). Application of molecular modeling methods in conformational analysis of biological systems. Study of reactivity by quantum chemistry methods. Computer modeling and study of reaction kinetics and thermodynamics. Application of molecular modeling methods in studies of active site reactivities of biochemical (enzymatic) systems, modeling of chemical reactions and transition states, spectroscopic spectra. Molecular docking: docking methods and algorithms, scoring functions of ligand-receptor interaction. Biomolecular modeling in the design of pharmacophores. Quantitative structure-activity relation QSAR methods (2D-QSAR, 3D-QSAR, 4D-QSAR, 5D-QSAR, 6D-QSAR). Kinds of structural indexes and techniques of their calculation. CoMFA and CoMSIA methods and their applications in biotechnology. • Data bases of structural proteins in biomolelular modelling. Homology and phylogenetic analysis of proteins. Minimization energy in peptides and proteins. Modeling of protein structure. Conformational analysis. Electrostatic properties of biomolecules. Examination of structure-activity relation (QSAR) Quantum chemistry investigation of antioxidative properties of flavonoids. Computer modeling of sun filters. Study of reactivity of enzyme systems, modeling of chemical reaction and its transition states. Molecular docking. • Carrying out of the assigned computational design.

Biophysics	K_W02, K_U06, K_K01

• The bases of the biophysics. Classification of biomolecules. Classification of biomacromolecules (biopolymers). Chemical structures. Super-molecules structure. Interactions of molecules and macromolecules. • Methods of the determination of molecular masses and their distribution for biopolymers:- the method of light scattering statistically (Rayleigh), dynamics (quasi-elastic) - the viscometery, osmometery, bulio- and cryoscopy, method of sedimentation, MALDI-TOF, Gel Permeation Chromatography (GPC) or Self-Exclusion Chromatography (SEC). • Biothermodynamic systems and processes. Phase transitions. Entropy , enthalpy, free energy, heat capacity biopolymers. The phenomena of thermo conductivity mass transportation, viscosity of polymers. Thermal analysis methods for examination the thermal proprieties of biopolymers: TGA, DSC, temperature-modulated DSC, TMA, thermal conductivity. • The chosen physical methods for the investigations of the structure of biopolymers: spectroscopic (IR, spectroscopy Raman, NMR), X-ray spectroscopy (SAXS, WAXS), degree amorphous and crystalline phases. Microscopic techniques: optical microscopy, electron microscopy, atomic force microscopy (AFM). Static and dynamic methods to determine the mechanical proprieties of polymers (dynamic mechanical analysis -DMA). Mechanical modules. • The elements of the biophysics of organs: the sense of the hearing system; visual system, respiration system, the circulation blood system. The influence of physical factors on alive organisms (mechanical, temperatures and moisture, the electric and magnetic field; the radiation ionizing and non-ionizing). Spectroscopy and scanning, topography NMR.

Bioprocess Engineering	K_W10, K_W19, K_U12, K_K01

• Heat Transfer: (Fixed) Stationary Heat Transfer, Heat Transfer Driving Force, Kinds of the Heat Transfer: Thermal Conduction, I-St Fourier Law, Thermal Conduction Coefficient, Heat Non- And Conductors, Thermal Conduction Across Wall, Heat Transfer Resistance, Heat Convection – Newton Equation, Heat Transfer Cases, Criterial Numbers And Equations, Heat Radiation, Heat Screen Meaning, Heat Losses to Environment, Overall Heat Transfer, Newton Equation for Overall Heat Transfer, Overall Heat Transfer Coefficient, Some Cases of Transient Heat Transfer, Basis Of Heat Exchanger Design. Mass Transfer: (Fixed) Stationary Mass Transfer, Driving Force, Mass Diffusion, I-St Fick Law, Mass Diffusion

Coefficients, Mass Transfer Resistance, Kinds of the Mass Diffusion, Mass Diffusion, Mass Convection, Newton Kinetic Equation, Mass Transfer Cases, Criterial Numbers And Equations, Overall Mass Transfer, Newton Equation for Overall Mass Transfer, Overall Mass Transfer Coefficient, Disappearance of Mass Transfer Resistance, Overall Mass Transfer Driving Force, Basis Of Mass Exchanger Design. Concurrent Heat and Mass Transfer – Basic Knowledge Absorption; A) Process Definition, B) Static's of the Process – Absorption Equilibrium, Kinds of the Equilibrium Line Notations, C) Process Kinetics, Mass and Overall Mass Transport in the Absorption, D) Mass Balance of the Absorption, Operation Line of the Absorption, Minimum of the Spraying Liquid Mass and Velocity, E) Overall Mass Transfer Driving Force int Absorption, F) Dynamic Model of the Absorption,Chemisorption. • Distillation And Rectification: Points A) to F) Analogous to the Same Above with the Following Differences: Distillation Equilibrium for Binary Component System, Kinds of the Equilibrium Line Notations - for Ideal System – Raoult Law, Nonideal Systems – Aberrations From Raoult Law, Azeotropes, Differential Distillation, Equilibrium Distillation, Mass and Overall Mass Transport in the Rectification, Batch Rectification, Continuous Rectification, Heat and Mass Balances of the Rectification, Heat and Mass Balances of the Operated Plate, Operation Lines of the Rectification, Minimum and Maximum Minimum of the Column Reflux, Column Efficiency Measured by Theoretical Plate Amount. Exstraction: Points A) to F) Analogous to the Same Above with the Following Differences: Extraction Equilibrium for Ternary Component System, Ideal System – Nernst Law, Nonideal Systems – Aberrations From Nernst Law, Stepping Extraction Parallel-Current and Counter-Current Extraction, Minimum and Maximum of the Extrahent Mass, Kinds of the Mathematics Solution of the Mentioned Above Extraction Cases, Column Extraction, Dynamic Model of the Column Extraction.

Bioreactors	K_W07, K_W11, K_U15, K_U19, K_K01

• Definition of bioprocess engineering. Stoichiometry of microbial growth, oxygen balance. Kinetics of cells growth, product formation, kinetics of enzymatic reactions. Bioreactors: batch reactor, chemostat, chemostat with recycle, multistage chemostat systems, plug flow reactor, bubble-column reactors, fluidization reactors, membrane reactors. Designing of bioreactors. Scaling-up and scaling-down.

Bioreactors II	K_W07, K_W11, K_U09, K_K02

• Designing of real bioreactors of different types with taking into account the kinetics of bioreaction and mass and heat transfer.

Biosensors	K_W10, K_U06, K_K01

• Classification of chemical sensors. Theoretical basics of chemical recognition. • Electrochemical sensors - potentiometric, amperometric and conductometric sensors. • Optical sensor, physics of optical fibers, optical fiber sensors – design, operation and examples. • Mass sensors, basics of piezo- and pyroelectricity, chemical layers of mass sensors. • Thermal sensors - pyroelectric sensors, gas catalytic sensors. • Applications of chemical sensors in industrial analytical control, clinical chemistry and environment protection. Prospects of development of chemical sensors.

Cell biology	K_W05, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• Similarities and differences in structure of prokaryotic and eukaryotic cells. • Basic research methods applied in studies of cell and its components. • Evolution and function of subcellular structures. • Mechanisms of cell membrane transport. • Signal transduction in the cell. • Cell cycle and course of mitosis and meiosis. • Basic laboratory methods and safety rules and regulations. • Microscopic observations of cells and tissues. • Isolation of chloroplasts and mitochondria from the plant cells. • Separation of chlorophylls and carotenoids be thin layer chromatography.

Chemical and biotechnological equipment	K_W11, K_W13, K_U17, K_K01

• Classification of chemical apparatus. Fundamentals of transport phenomena of heat and mass momentum. The nature of the fluid flow. Fluid flow resistance. Liquid outflow from the tank • Apparatus for mixing, aeration and disintegration of biomass. Demand for mixing power. • Bioreactors and fermenters - construction solutions and the principle of operation. Bioprocesses in fluidised bed. • Characteristics of comminuted materials. • Slurry separation by deposition, sedimentation, flotation, classification. • Filtration and spinning of biological suspensions, process rules and apparatus. • Heat exchangers, evaporators and sterilizers. • Apparatus for absorption and adsorption. • Apparatus for distillation and rectification. • Apparatus for extraction and crystallization

Computer science	K_W03, K_W14, K_U02, K_U08, K_K01

• 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 Turbo Pascal v. 7.0. Construction of programs and units in Pascal. Declaration and implementation section of the unit. Data types defined in Pascal. • Main control statements in Pascal. 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. • The Windows operating system. Searching for information on the Internet. Internet-based education. • Microsoft Office package: Word, Excel, PowerPoint. Development of laboratory data. Preparing of presentation. • Chemical structure editors. • Getting to know the skeletal program TEST.PAS. Preparation of the project, the development of the algorithm, implementation of procedures, running and testing program.Development of project documentation. Acceptation of the student's project.

Computer-aided research	K_W03, K_U01, K_U06, K_U08

• Strategies of searching chemical structures and metabolic databases • Computer database of protein families • CAOS - computer prediction of biodegradation pathways for chemical compounds and generation of combinatorial libraries • Computer design of new drugs • Chemical similarity

Drug design and synthesis	K_W10, K_W12, K_U16, K_U17, K_K03

• Drug from the idea for the implementation: Leading Structure - search; relation between the structure and the activity of the drug; Pharmacokinetics; QSAR; Combinatorial Synthesis. Laboratory: chosen methods of synthesis of drugs. • Definition of the medicine/drug, stages of seeking the medicine, choice of the site of action of the medicine, choice of the biological assay, seeking the leading structure. • Synthesis on the solid phase - bases and assumptions. • Combinatorial synthesis - idea, methods. • Isolation and purification of the active ingredient, elucidation the structure of the active compound. • Pharmacophore, isostere - definition, examples. • Synthesis of the most populardrugs e.g. prazole, antibiotics, betablockers and statins. • Elements of strategy of planning the synthesis of new potential drugs. The most popular types of the reaction used in the synthesis of medicines/drugs in including analysis of the applied synthesis in the pharmaceutical industry. • Written passing the subject. • Performing five laboratory exercises from the area of the isolation, the synthesis and analysis of medical products during of 5 lesson according to instructions placed on sd of the coordinator, before beginning of the cycle classes.

Engineering graphics	K_W03, K_W14, K_U02, K_U06, K_K01

• Technical charts, project views with Monge's method, perspective pictoriali • sections. • Dimensioning • Drawing of various joints. • Tolerances, fits in mechanical engineering. Description of microstructure on machine element surfaces. Assemble drawing and drawing of elements. • Standardized graphical symbols apparatus and equipment used in the processes of chemical technology • Reading the documentation.

Engineering project	K_U01, K_U03, K_U04, K_U06, K_U08, K_U09, K_U10, K_K01, K_K04

• 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.

Environmental protection and biotechnology	K_W14, K_U03, K_U19, K_K02, K_K05

• Definitions and fundamental phrases. Environment, environment protection, ecology, ecological impact, system, ecosystem, paradigm, civilization. Elements of theory of systems. Reductionism versus holism in reality description and understanding. Micro- and macro-explanation concept. Soft and hard technologies. • Ecological equilibrium. Elements of ecological equilibrium of Earth. Energy balance of Earth. Cycles of chemicals in the environment. Circulation of matter (H_2O, CO_2, N_2, O_2 , heavy metals) and energy. Populations and their features. Agglomeration

process, dissipative structures. Agriculture and ecology. Contamination caused by farm plant and animal production. Soil components and their transformation. Degradation and protection of soils. Biological sewage and waste water purification. Importance of fuels and energy in agriculture economy. • Chemical inorganic and organic pollutants in environment and their biological and medical action. Chemical inorganic and organic pollutants in environment and their biological and medical action. Classifications and systematics of pollutants. Inorganic and organic persistent pollutants, their scattering, bioaccumulation, toxicology (enzyme dysfunction, heme biosynnthesis disfunction, oxidative phosphorylation inhibition, narcosis, DNA modification), and hormone-like activity.Tobacco smoke as a pollution agent. Purification of liquid waste by means of defined bacteria cultures. Ecological validation of marketable washing powders. • Toxic metals and organic pollutants level in air, water, soil and food as an indicator of environment quality. System approach to calculation and conversion of different solution concentration expressions and units especially for applied in ecology and in medical analytical chemistry. Determination of toxic metals as Hg, Cd and Pb in biological and environment samples. Determination of soil quality parameters. Tests and ecological validation of common plastics. • Energy production and ecology in XXI age. Ecological valuation and economy of applied energy sources. Renewable sources of energy. Biomass and bio-fuels. Soft technologies rising up on the basis of solar energy as wind, solar collectors, heat pumps etc. Solar economy and possibility of solar age. Thermal and photovoltaic technology applications of solar energy. The passage to the Solar Age and its political, legislative and tax limitations. Geothermic energy as a large scale energy source of growing importance. Ecological validation of marketable sources of light. Analysis of thermal solar energy home set with solar collector. Analysis of photovoltaic solar energy home set. • Wastes disposal. Wastes in nature technologies in comparison to that in man's technologies. Characteristics of wastes generated by power industry and other kinds of industry. Environmentally hazardous products. The life cycle assessment approach and ISO standards.. Waste management in local communes. An overview of waste utilization methods. Waste combustion. Ecological and ethical aspects of chemical production. • Current ecological problems. The current ecological problems of Poland and UE. Look over of environment friendly technologies and biological methods of environment protection. Environment legislation in Poland and UE. The problem of ecological taxes.

Enzymology	K_W08, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• Construction of enzymes, mechanism of action, reaction kinetics • Techniques for enzyme analysis • The use of enzymes in biotechnology

General and inorganic chemistry	K_W04, K_U06, K_K01, K_K03

• 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. 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. 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. 4-7. Properties of elements. Inorganic compounds, preparation methods end properties. Main group metals (1, 2, 13). Elements of group 15-18. 8. D-block elements. Crystal field theory. Spectroscopic and magnetic properties. 9. F-block elements. 10. 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.

General microbiology	K_W07, K_W14, K_U06, K_U09, K_U15, K_K01, K_K03

• The structure and function of prokaryotic cells • Metabolic diversity of microorganisms • Bacterial secondary metabolites and their importance in the environment • The role of microorganisms in biogeochemical cycles • Interaction of microorganisms • The basic microbiological techniques • Isolation and preliminary identification of microorganisms

Genetic engineering	K_W06, K_W09, K_W12, K_W14, K_U06, K_U09, K_U15, K_U19, K_K01, K_K03, K_K07

• Methods for obtaining DNA fragments: cutting the genomic DNA with restriction enzymes, chemical synthesis, reverse transcription, polymerase chain reaction (PCR). The use of these fragments for various purposes in molecular genetics. Molecular cloning of genes in prokaryotic and eukaryotic cells. Plasmid vectors, cosmids, phage vectors, shuttle vectors, YAC (yeast artificial chromosome). Construction of vectors: restriction enzymes, ligation. Mechanisms for obtaining transgenic organisms: transformation, transduction, transfection. Techniques for analysis and identification of transformants. Expression systems in bacteria and eukaryotic cells. Manipulation of gene expression. Controlled in-vitro mutagenesis. Techniques for transgenic plants and animals. Purification and identification of the recombinant proteins obtained by different methods of analysis: affinity chromatography, electrophoresis and immunoblotting, mass spectrometry. • Evolution of NCBI model. Understanding the diversity of DNA sequences deposited in the databases. Finding and selective use of information in planning experiments. Designing PCR primers for the selected sequence and in any orientation, with attached restriction sites occurring at the start and stop codons for protein domains. The construction of restriction map, characterization of restriction enzymes. Cloning without the use of restriction enzymes. Codon optimization. Designing SNP detection methods (PCR-RFLP, minisequencing) • Application of the techniques of genetic transformation for cloning, sequencing and overexpression. Transformation of transgenic E. coli with pET expression vector or pGlo coding GFP protein. Cultivation of bacteria on the discriminating medium. The chemical transformation and electrotransformation. Isolation of colonies containing cloned gene. Preparation of competent bacteria and plasmids for transformation.

Genetics	K_W06, K_W14, K_U03, K_U06, K_U09, K_K01, K_K03

• Rules of inheritance, discoveries of Mendel, Morgan, basis of the quantitative and population genetics • The structure of DNA and organization of genetic material • Mutations, chromosomal aberrations, aneuploidy, polyploidy • Genetic crosses, determining the phenotype of offspring and parents, including prediction of Blood type and genetic diseases in humans and prediction of the outcomes of breeding procedures in plants and animals

Immunological techniques in biotechnology	K_W05, K_W09, K_W14, K_U06, K_U09, K_U15, K_U17, K_K01, K_K03

• Structure of animal and human immune system, lymphoid organs – primary and secondary, cytokine receptors and their properties, complement system • Antigens and the mechanisms of their identification. Characteristics of innate and acquired immunological response mechanisms. Mechanism of receptor activation in B and T cells by an antigen: antigen processing and presentation • Signal transmission between the components of immune system, structure of the immune system T cell receptors • In vivo production of monoclonal and polyclonal antibodies. Obtaining monoclonal antibodies using the method of in vivo and in vitro immunization, and the method of genetic engineering • Methods of the qualitative and quantitative evaluation of detectable macromolecules, using the ELISA method, immunoprecipitation, immunobloting, flow cytometry • The use of recombinant antibodies in a diagnosis and therapy. Classic and recombinant vaccines

In vitro cultures	K_W14, K_U06, K_U09, K_U19, K_K03

• Definition of plant in vitro culture. Application of plant in vitro culture • Organisation of in vitro culture laboratory: equipment, rules of sterile work, • Methods of terilization for glasware, media, tool. • Media used in plant in vitro culture: types of media, ingredients (macro- microelemets, vitamins, plant hormones, aminoacids, sugars, geling agents). Composition and preparation of Murashige nad Skoog medium 1962. • Primary and secondary explants. Sources of primary explants. Methods of primary expalnts harvesting. • Organogenesis in in vitro culture. Micropropagation as technological application of in vitro culture. • Kallus culture: induction, maintenance, application. • Suspension culture: induction maintenance, application. • Root culture. • Application of in vitro culture in obtaining virus free plants. • Anther culture. Microspore culture and production of dihaploids. • Isolation, culture and fusion of plant protoplasts. • Work safety • Rools of sterile work in plant in vitro culture laboratory. Operetion of equipment. • Preparation of medium for carrot callus induction. • Induction of calli from primary explants of carrot • Preparation of medium for micropropafation of wild strawberry • Transpantation of wild strawberry microplants • Isolation of mature rye embryos.

Industrial microbiology	K_W07, K_W10, K_U12, K_U18, K_U19, K_K01

• Biological and technological criteria for the classification of microorganisms used in the industry • Methods for the isolation of microorganisms for industrial use from environmental samples and optimization of conditions in laboratory culture • The correct use of terminology in the field of naming microbiological • Secondary metabolites as precursors and products of specific biosynthesis • Fermentation processes and their implementation on an industrial scale • Mechanisms of xenobiotics biodegradation • Microbiology of food • Techniques for isolating microorganisms for industrial use from the environmental samples • Screening tests of proteolytic microorganisms in a laboratory • Methods for improving production characteristics of industrial microorganisms	
Instrumental analysis	K_W04, K_W10, K_U16, K_U17, K_K01
• Analytical process, its elements and statistical evaluation of each step. Analysis of elements and compounds by spectroscopic methods. Atomic Emission Spectroscopy - basis of the method, methods of sample atomization and excitation, applications. Atomic absorption spectroscopy. Molecular spectroscopy in the ultraviolet and visible light. Infrared spectroscopy. Spectra recording techniques, methods of quantitative and qualitative analysis. Fundamentals of nuclear magnetic resonance spectroscopy. The quantitative and structural analysis based on the NMR spectra. Fundamentals of mass spectrometry. Interpretation and application of analytical mass spectra for organic compounds. Chromatographic methods for separation of mixtures. Basic principles and classification. Theoreticasl basis of separation process. Retention mechanisms and parameters. Separation efficiency. Definition and determination of resolution index, theoretical plate number, selectivity factor. Separation techniques in liquid chromatography - adsorption chromatography, partition - normal/reverse chromatography, ion-exchange chromatography , gel filtration chromatography. Selection of the chromatographic conditions - rules for the selection of the stationary and mobile phases. High Performance Liquid Chromatography HPLC and thin-layer HPTLC. Isocratic and gradient techniques, instrumentation. Gas chromatography. The rate theory of chromatography - band broadening, column efficiency. Optimization of column performance. Chromatographic methods of qualitative and quantitative analysis. Potentiometric methods. Design, operation and application of the selected ion-selective electrodes. Conductometry and its analytical application. Voltammetric methods - linear-sweep LSV, cyclic CV, and strippIng CSV, ASV techniques. Quantitative and qualitative analysis. Selected applications in analytical laboratory and industrial applications, criteria for the method selection. • Identification of components in the mixture of hydrocarbons and their determination by gas chromatography GC. Determination of hydrocarbons and their derivatives using HPLC. Analysis of the composition of mixtures of organic compounds using a GC-MS. Identification and a quantitative analysis by IR spectroscopy. Determination of the concentration of substances bythe UV-VIS spectroscopy. Structural analysis on the base of 1H-NMR spectra. Determination of the element content in the solutions by atomic absorption spectroscopy (AAS). Polarimetric determination of sucrose in aqueous solution. Quantitative determination of elements by cyclic voltammetry CV. Determination of iodide and chloride by potentiometric precipitation titration. Determination of the concentration of the phenol by conductrometric titration method.	
Mathematics	K_W01, K_U06, K_K01
• 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. • Test based on the materials covered during lectures and tutorials. • 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. • Test based on the materials covered during lectures and tutorials. • 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.	
Molecular biology	K_W05, K_W06, K_W14, K_U06, K_U09, K_K01, K_K03
• Basic terminology in the field of molecular biology. Differences in the structure of genetic information between pro and eucariots. Introduction to labolatory procedures - isolation of nucleic acids. • Plasmids: structure, replication, biological function, transfer of information between cells, resiatance to unfavorable environmental conditions like antibitics, heave metal ions, sulfonamids, phenol and its derivatives. Virulence towards host, elimination of competitors from environment. Systematcs of pasmids. Application of plasmids in genetic ingeniering; Ti, Ri, E. coli plasmids.Introduction to laboratorie; restriction enzymes, restriction mappiong • Structure of the bacterial chromosome. Recplication of the bacterial chromosome. Hetthylation of bacteroal chromosome. RCR. • Transcription in procariots • Structure and function of bacterial ribosoms. Translation in procariotic cells. Posttranslational modification of proteins. • Sources of diversity in microorganisms. • Compartmentalization of eucariotic cells and its influence on structure of eucariotic genomes. • Structure of eucariotic chromosom: centromer, telomers, eucgromatin, heterochromatin, nucleosom, histones. Replication of eucariotic chromosom. • E. coli plasmids isolation. • DNA electroforeis in agarose gel. • Digestion of DNA with restriction enzymes. • PCR • Restriction mapping , aanalizys of PCR products. • DNA ligation	
Organic Chemistry	K_W04, K_W10, K_U16, K_U17, K_K03
• Includes messages from the scope of the structure and the property of organic compounds, onomastics, the stereochemistry of both mechanisms of the reaction and elements of the organic synthesis. Notions of the organic chemistry, patterns of organic compounds, structure of particles, functional groups, reactions in the organic chemistry, marking of structures of organic compounds. Classification of organic compounds. Types of trusses, polarization, inductive effect, free radicals, karbokationy, karboaniony. Notion elektrofila and nukleofila. Phenomenon of the resonance. Isomerism. The acidity and the alkalinity of organic compounds. Alkanes, cycloalkanes, olefines alkynes, dieny, arenas, fluoro derivatives, organometallic. compounds. • Basic concepts: patterns of organic compounds, drawing, functional groups, level of oxidizing, nomenclature. Types of bonds, hybridization. • Alkanes, cycloalkanes, olefines, dieny, alkynes - characteristics of these groups, physical and chemical characteristics, isomerism. • Aromatic hydrocarbons - characteristics, physical and chemical properties, basic reactions. • Isomerism-kind of, examples. • The nucleophilic substitution and the elimination. • Fluoro-derivatives. • Organometallic compounds. • Revision of lecture material. • Continuation of lecture contents of the previous semester and includes messages about groups of such connections as: alcohol, phenols, ethers, sulfur-compounds, nitro-compounds, amines. Aldehydes, ketones, carboxylic acids and derivatives. Lipides, carbohydrates, amino acids, proteins. Heterocyclic compounds. • Alcohol and phenols - properties, reactions. • Ethers, compounds of sulphur. • Aldehydes and ketones - characteristics, reactions and property. • Carboxylic acids, derivatives, reactions, properties. • Amines-obtaining, properties, reactions. • Amino acids and peptides. • Carbohydrates - characteristics, reactions. • Chemistry of the life. • Revision of lecture material. • Obtaining and structure elucidation product from different class of organic compounds.	
Packages of application software	K_W03, K_U02, K_U08
• Application of MS Excel to tabelarize 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 or Maple. Creation of simple programs for solving selected mathematical problems.	
Physical chemistry	K_W04, K_U06, K_K01, K_K03

• 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. Colloidal solutions, micelles. 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 equilibria, 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. The transition state theory. Complex reactions. Kinetics of enzymatic reaction. Basics of katalysis. Adsorption. Adsorption theories. Electrolyte solutions. Debye-Hückel theory. Specific and molar conductance of strong and weak electrolytes. Transport numbers. Ionic mobility. Thermodynamics of electrolyte solutions. Electrochemistry. Semicells and electrochemical cells. Chemical reactions in an electrochemical cell. Electromotive force of electrochemical cells. Thermodynamics of electrochemical cell. Physicochemical applications of semicells and electrochemical cells. • Physicochemical calculations connected with chemical equilibrium, chemical kinetics, simple, complex and enzymatic reactions, theory of electrolyte solutions, ionic conductance and electrodics. • Determination of molar refraction of organic liquids. Determination of surface tension of liquids. Determination of critical micelle concentration. Determination of reaction order and rate. Determination of thermical activation of a chemical reaction. Determination of phase equilibrium in three - component system. Determination of adsorption isotherm. Determination of limiting molar conductivity of electrolyte solution. Determination of ΔG, ΔH and ΔS of chemical reaction. Electrochemical determination of solubility constant.

Physical education	K_K01, K_K03, K_K04

• 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). • 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).

Physics	K_W01, K_W02, K_K03

• 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

Plant biotechnology	K_W06, K_W09, K_W12, K_W14, K_U03, K_U09, K_U18, K_U19, K_K02, K_K07

• Genetics and Biotechnology. Elements of population genetics, genetics and plant breeding. Cytogenetics in plant biotechnology. Molecular diagnosis of plant and pathogen. Genomics research plants. Feedback and gene mapping. Isolation and characterization of genes. Transgenic plants - methods of transformation, identification and breeding. The cell wall - structure and improve biotechnology. • The concept of biotechnology. Biomass feedstock biotechnology. Biotransformation of selected chemicals. Plant biotechnology to improve the quality of food, modified starch and other carbohydrates. The transgenic plants as a source of modified oils of storage proteins with improved functional properties. Use of bioreactor cultures of plant cells and tissue. Production of immunotherapeutic agents and biopharmaceuticals in plants. Production of bio fuel. • Regulation of physiological processes, plant growth and development by endogenous and exogenous factors. Creating a structure gene in plant transformation. Industrial strategies for detection of bioactive compounds in plants. Transgenic plants in improving resistance to biotic, abiotic and herbicides. Transformations and functions of lipids (waxes, cutin and suberin).

Process design	K_W03, K_W13, K_W13, K_W14, K_W19, K_W19, K_U02, K_U08, K_U14, K_U14, K_U15, K_U19, K_U19, K_K01, K_K02, K_K03

• Introduction to methods of designing integrated systems technology. Characteristics of simulation programs. Basic rules for the selection of thermodynamic models • An introduction to computing simulation processes (flow of information, analysis of degrees of freedom, the classification of simulation methods). The calculation of chemical reaction processes and reactors. • The criteria for evaluation of the project - "pure" chemical technology. Hierarchical method, an example application. Calculation of the heat exchangers. • 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). • 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.

Process safety	K_W12, K_W19, K_U12, K_U15, K_U19, K_K02

• Basic terminology and applicable legal regulations in the field of process safety • Impact of chemicals hazards on the human body and the environment. • Mathematical description of selected types of failure • Models for dispersing substances • Failure risk analysis methods

Professional training	K_U02, K_K01, K_K02, K_K03

• 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.

Proteomics and protein engineering	K_W05, K_W10, K_W12, K_W14, K_U03, K_U09, K_U18, K_U19, K_K02

• Goal and importance of protein engineering • Bioinformatic methods in analysis and characterisation of proteins and its recombinant derivatives • Selected aspects of biophysical and biochemical protein characterisation (i) in-silico (ii) by experimental methods • Design and production of recombinant proteins • Selected aspects of natural and non-natural protein modifications and their importance

Purification of biotechnology products	K_W10, K_U17, K_K03

• Strategies to recover and purify product. The permeate techniques of the mixtures separation: ultrafiltration, osmosis, reverse osmosis, microfiltration, dialysis, electrodialysis. Mathematical models of the processes. The examples of applications for species separation in biotechnology. Chromatographic and adsorptive technique of species separation. Thin layer chromatography, column periodical chromatography and continuous chromatography (SMB). Expanded bed adsorption chromatography. The normal and reversed phase chromatography. Ion exchange and gel chromatography. Theory of chromatographic separation: basic mathematical models of adsorption and mass transfer. The influence of process parameters: temperature, composition of mobile phase, solid phase, pH, ion strength of mobile phase on the mixtures separation. The optimization of periodical and continuous process. Principles of selections of chromatographic systems. Capillary electrophoresis and electrochromatography. Drying methods, crystallization methods.

Scientific and technological information	K_W03, K_U01

• 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_W15, K_U06, K_K04

• 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_W01, K_W03, K_W14, K_U10, K_K01

• 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_W13, K_W14, K_U12, K_K01, K_K02, K_K04

• 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).

Toxicology	K_W14, K_U03, K_U19, K_K02, K_K05

• Introduction on the toxicology, definition of poison, intoxication, intoxication types, toxicity of chemical compounds, accumulation, persistence, way of introduction of poisons in the organisms. • Factors which influence of toxicity of poisons, synergisms and antagonisms. • Biotransformation of poisons in the organisms and degradation process of the poisons in the environment, elimination of poisons from organisms (pathway and biochemical mechanisms of elimination), etiology of intoxication, definition of abbreviation which will be used in the toxicology. • Prevention of the intoxication and basic therapy of intoxication REACH process – legislative in the European Union. • Risk assessment, definition of RA, identification of harmful substance, dose – response, exposition, risk characteristic, calculation of ADI (or RfD) and LD50, definition of abbreviation NOEL, NOAEL, NOEC, NOAEC, SF, UF, MF, ADI • Practical presentation of risk assessment of use of herbicide in the aquatic environment. • Developmental toxicology, toxicology versus spermatogenesis, oogenesis and fertilization. Evaluation of toxic compounds on the embryo and developmental organism after birth to adulthood. • Toxicology of choice inorganic compounds (CO, CN-, NO2-, NH3, H2S, Cl2, PH3 …). Toxicology of acids and hydroxide. • Toxicology of selected organic compounds. • Toxicology of selected heavy metals (Pb, Cd, Hg, Cu, As, Ba, Mg ....) • Toxicology of pesticides – divide of pesticides according to use in the agricultural practice, toxicology of selected pesticides according to chemical groups • Intoxications of selected drugs • Mycotoxins - characterization, toxicity, risk, divide by effect of the living organism • Poison plants – chemical compounds of toxic plants, divide toxic plants by effect of the living organism (by effect on the bodily organs) • Poisonous animals – chemical compounds of animal toxins, representative animal species. • General information about toxicology, diagnose of intoxication, sampling, packing and sending for chemical toxicology analysis • Determination of noxa in biological material without samples adjustment • Determination of toxicologically important chemical compounds separable by water steam distillation • Determination of warfarine (kumarine) in the biological material • Determination of alkaloids in biological material by TLC method • Determination of drugs in the biological material by TLC method (salinomycín, monenzin, paracetamol) • Determination of herbicides MCPA and DNOK in the biological material

programme content of elective modules

Application of biotechnology in modern therapy	K_W05, K_W12, K_U06, K_K01, K_K07

• Biotechnology-derived drugs (biopharmaceuticals) and conventional medicines. • Animals as a living bioreactors. • Biotechnological methods for the production of human hormones. • Monoclonal antibodies - the use in the treatment of immunological diseases and cancer, and diagnostics. • Vaccines - types, potential for development. • Xenotransplantation - the directions of development. • Induced pluripotent stem cells. • Immunosuppressive drugs: modifications and applications. • Artificial skin. • Angiogenesis in vitro. • Diagnostic tests - RIA and ELISA • Nanoparticles in biomedical sciences. • Lecture credit.

Bioinorganic chemistry	K_W04, K_W05, K_U06, K_K01

• Metal coordination sites - their role in bioprocesses in biological systems. Porphyrin ligands and other macrocyclic systems. Transport and storage of transition metal ions. The formation constants of transition metals complexes and methods of their determination. Factors influencing for the potential of the metal complexes. Biological and synthetic molecular oxygen carriers. The transfer of electrons in biochemical reactions. The reactions of reactive oxygen species in biological systems. Heme proteins and copper proteins in redox reactions. Medical elements of inorganic chemistry, metals and their compounds in medicine (prevention, diagnostics)

Cell signalling	K_W05, K_U06, K_K01

• Introduction to the subject. Structure and function of membrane proteins. • General description of signal reception by cell membrane receptors. • Seven-helix receptors. • Receptor tyrosine kinases. • Cytokine receptors. • Receptor serine/threonine kinases. • Guanylyl cyclase receptors. • Tumor necrosis factor receptor family. • Notch receptors. • Hedgehog receptors. • Toll-like receptors. • Apoptosis and necrosis. • Genetic control of apoptosis. • Written qualification

English (A)	K_U02, K_U06, K_U07

• 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. • Speaking practice - preparation for the oral examination.

English (B)	K_U02, K_U06, K_U07

• 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 - preparation for the oral examination. • Speaking practice - preparation for the oral examination.

French (A)	K_U02, K_U06, K_U07

• 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_U02, K_U06, K_U07

• 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_W15, K_W16, K_W18, K_U11, K_U14, K_K06

• 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_W15, K_W16, K_W18, K_U11, K_U14, K_K06

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

German (A)	K_U02, K_U06, K_U07

• 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.

German A	K_U02, K_U06, K_U07

• 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 abbreviations. 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.

Molecular taxonomy	K_W12, K_U06, K_K01

• Evolutionary biology. Classification and phylogeny. Mechanisms and the way of evolution. The formation of genetic variation. Genetic variation in natural populations. The evolution of phenotypic traits. Species and speciation. • The evolution of proteins, genes and genomes. Applications of molecular phylogenetics

Remediation of toxic substances in environmental material	K_W07

• Geochemical cycle. Soil as the ecological environment. Emission of industrial pollution to the environment. Pollution of geochemical cycle (asbestos, chromium(VI), lead, mercury, cadmium, synthetic organic compounds, dioxins, DDT and derivative of compounds, PCB, PAH. Protecting the environment from production of biotech and chemical industries. Basics of post-production waste and biotechnological aspects of environmental protection. Physical and chemical properties of soils. Soil organic matter. The content of organic carbon (humus) in the soil. Macro and micro-organisms in the soil environment. Oxidation-reduction properties of the soil. Sorption capacity of the soil. Distribution of soils in Poland, according to the state of emergency. Protection of soil. Remediation and bioremediation. Physicochemical methods of remediation. Biological methods of remediation. Microorganisms and their use in the process of rehabilitation of degraded soils. Biodegradation as a method of purifying contaminated soil petroleum products. Phytoremediation. Landfarming. Reclamation of degraded soils. Degradation of soils and their resistance to degradation. Eco-technical tasks in the field of protection and restoration of soil.

Russian (A)	K_U02, K_U06, K_U07

• Healthy lifestyle - reading comprehension, discussion. • Family celebrations - getting married and traditions connected with it. Reading comprehension and speaking activities. The use of pronouns друг друга. • State and church holidays - preparations; describing holiday customs. Coordinate clauses. • Evening at the theatre - a play review writing. Grammar: subordinate relative clauses; use of the который pronoun. • Mass media - the role in daily life of modern society. Speaking: giving opinion on radio and TV programmes. • "Абитура на ура" - reading comprehension tasks. • Popular professions and workplaces. Speaking: expressions of opinion about workconditions. Grammar: negative pronauns: никто, ничто. • Workactions connected with the professions. Speaking, grammar. Use of verbs:стать, работать (кем). • Writing of formal letters: CV and motivation letter. Grammatical constructions:несмотря на то, что • Work advertising - writing. Lexical exercises. • Universities in Russia - rules and reasons for studying - discussion. Reading comprehension tasks. • Talking about working abroad - pro and contra arguments - discussion. • Interview for a job - dialogs. Grammar exercises: use of pronauns: сам, самый, • School trip - oferts - offers of travel agencies. Giving information. Grammar exercises: verbs: посетить/посещать • At the camp - main ewents. writing exercises. • Travel with train - announcement at the station. Grammar: noun путь - declination. • Meanse of transport - underground - positive and negative sites. Discussion. Reading comprehension • Visit in travel agency - negotiations about travel destination. Grammar: verbs - заказать/забронировать - use; forms. • Writing of the formal letters to travels organizer. Lexical exercises. • Renting a flet - discription of the rooms. Reading comprehension tasks. • Houses to rent - advertisements, writing exercises. Short forms of adjectives. • Accidents during the travel, reading text, lexical exercises. • Daily routines and obligations in household - discussion, comprehensive tasks. • Speaking: partnership, woman and man in modern society. Writing exercises. • Generation gap - reasons. typical conflikts, sozial norms - discussion. Grammar - irregular verbs. • The history of life of famous writer M. Bulhakov - problems in his novels. Lexical exercises. • Our holydays. Writing of postcards.Verbs forms - grammar exercises. • Free time - organization. Work with text " Отдых в современном общество" - comprehension tasks. • Sport - emotion, sport spectacles. Lexical exercises. • Speaking: sportly life style - positive and negative aspects. • Natural environments destruction - reasons and consequences. Reading comprehension tasks. • Greenhouse effect and his consequences. How to protect our enwironment - discussion. • Speaking: visit at a restaurant - ordering, menu analysis. Writing recipies. Grammar: imperative forms of verbs. • Speaking: Problems of school leavers in modern socjety. Work with text: Трудоустройство" • Job offers - loan and workconditions. Graduating of adjectives - grammar exercises. • Doccuments connected with the job - writing applications for a job. • Use of business idiom - examples. • Taxes - kinds. Lexical exercises. • Advertisements - discription, visualisation of information. • Contract of employment - a model analysis; employees' duties. Contract of employment - writing exercises. • Economy - definition, main ideas. Lexical and grammar exercises. • Economy reforms in Russia in the 1990s. "Рынок - не рынок" - reading comprehension. • The Russian Federation - administrative division, state institutions. Lexical exercises. • Russian economy policy. "Российский экспорт - импрт" - reading comprehension. • Enterprises - types and organization. Functions of enterprises - main branches, finances. Verb "заниматься" with gerunds. • Enterprise - legal status and general shaleholders meeting. • Profitability indicators - vocabulary. Grammar exercises. • International companies on the Russian market. "Окно на восток российского бизнеса" - reading comprehension, analysis, presentation, discussion. • Speaking: presenting companies - branches. • Advertisements - types, structure. Writing exercises. • Commercial documentation - orders, confirmation, simple covering letters. • Speaking activities

Russian (B)	K_U02, K_U06, K_U07

• Appearance. • Features of character. • Asking for personal details. Processing and transferring information. • Ethical problems. Personal pronoun 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 Bulhakove. • 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 Biotechnology.