BIOPHAM Master - Syllabus of the courses proposed at University of Silesia in Katowice (USK)

Summary of the courses offered at the University of Silesia in Katowice including workloads

Course name	ECTS	Lectures (in hours)	Practical works in lab. or computer room (in hours)
APPLICATION OF VIBRATIONAL SPECTROSCOPY IN THERAPEUTIC SUBSTANCE STUDIES	4	15h	30h in lab.
MOLECULAR BIOPHYSICS	5	15h	30h in lab.
COMPUTER MODELING (Option A)	4	-	30h in computer room
DRUG CHEMISTRY AND TECHNOLOGY OF DRUG FORMS (Option B)	3	-	45h in lab.
FUNDAMENTALS OF MOLECULAR MODELING (Option A)	5	30h	30h in computer room
PHARMACOLOGY AND PHARMACOGNOSY (Option B)	5	30h	30h in lab.
SELECTED ISSUES FROM BIOMATERIALS TOXICOLOGY (Option B)	2	30h	15h in lab.
SPECIALIZED LABORATORY (Option B)	2	-	30h in lab.
SPECIALIZED LECTURE: DIELECTRIC SPECTROSCOPY IN THE STUDY OF DYNAMICS OF BIOLOGICAL SYSTEMS (Option A)	3	30h	-
SUB TOTAL	*21*	**90h (option A)** **90h (option B)**	**120h (option A)** **180h (option B)**
TRANSFERRABLE SKILLS	*9*	*120h (including lectures, oral presentations, language courses, case studies,…)*	
TOTAL	**30**	**330 - 390 h**	

Option A “modelling & simulation”

Option B “Advanced experimental techniques”

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<table>
<tr><td>Course name</td><td colspan="3">MOLECULAR BIOPHYSICS</td></tr>
<tr><td>Credit Points (ECTS)
5</td><td>Workload:
lecture (15h)
laboratory classes (30h)</td><td>Duration
1 semester</td><td>Offered (Term)
3</td></tr>
<tr><td>Institution in charge</td><td colspan="3">University of Silesia</td></tr>
<tr><td>Instructors</td><td colspan="3">Dr hab. Roman Wrzalik</td></tr>
<tr><td rowspan="2">Purpose of the module</td><td>BIOPHAM Track</td><td colspan="2">Mode</td></tr>
<tr><td>1</td><td colspan="2">Compulsory</td></tr>
<tr><td>Contents</td><td colspan="3">By participating in the classes, the student will deepen their knowledge in the field of biophysics by performing research on various biological objects, from single molecules, through subcellular complexes and structures, to the structures of living matter using methodology and physics methods. It will be an opportunity to understand the basics of many advanced research techniques and take part in experiments performed using them. Familiarize yourself with, among others with the following research methods:
1. Spectroscopy and fluorescence microscopy used to observe the structure and follow cell life processes.
2. Multidimensional nuclear magnetic resonance (NMR) in imaging of tissue structure and observation of cellular changes.
3) Atomic force microscopy (AFM) in the study of individual molecules, forces of interaction between them and the structure of molecular and cellular systems as well as characteristics of their mechanical (viscoleastic) properties.
4) Microscale Raman spectroscopy - Raman mapping and surface enhanced Raman spectroscopy (SERS). 5) Electron cryomicroscopy of single molecules and molecular systems.
6) Mass spectrometry in the study of the atomic and molecular composition of substances and tissues (ToF-SIMS).
7) Analytical centrifugation.
8) Theoretical methods for modeling the structure, spectra and properties of molecules and their systems - the use of molecular dynamics and ab-initio modeling methods.</td></tr>
<tr><td>Examination</td><td colspan="3">Lecture: Written test/ Oral examination
Laboratory classes: written test + report</td></tr>
<tr><td>Requirement for examination</td><td colspan="3"></td></tr>
</table>

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More information	CLASSIFICATION: BIOPHYSICS
Learning outcomes	• student understands the physical basis of known research techniques used in molecular biophysics, • student is able to characterize and develop the results of research obtained for biological systems, • student knows the principles of operation, capabilities and specificity of high-class research equipment, • student through acquired knowledge of physics and biology knows how to propose a method of research of various biological systems, thanks to which he becomes a natural partner of biologists and doctors.

Course name	SELECTED ISSUES FROM BIOMATERIALS TOXICOLOGY		
Credit Points (ECTS) 2	Workload: lecture (30h) laboratory classes (15h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Dr hab. Magdalena Popczyk		
Purpose of the module	BIOPHAM Track	Mode	
	1	Compulsory for Option B: Advanced experimental techniques	
Contents	This course will provide students with the issues related to biomaterials toxicology, including terms and definitions such as: toxin (poison), toxicity, degrees of toxicity, types of intoxications, adsorption of toxic substances and biocorrosion. The module shall ensure that students are knowledgeable about toxic action mechanisms and dynamics, based on which students shall understand the importance of biomaterials toxicity and its adverse effects of impact on the organism. The accomplishment of the above objectives will require learning a number of issues from the scope of the first level of education. Program: laboratory 1. Organization of classes. 2. Ways of distributing harmful compounds to the body. The effect of drugs on the presence of an implant in the body. The effect of alcohol on presence of the implant in the body.		

	3. Effect of drugs on the presence of the implant in the body. Toxicity of metals found in titanium-containing biomaterials additives. Toxicity of metals present in 316L implant steel. 4. Diseases caused by the presence of metals in food. Toxicity of ceramic implants. Life expectancy of implants. 5. Toxicological assessment of cosmetic raw materials. Toxicity of plastics. Methods for determining metals in the material biological. 6. Methods of neutralizing poisons. Toxicity of metals and semi-metals. 7. Toxicity of non-metals and their inorganic compounds. Toxicity of addictive substances (hallucinogens). 8. Written test / test. Program: lecture 1. Toxin (poison), toxicity, degrees of toxicity, types of poisoning. 2. Mechanisms of toxic action. 3. Adsorption of toxic substances. 4. Metabolic disorders caused by poisons. 5. Morphological disorders caused by poisons. 6. The carcinogenic response of a living organism to the implant. 7. Allergic reaction of the living organism to the implant. 8. Allergy mechanisms. 9. Allergies caused by implants. 10. Infection mechanisms caused by implanted materials. 11. Biocorrosion.
Examination	Oral examination + Written test + Report
Requirement for examination	
More information	CLASSIFICATION: CHEMISTRY
Learning outcomes	• Understanding the relationship between material properties and basic laws of nature. • Acquiring basic knowledge about theoretical specification of material properties (specific heat, susceptibility etc.). • Analysis of various type computational approximations. • Acquiring the knowledge about materials electron structure, magnetism, dielectric and other properties. • Acquiring the skill to resolve theoretical problems from the field of material properties computation. • Acquiring the skill to apply specified computational methods and approximations. • Analysis of various type approaches to theoretical determination of material properties

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<table>
<tr><td>Course name</td><td colspan="3">SPECIALIZED LABORATORY</td></tr>
<tr><td>Credit Points (ECTS)
2</td><td>Workload:
laboratory classes (30h)</td><td>Duration
1 semester</td><td>Offered (Term)
3</td></tr>
<tr><td>Institution in charge</td><td colspan="3">University of Silesia</td></tr>
<tr><td>Instructors</td><td colspan="3">Dr Katarzyna Balin (Tof-SIMS), mgr Robert Gawecki (optics laboratory), dr Paulina Maksym (biological laboratories), dr hab. Roman Wrzalik (UV-Vis, IR, Raman spectroscopy), dr Dorota Zygadło (glasses optics labs)</td></tr>
<tr><td rowspan="2">Purpose of the module</td><td>BIOPHAM Track</td><td colspan="2">Mode</td></tr>
<tr><td>1</td><td colspan="2">Compulsory for Option B: Advanced experimental techniques</td></tr>
<tr><td>Contents</td><td colspan="3">During the course, students have the opportunity to familiarize themselves with modern scientific equipment and the possibilities of testing with their help medicines and biological materials as well as the visual system. Students can choose to work in the following research laboratories:
1. biophysical and biochemical laboratories - cell culture and research,
2. laboratory of optics and optical spectroscopy methods,
3. ESCA, ToF-SIMS laboratory,
4. spectacle optics laboratory,
5. X-ray spectroscopy laboratory.</td></tr>
<tr><td>Examination</td><td colspan="3">written test + report</td></tr>
<tr><td>Requirement for examination</td><td colspan="3"></td></tr>
<tr><td>More information</td><td colspan="3">CLASSIFICATION: BIOPHYSICS</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">• student acquired the skills to work in biological and biochemical laboratories,
• student learned about the latest physicochemical equipment used in the study of biological systems and organic substances,
• student is able to develop the results of measurements and present them in the form of projects and scientific publications.</td></tr>
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<table>
<tr><td>Course name</td><td colspan="3">FUNDAMENTALS OF MOLECULAR MODELING</td></tr>
<tr><td>Credit Points (ECTS)
5</td><td>Workload:
lecture (30h)
laboratory classes (30h)</td><td>Duration,
1 semester</td><td>Offered (Term)
3</td></tr>
<tr><td>Institution in charge</td><td colspan="3">University of Silesia</td></tr>
<tr><td>Instructors</td><td colspan="3">Prof. Aleksander Bródka, dr Kajetan Koperwas</td></tr>
<tr><td rowspan="2">Purpose of the module</td><td>BIOPHAM Track</td><td colspan="2">Mode</td></tr>
<tr><td>1</td><td colspan="2">Compulsory for Option A: Modelling & Simulation</td></tr>
<tr><td>Contents</td><td colspan="3">During the lecture, the student becomes acquainted with the following issues:
Molecular mechanics:
-Description of binding and non-binding interactions.
-Force fields: MMFF94, GAFF and GROMACS.
- Optimization methods: simple gradient method, fastest gradient and conjugate gradients, Metropolis algorithm.
Classic computer simulations:
-Models of molecules and potentials of inter-molecular interactions.
Deterministic computer simulation methods - isolated molecular systems and extended systems (periodic boundary conditions, nearest image convention, spherical truncation, shifted potential), equations of motion, methods of solving difference equations, dynamics with constraints, long-range interactions, molecular dynamics for a microcanonical ensemble, canonical and isobaric-isothermal; mean values and fluctuations, thermodynamic quantities, temporal correlation functions, correlation times and transport coefficients, structural properties (binary decomposition function, static structure factor), long-range potential energy and pressure corrections.
-Stochastic computer simulation methods - Monte Carlo method (Metropolis method, simulations for the canonical ensemble).
During the laboratory classes free software such as GROMACS, Avogadro, VMD, NAMD, will be used to:
-Constructing a given molecule and determining its most probable conformation.
-Conducting a molecular dynamics simulation of a system of atoms.
-Conducting molecular dynamics simulations of a system of simple molecules</td></tr>
<tr><td>Examination</td><td colspan="3">Two tests from laboratory classes and Written test/ Oral examination from lecture</td></tr>
<tr><td>Requirement for examination</td><td colspan="3"></td></tr>
</table>

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More information	CLASSIFICATION: COMPUTATIONAL PHYSICS
Learning outcomes	• Student has a basic knowledge of molecular dynamics simulation and Monte Carlo method • Student knows the basics of molecular dynamics. • Student is able to determine the advantages and limitations of known methods of computer simulations. • Student is able to choose the model of interactions, statistical set and parameters of classical simulations appropriate for the analyzed system. • Student is able to use the available open programs to model simple molecules and simulate the dynamics of the system of atoms and molecules.

Course name	COMPUTER MODELING		
Credit Points (ECTS) 4	Workload: laboratory classes (30h)	Duration 1 Semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Dr hab. Arkadiusz Bubak		
Purpose of the module	BIOPHAM Track	Mode	
	1	Compulsory for Option A: Modelling & Simulation	
Contents	During the course, students in practice become familiar with: 1. Deterministic modeling based on numerical solving for ordinary differential equations - examples and applications in biophysics: - transmission of nerve impulses, - tumor growth, - molecular motors, 2. Amino acid and protein databases. 3. Modeling of molecules and their systems using density functional methods (DFT); geometry parameters, charge distribution characteristics and molecular spectra of organic molecules (e.g. amino acids). 4. Modeling of organic molecules and their systems using molecular dynamics methods.		
Examination	average of marks for self-made projects		
Requirement for examination			

More information	CLASSIFICATION: COMPUTATIONAL PHYSICS
Learning outcomes	• student has knowledge of advanced modeling methods in physics, chemistry and biology, • student knows the basic mathematical relations used in molecular modeling, • student knows how to use mathematical modeling apparatus to solve complex problems in physics and biophysics, • student is able to use selected software packages for the analysis of molecular structure, proteins, drugs, etc.

Course name	DRUG CHEMISTRY AND TECHNOLOGY OF DRUG FORMS		
Credit Points (ECTS) 3	Workload: laboratory classes (45h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Dr hab. Anna Mrozek-Wilczkiewicz		
Purpose of the module	BIOPHAM Track	Mode	
	1	Compulsory for Option B: Advanced experimental techniques	
Contents	During the course, students in practice become familiar with: 1. Molecular modeling of therapeutic compounds. 2. Preparation of selected therapeutic compounds 3. Characterization of new drugs by NMR, MS, XRD methods. 4. In vitro biological activity studies.		
Examination	average of marks for self-made projects + report		
Requirement for examination			
More information	CLASSIFICATION: PHARMACY		

Learning outcomes	• student learned the methods of obtaining biologically active substances, • student knows the basics of molecular design and drug synthesis technology, • student is able to plan and carry out the synthesis of selected organic compounds, • the student knows the health and safety regulations in force in the chemical laboratory and the use of safe disposal of chemical waste, • student knows the classification of drugs and their effects on living organisms, • student is able to apply selected spectroscopic methods (NMR, MS, XRD) and interpret a wide range of simple molecular methods in order to apply their chemical structure.

Course name	PHARMACOLOGY AND PHARMACOGNOSY		
Credit Points (ECTS) 5	Workload: laboratory classes (30h) lecture (30h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Dr hab. Dorota Tarnawska		
Purpose of the module	BIOPHAM Track	Mode	
	1	Compulsory for Option B: Advanced experimental techniques	
Contents	The content of the lecture includes: 1. Subject and basic concepts of pharmacology, pharmacy and pharmacognosy. 2. Drug nomenclature. Drug forms. 3. Drug properties and types of actions in the body. Side effects. Drug toxicity. 4. Factors affecting drug performance. Drug absorption. Fundamentals of drug action mechanisms. Non-specific drugs. 5. Drug distribution, redistribution and biotransformation. Drug excretion. Drug transport. 6. Chemical stability of the drug. Structural determinants of chemical stability. Structural factors affecting durability. 7. Drug metabolite. First phase processes 8. Pharmacokinetics. The concept of a model compartment. 9. Cell structure and drugs. The fate of drugs in the body. Basic information about the cell and cellular mechanisms of drug action. 10. Hydrophobicity vs hydrophilicity. Ionization of the drug. Lipinski rule and pharmacokinetics. 11. ADMET and pharmacokinetics. Pharmacokinetics and drug design.		

	12. Solubility and transport through membranes. The effect of acyl and alkyl substituents and their substitution on drug polarity 13. Introduction of genes to cells. Antisense therapy. Prodrugs generated by genetic engineering. 14. Pharmacogenetics (pharmacogenomics). Genomics technology in the search for drugs. Laboratory - selected issues: 1) Oxidation reactions. Aromatic hydroxylation. Epoxidation of alkenes. 2) Oxidation of aliphatic and alicyclic carbon atoms. Oxidation of moieties containing a carbon-nitrogen connection. Oxidation of the carbon-oxygen bond.
Examination	Lecture: Written test/ Oral examination Laboratory classes: average of marks for self-made projects + report
Requirement for examination	
More information	CLASSIFICATION: PHARMACY
Learning outcomes	• student knows the basic concepts of pharmacy and pharmacognosy, • student understands the basics of drug action mechanisms, • student learned the properties of selected active substances, their effects in the body, side effects, • student learned the chemical conditions for the use of active substances and biochemical reactions at the cell level, • student gained basic knowledge about prodrugs generated by genetic engineering, • the student has knowledge of the applications of genomics technology in the search for drugs.

Course name	SPECIALIZED LECTURE: DIELECTRIC SPECTROSCOPY IN THE STUDY OF DYNAMICS OF BIOLOGICAL SYSTEMS		
Credit Points (ECTS) 3	Workload: lecture (30h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Prof. dr hab. Marian Paluch		
Purpose of the module	BIOPHAM Track	Mode	
	1	Compulsory for Option A: Modelling & Simulation	
Contents	The content of the lecture includes:		

	1. Dielectric in a constant field (macroscopic and microscopic dielectric parameters, mechanisms of dielectric polarization, local field models and records of phase transformations in dielectric measurements). 2. Dielectric in an alternating field (the phenomenon of dielectric relaxation: dipole and electrical conductivity). 3. Theoretical foundations of the phenomenon of polarization of heterogeneous media (two-, three- and multiphase systems, membranes). 4. The phenomenon of dieelectrophoresis. 5. Dielectric properties of selected biological materials (cells, tissues, proteins, blood, biopolymers)
Examination	Written test/ Oral examination
Requirement for examination	
More information	CLASSIFICATION: PHYSICS
Learning outcomes	• student knows elementary theory of interaction of electric field with dielectric materials, • student knowns the basics of broadband dielectric spectroscopy measurements, how to apply it for the study of biological systems and how to analyse obtained dielectric measurements, • student knows theory of suspensions of particles in homogenous fields, • the student has knowledge of the applications of the phenomenon of dielectrophoresis for the study of small biological organisms.

Course name	APPLICATION OF VIBRATIONAL SPECTROSCOPY IN THERAPEUTIC SUBSTANCE STUDIES		
Credit Points (ECTS) 4	Workload: lecture (15h) laboratory (30h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Prof. dr hab. Marian Paluch (lecture), dr hab. Roman Wrzalik (laboratory)		
Purpose of the module	BIOPHAM Track	Mode	
	1	compulsory	

Contents	The entire course consists of lectures and laboratory exercises that introduce students to the theory and practice of the application of two complementary research techniques: infrared absorption (IR) spectroscopy and Raman scattering (RS). This will give them the knowledge to solve many important problems in pharmacy: 1) drug identity, 2) test purity, 3) crystal structures of drugs, 4) characteristics of polymorphism, 5) tautomerization, 6) interactions between active drugs and excipients. In the first part of the lecture, students will be introduced to the basic principles of vibration spectroscopy, in the second part the possibilities of using spectroscopic methods in pharmacy will be presented in detail. During the laboratory work, they learn the practical aspects of various vibration spectroscopy measuring techniques.
Examination	Test on issues discussed in the lecture and evaluation of the report containing the development of measurement results.
Requirement for examination	
More information	CLASSIFICATION: PHYSICS - CHEMISTRY
Learning outcomes	The student has acquired knowledge and practical skills: • the laws of physical chemistry underlying vibration spectroscopy methods, • gathered extensive information on the usefulness of vibration spectroscopy in the analysis of pharmaceutical materials, • knows how to perform basic measurements using IR and Raman spectrometers, • can analyse the results of measurements obtained from these two techniques.

Course name	LANGUAGE COURSE: SCIENTIFIC ENGLISH		
Credit Points (ECTS) 4	Workload: lecture (45h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Dr hab. Dariusz Kajewski		
Purpose of the module	BIOPHAM Track	Mode	

	1	compulsory
Contents	The module aims to develop all language competences and prepare students to communicate freely in English. Curriculum: - Discussion on the methods of financing scientific research. - Comparing research and development activities. - Describing the activities and coordination of research teams. - Reporting factors of logical inference. - Discussion about students' research needed for the thesis.	
Examination	Average of partial grades from the whole semester, activity during classes, frequency	
Requirement for examination		
More information	CLASSIFICATION: TRANSFERABLE SKILLS COURSES	
Learning outcomes	Student: • understands the importance of oral communication and texts of varying complexity, including understanding discussions, topics general and specialist in the field of the subject; • formulates clear and transparent oral and written statements, using the rules of organization of statements and appropriate registry • communicates with the use of various channels and communication techniques in various fields of science and disciplines research appropriate for a given field of study • searches for, selects, analyses, evaluates, and classifies information using various sources and methods	

Course name	PROTECTION OF INTELLECTUAL PROPERTY; HEALTH AND SAFETY, ERGONOMICS		
Credit Points (ECTS) 1	Workload: lecture (15h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Dr Antoni Sznirch		
Purpose of the module	BIOPHAM Track	Mode	
	1	compulsory	
Contents	During the lecture, the student becomes acquainted with the following issues:		

	- the concept of intellectual property; - goals and principles of copyright protection; - the concept of work and author; - the concept of an idea and its protection; - author's personal and property rights and their protection; - the concept of plagiarism and legal liability for infringement of copyright; - ethical ways of using someone else's creativity; - personal and public use permitted; - the concept of personal rights and their protection; - the concept of invention, industrial design, utility design, trademark and their protection;
Examination	Final test on issues discussed in the lecture.
Requirement for examination	
More information	CLASSIFICATION: TRANSFERABLE SKILLS COURSES
Learning outcomes	• student knows and understands the basic legal, economic and ethical aspects of scientific activity; • student knows and understands the basic concepts and principles of the protection of intellectual property and copyright; • student can obtain information from literature, databases and other sources; is able to integrate the obtained information and interpret it, draw conclusions, and formulate and justify opinions understands the need to improve professional and personal competences; • student understands and appreciates the importance of intellectual honesty in the actions of oneself and others; acts ethically; • student understands the social aspects of applying the acquired knowledge and skills and the related responsibility; • student knows the basic principles of occupational health and safety

Course name	SUBJECT IN THE FIELD OF HUMANITIES		
Credit Points (ECTS) 3	Workload: lecture (30h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Dr hab. Paweł Tomczok		

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Purpose of the module	BIOPHAM Track	Mode
	1	compulsory
Contents	The aim of the module is to expand the student's knowledge and social skills with content outside the field of study.	
Examination	Final test on issues discussed during the lecture.	
Requirement for examination		
More information	CLASSIFICATION: TRANSFERABLE SKILLS COURSES	
Learning outcomes	• Student has a general knowledge of selected scientific methods and knows issues specific to the discipline of science not related to the field of study; • Student has the ability to pose and analyze problems on the basis of the acquired content in the field of science not related to the field of study; • Student understands the need for an interdisciplinary approach to solving problems, integrating knowledge from various disciplines and practicing self-education aimed at deepening the acquired knowledge.	

Course name	INTRODUCTION TO ENTREPRENEURSHIP		
Credit Points (ECTS) 1	Workload: lecture (30h)	Duration 1 semester	Offered (Term) 3
Institution in charge	University of Silesia		
Instructors	Dr Marek Łukaszewski		
Purpose of the module	BIOPHAM Track	Mode	
	1	compulsory	
Contents	Economic development, money and development. Entrepreneurship, features of an enterprising person. Social and economic importance of Entrepreneurship. Courage of vision and risk of action. Is it worth getting involved in ventures? A scientist as an entrepreneur. Innovation and innovation. The mental revolution of the transition from scientist to entrepreneur. How do scientists and entrepreneurs solve the problem? Place of science and scientist in entrepreneurship. "Doing" science in an		

	entrepreneurial environment. Protection of intellectual property. Is the protection of intellectual property necessary and does it serve economic development? How to start creating a new company? Planning the creation of a new company. Stages of the company's life, the specificity of the innovative company "Death Valley". Project management. Competition and sector analysis. SWOT, PEST for selected sectors. Strategy, marketing and positioning of the company on the market. Enterprise Finance for Dummies. Break-even point.
Examination	Final test on issues discussed during the lecture and essay
Requirement for examination	
More information	CLASSIFICATION: TRANSFERABLE SKILLS COURSES
Learning outcomes	• Student has basic knowledge of creating and developing forms of individual entrepreneurship; • Student knows and understands the basic concepts and principles of the protection of intellectual property and copyright; • Student can work individually and in a team; can estimate the time needed to complete the commissioned task; • Student knows and understands the legal, economic and ethical aspects of scientific activity; • Student knows how to work in a group taking different roles in it; understands the division of tasks and the need for the unit to fulfill the entrusted task; • Student can think and act in terms of entrepreneurship (costs, economic effects, profit and loss, profitability).