Wrocław University of Science and Technology

Study programme

Organizational unit:	Faculty of Chemistry
Field of study:	Biosciences
Level of study:	second degree 3 semesters
Form of study:	full-time studies
Education cycle:	2025/2026

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Field of study characteristics

Basic information

Organizational unit:	Faculty of Chemistry
Field of study:	Biosciences
Study level:	second degree 3 semesters
Study form:	full-time studies
Education profile:	general academic profile
Language of study:	English
Valid from the education cycle:	2025/2026
Number of semesters:	3
Total number of hours of classes:	directional: 705 Medicinal Chemistry: 420 Bioinformatics: 435
Total number of ECTS points required to complete a given level of study:	90
Professional title awarded to graduates:	magister inżynier

Fields of science and scientific disciplines

Scientific disciplines to which the field of study is assigned:

Field of the exact and natural sciences

Assigning the major to the fields and disciplines to which the learning outcomes relate:

Discipline	Percentage
Chemical science	100%

Main discipline: Chemical science

Description of the field, profile of the graduate and possibilities of continuing studies

A graduate of Biosciences program should:

- have mastered theory and practice in the use of modern methods of medicinal chemistry, theoretical and computational chemistry and bioinformatics tools enabling: drug design, structural and spectroscopic analysis and insight into the dynamics of processes occurring at the molecular level in macromolecules;
- know the basics of bioinformatics data analysis, machine learning, data mining and big data science;
- have in-depth programming skills in Python.

A graduate of a master's degree in Biosciences has a high chance of being employed in IT companies, the pharmaceutical industry and in research laboratories.

A graduate completing studies in the field of Biosciences should be prepared to plan and conduct scientific research, and thus undertake education at the Doctoral School.

Eligibility to apply for admission to a doctoral school, non-degree postgraduate programmes.

Currentness of the study programme

Concept and goals of education

The master's degree program in Biosciences has been designed as an interdisciplinary educational path, combining advanced knowledge in bioinformatics, medicinal chemistry, and computational sciences, providing a balanced theoretical and practical education. The program aims to train highly qualified specialists prepared to work at the intersection of biological, chemical, and information technology sciences. Its interdisciplinary nature addresses the needs of the modern biotechnology, pharmaceutical, and IT industries, educating experts ready to tackle scientific and industrial challenges.

The program achieves the following educational objectives:

- gaining knowledge in bioinformatics and medicinal chemistry through integrated interdisciplinary education, combining tools and techniques from both fields to effectively solve biological, chemical, and medical problems at the molecular level,
- gaining practical research and technological skills enabling the design of studies and interpretation of experimental results, as well as the use of computational tools for drug design, analysis of the structure and activity of chemical compounds, and biological macromolecules,
- gaining advanced programming and computational skills (both in bioinformatics and chemistry) in data analysis, particularly in automating data processing in bioinformatics, analyzing genomic sequencing (NGS) results, and creating computational models in medicinal chemistry and bioinformatics,
- development of research and creative competencies through the implementation of scientific projects and laboratory work, preparing students to conduct independent research and collaborate in interdisciplinary research teams,
- development of social and teamwork skills, with an emphasis on leading research projects and effectively communicating research results, as well as education in research ethics and the social responsibility associated with engineering and scientific activities,
- preparation for employment in the biotechnology, pharmaceutical, and IT sectors, as well as in research laboratories, by providing students with knowledge and skills that are highly valued in the job market, while also enabling them to pursue further education in doctoral programs.

Information regarding the inclusion of socio-economic needs in the study programme and the compliance of the major learning outcomes with these needs

The needs of the labor market in the field of Biosciences are indirectly presented in this Study Program under the heading Profile of the graduate, employment opportunities. The preparation of graduates listed there is reflected, among others, in the following learning outcomes: (1) Is able to conduct scientific experiments, develop and interpret their results and relate them to appropriate theories or scientific hypotheses, (2) Using techniques appropriate to the field studied, I can characterize in terms of properties physicochemical and biological biological systems using both quantum chemistry and molecular modeling tools as well as selected experimental methods, (3) Has in-depth knowledge of quantum chemistry, molecular dynamics and molecular modeling, (4) Has in-depth programming skills in Python and knows the operating system Linux, (5) Has practical knowledge of various methods of bioinformatic data analysis in contemporary research in the field of exact and natural sciences, (6) Is aware of the importance and understanding of non-technical aspects and effects of scientific and engineering activities, including their impact on the environment, and as well as the associated responsibilities. The expected learning outcomes meet the current needs of the biotechnology industry, including companies and workplaces dealing with the design, synthesis and development of biologically active substances technology, the pharmaceutical industry, as well as the IT sector.

Other important factors determining the validity of the study programme

The relevance and attractiveness of the Biosciences master's program in the context of the current needs of science, industry, and society are influenced by:

- the dynamic development of biotechnology and bioinformatics, two of the fastest-growing fields of science, crucial for innovative industries and requiring the use of advanced computational tools for genomic data analysis and drug design,
- the increasing demand for personalized medicine, based on the analysis of individual patients' genomic data, including the design of personalized drugs using advanced bioinformatics and chemical tools,
- the interdisciplinary and complex nature of contemporary research challenges in biological and chemical sciences, particularly in drug design, biological data analysis, and molecular modeling, which require knowledge and skills from various fields such as biology, chemistry, computer science, and even physics,
- the growing role of Big Data and machine learning, driven by the exponential increase in biological data, requiring innovative tools for analyzing large datasets,

- advancements in chemical and synthetic technologies used in medicinal chemistry, enabling the design of highly specific and effective drugs.

Thanks to its interdisciplinary nature and emphasis on practical programming and computational skills, the Biosciences program is current and adapts to the growing challenges of data analysis and the design of drugs, biocatalysts, and sensors. Key actions that ensure graduates' competitiveness in the face of rapidly changing demands in science, industry, and the job market include:

- incorporating the latest research topics into the curriculum, made possible by employing academic staff who are active researchers in the scientific fields represented by the Biosciences program,
- collaborating with research institutions to broaden the scope of current activities,
- involvement in research projects and grants, providing access to the latest research findings,
- enhancing the practical aspect of education and developing new forms of teaching that engage students in solving real-world research problems,
- increasing the internationalization of the program through student and staff exchanges,
- continuously improving the competencies of the teaching staff,
- collaborating with alumni to gather information on current challenges and needs in the job market.

The connection of the programme with the University's mission and its development strategy

The mission and strategy of Wrocław University of Science and Technology were defined in the document entitled: "Strategy of Wrocław University of Science and Technology 2023-2030". The second-cycle study program in Biosciences fits into the key areas of the strategy and the overarching strategic goals both in the area of education, scientific research and cooperation with the environment. It is also consistent with the mission of "creating and transmitting knowledge that responds to new challenges and opportunities emerging before society, economy and civilization. The study program is consistent with the strategic goals by: (1) developing creative skills in the nature of scientific work through an increased number of classes related to the completion of a diploma thesis, (2) a large share (over 50%) of active classes, such as laboratories, exercises, seminars and projects , (3) ensuring a balance between the general and specialized knowledge, (4) providing students with knowledge and skills covering the latest achievements of science and technology in the field of bioinformatics and medicinal chemistry, (5) developing social competences, with particular emphasis on the development of teamwork skills, (6) developing the ability to work using the project method in the IT and (bio-)chemical laboratories.

Learning outcomes

Code	Description of the directional learning outcome	Characteristics for qualifications at level 6 or 7 of the Polish Qualifications Framework	Characteristics for qualifications at level 6 or 7 of the Polish Qualifications Framework, enabling the acquisition of engineering competences
Knowledge			
K2_BSS_W01	Possesses in-depth knowledge of mathematics enabling understanding, quantitative description and/or modeling of chemica and/or biotechnological processes.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_BSS_W02	Has structured and theoretically based the knowledge of advanced methods used in the identification and characterization of biomolecules and the organization of a research laboratory.	P7U_W, P7S_WG	
K2_BSS_W03	Knows the principles of formulating hypotheses, building models and formulating theories in the context of the concepts of development of biotechnology and chemistry.	P7U_W, P7S_WG	
K2_BSS_W04	Knows the concepts and principles of intellectual property protection, patent protection and copyright in the context of the preparation of master thesis.	P7U_W, P7S_WK	
K2_BSS_W05	Has in-depth knowledge of chemistry necessary to perform chemical analyses, illustrating them with chemical reactions. Recognizes and explains the accompanying physicochemical phenomena.	P7U_W, P7S_WG	
K2_BSS_W06	Possesses based knowledge enabling the description and characterization of modern instrumental analytical and/or computational methods.	P7U_W, P7S_WG	
K2_BSS_W07	Has extended knowledge of the structure of matter and its mathematical description. Explains the laws important in structure identification.	P7U_W, P7S_WG	
K2_BSS_W08	Knows the postulates of quantum mechanics and the mathematical bases of computational methods of quantum chemistry and molecular mechanics.	P7U_W, P7S_WG	
K2_BSS_W09	Knows the concepts of molecular mechanics and dynamics.	P7U_W, P7S_WG	
K2_BSS_W10	Has knowledge of mathematics to the extent necessary to design and drug analysis. Knows the theoretical basis of computational methods and computer techniques used in drug design.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_BSS_W11	Has knowledge of mathematics, numerical and computational methods on the level of molecular modeling and correlating the obtained results with experimental and observational data.	P7U_W, P7S_WG	
K2_BSS_W12	Knows the theoretical foundations of the functioning of appropriate scientific equipment in the field of drug analysis.	P7U_W, P7S_WG	
K2_BSS_W13	Knows the physicochemical basis of techniques used in designing of new materials for biotechnology, nanomedicine and pharmacy.	P7U_W, P7S_WG	
K2_BSS_W14	Knows informatic tools useful in biological research.	P7U_W, P7S_WG	
K2_BSS_W15	Has structured, theoretically based knowledge in area biopharmaceuticals.	P7U_W, P7S_WG	
K2_BSS_W16	Understands the economic, legal and ethical conditions of professional activity.	P7U_W, P7S_WK	P7S_WK_INŻ

Code	Description of the directional learning outcome	Characteristics for qualifications at level 6 or 7 of the Polish Qualifications Framework	Characteristics for qualifications at level 6 or 7 of the Polish Qualifications Framework, enabling the acquisition of engineering competences
K2_BSS_W17	Has in-depth knowledge of mathematical and IT tools enabling understanding, quantitative description, modeling and design of materials or engineering objects or chemical/biotechnological processes.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_BSS_W18	Has in-depth knowledge of exact and natural sciences as well as engineering and technology, allowing the use of methods and concepts necessary to describe materials, chemical or biotechnological processes.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_BSS_W19	Knows concepts of entrepreneurship and the functioning of an enterprise.	P7U_W, P7S_WK	P7S_WK_INŻ
Skills			
K2_BSS_U01	Selects and applies mathematical methods in planning and analysis of the experiments.	P7U_U, P7S_UW	P7S_UW_INŻ
K2_BSS_U02	Selects and is able to use appropriate methods, techniques and research tools within the appropriate field of study necessary to explain the given problem.	P7U_U, P7S_UW	
K2_BSS_U03	Uses computer software to prepare results and statistically analyze the experimental data.	P7U_U, P7S_UW	P7S_UW_INŻ
K2_BSS_U04	Uses acquired knowledge in chemistry to related fields of science and scientific disciplines. Demonstrates the ability to work in interdisciplinary teams.	P7U_U, P7S_UO	
K2_BSS_U05	Is able to develop research results, critically analyze them and formulate the conclusions.	P7U_U, P7S_UW	
K2_BSS_U06	Is able to present the results of own research in the form of a written study.	P7U_U, P7S_UW, P7S_UK	
K2_BSS_U07	Is able to present the goals and results of scientific work in the form of an oral presentation using modern techniques of communication.	P7U_U, P7S_UW, P7S_UK	
K2_BSS_U08	Is able to plan experiments and perform basic analyzes using appropriate instrumental equipment and evaluate the results of the experiments. Possesses ability to make theoretical calculations and use available software to simulate the experiment.	P7U_U, P7S_UW	
K2_BSS_U09	Is able to use selected the programs that implement quantum chemical computational methods.	P7U_U, P7S_UW	
K2_BSS_U10	Is able to apply methods of molecular mechanics and dynamics to solve chemical problems and use algorithms of differentiation, integration and trajectory analysis.	P7U_U, P7S_UW	
K2_BSS_U11	Is able to efficiently use modern informatic tools for solving problems in the field of biological and chemical sciences.	P7U_U, P7S_UW	
K2_BSS_U12	Is able to use basic methods of quantum chemistry to describe the structure and physicochemical properties of molecules.	P7U_U, P7S_UW	
K2_BSS_U13	Is able to write programs or scripts solving numerical problems in the area of computational chemistry and engineering sciences.	P7U_U, P7S_UW	P7S_UW_INŻ
K2_BSS_U14	is able to independently plan and implement continuous own education in the field of chemical engineering and related sciences; is able to pass on his knowledge to others.	P7U_U, P7S_UU	

Code	Description of the directional learning outcome	Characteristics for qualifications at level 6 or 7 of the Polish Qualifications Framework	Characteristics for qualifications at level 6 or 7 of the Polish Qualifications Framework, enabling the acquisition of engineering competences
K2_BSS_U15	Acquires, critically evaluates, and creatively processes information from scientific literature, databases, and other appropriately selected sources, including English-language ones.	P7U_U, P7S_UW, P7S_UK	
Social competence			
K2_BSS_K01	is ready to critically evaluate his knowledge and received content.	P7U_K, P7S_KK	
K2_BSS_K02	understands the need for entrepreneurial thinking and action and is aware of the need to act in the public interest.	P7U_K, P7S_KO	
K2_BSS_K03	understands the need to take initiatives, inspire and organize activities for the benefit of the socio-economic environment.	P7U_K, P7S_KO	
K2_BSS_K04	is ready to cooperate responsibly in a group, performing role taking into account the needs of the team (and/or social needs).	P7U_K, P7S_KR	
K2_BSS_K05	is ready to comply with the principles of professional ethics and respect the law, including copyright.	P7U_K, P7S_KR	
K2_BSS_K06	recognizes the importance and understands the non-technical aspects and consequences of scientific and engineering activities, including their impact on the environment, as well as the associated responsibilities..	P7U_K, P7S_KK, P7S_KO	
K2_BSS_K07	is aware of the social role of a technical university graduate and the need to maintain the ethos of the engineering profession.	P7U_K, P7S_KR	
K2_BSS_K08	is ready to recognize the importance of knowledge in solving problems in the field of study and related sciences; recognizes the need to seek expert opinion when difficulties arise in solving problems.	P7U_K, P7S_KK	
Language outcomes			
SJO_S2_U01	Be able to use a foreign language at B2+ ESCJ level and specialised terminology	P7S_UK	

Detailed information on ECTS points

Biosciences

Name	Medicinal Chemistry	Bioinformatics
Total ECTS	90	90
Total number of hours of classes	1125	1140
Number of ECTS points assigned to classes related to scientific activities conducted at the university in the discipline or disciplines to which the field of study is assigned (DN)	71/90 (78.89%)	71/90 (78.89%)
Number of ECTS points allocated to classes developing practical skills (including laboratory, project) (P)	48.7	52.3
The number of ECTS points that a student will receive by completing classes that require the direct participation of academic teachers or other persons conducting classes and students (BU)	46.2	46.5
Percentage of ECTS for elective courses	72/90 (80%)	72/90 (80%)
The number of ECTS points that a student will receive by completing classes in the humanities or social sciences appropriate for a given field of study	5	5
The number of ECTS points that a student will receive by completing classes in basic sciences (mathematics, physics/chemistry)	8	12

Organization of studies

Implementation of the study programme

Allowable ECTS deficit

Semester	Allowable deficit of ECTS points after a semester
Semester 1	15
Semester 2	15
Semester 3	0

Detailed requirements

Each subject must be passed according to the study plan. If a subject needs to be repeated, it should be retaken in the next semester when it is offered.

Methods of verifying the intended learning outcomes

Activity form	Methods of verifying the intended learning outcomes
Classes	Credit - oral, written; short test, input task, evaluation of the sub-tasks
Project	Project preparation, project implementation, project documentation, case study analysis,
Laboratory	Preparation of laboratory reports; oral statements, class participation; short test, input task, evaluation of the sub-tasks
Seminar	Multimedia presentations conducted and prepared individually or in groups; case study analysis, class participation, paper
Diploma thesis	Evaluation of work in the preparation of a diploma thesis; diploma examination
Lecture	Exam - oral, written, credit, test - oral, written

Description of the process leading to achieving learning outcomes

Verification and assessment of learning outcomes with reference to courses or groups of courses throughout the entire education cycle takes place in relation to the information contained in the subject cards (syllabuses). The student acquires knowledge and skills by participating in theoretical and practical classes, which are largely based on the results of scientific research conducted by academic teachers - course tutors conducting classes with students. The basis of teaching and learning process are laboratory, seminar and project courses. Education in the field of studies is conducted in accordance with the principle of increasing the complexity of theoretical and practical tasks set for students. Modern teaching methods are implemented in the teaching practice, thanks to which the students' activity during the classes increases. Theoretical courses in the form of lectures and seminars are supplemented with project and laboratory classes, which include, among others: computer modelling and design, as well as conducting scientific research. The program is complemented by humanities and foreign language courses. The course of study concludes with a diploma examination and a presentation of master's thesis.

Internships

Not applicable.

Diploma exam

The diploma process at the second level of studies includes Graduation proseminar I (15 h), Graduation laboratory 1 (60 h), Graduation seminar (15 h) and Graduation laboratory 2 (210 h) and ends with a Diploma Examination before an Examination Board consisting of employees of the Faculty of Chemistry. The Examination Boards are appointed by the Dean. The condition for a student to take the Diploma Examination is to achieve all the learning outcomes specified by the Senate of the Wroclaw University of Science and Technology for the second-cycle study program in the field of Biosciences and to obtain a positive assessment of the Diploma Thesis.

The Diploma Examination consists of two parts. The first stage of the exam is intended for multimedia presentation of the diploma thesis. During the presentation, the student presents the purpose and scope of the work, the method of solving the problem and the conclusions resulting from the work. The duration of the presentation is approx. 10 minutes. The second, fundamental stage is an exam in which the student answers questions from the Examination Board from areas corresponding to the field of study. The list of mandatory topics for the Diploma Examination in a given academic year is prepared and approved by the Program Committee of the Field of Study. The list of exam topics is consulted by the Program Committee of the Field of Study with academic teachers teaching individual subjects in terms of compliance with the program content in the Biosciences field of study.

The components of the Diploma Examination, the composition of the Examination Boards and the list of topics are made available to students on the website of the Faculty of Chemistry https://wch.pwr.edu.pl/studenci/dyplomanci/zagadnienia-do-egzaminu-dyplomowego before the start of the semester in which the Diploma Examination is planned. The Diploma Examination is conducted in accordance with the requirements of the Regulations of Studies at the Wroclaw University of Science and Technology and the Internal Procedure for the Organization and Course of the Diploma Examination (Dean's Order).

Study plan

Biosciences

Semester 1

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Theoretical Chemistry	Lecture: 30 Classes: 15 Laboratory: 30	Lecture: Exam Classes: Graded credit Laboratory: Graded credit	Lecture: 2 Classes: 2 Laboratory: 2	Obligatory
Elective Course	Lecture: 30	Graded credit	2	Obligatory group
The student chooses one subject				
Medicinal and Biological Chemistry	Lecture: 30	Graded credit	2	Elective
Methodology of Experimental Research	Lecture: 30	Graded credit	2	Elective
Bioprocess Project	Lecture: 30	Graded credit	2	Elective
Advanced Polymers for Chemical and Medical Applications	Lecture: 30	Graded credit	2	Elective
Managerial Course I	Lecture: 15	Graded credit	2	Obligatory group
The student chooses one subject				
Mediation and Negotation	Lecture: 15	Graded credit	2	Elective
Soft Skills for Engineers	Lecture: 15	Graded credit	2	Elective
Foreign Language 2.1	Classes: 30	Graded credit	2	Obligatory group
The student chooses classes from the offer of the Department of Foreign Languages				
Foreign Language 2.1	Classes: 30	Graded credit	2	Elective
Graduation Proseminar	Seminar: 15	Graded credit	1	Obligatory elective
Sum	**165**		**13**	

Specialty: Bioinformatics

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Molecular Dynamics	Lecture: 30 Laboratory: 30	Lecture: Graded credit Laboratory: Graded credit	Lecture: 4 Laboratory: 2	Obligatory in specialty
Bioinformatics	Lecture: 30 Laboratory: 30	Lecture: Exam Laboratory: Graded credit	Lecture: 3 Laboratory: 2	Obligatory in specialty
Networks and Workstations with UNIX System	Laboratory: 30	Graded credit	2	Obligatory in specialty
Applied Informatics	Laboratory: 60	Graded credit	4	Obligatory in specialty
Sum	**210**		**17**	

Specialty: Medicinal Chemistry

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Introductory Statistics	Classes: 15	Graded credit	2	Obligatory in specialty
Metabolomics	Lecture: 15	Graded credit	2	Obligatory in specialty
Spectroscopic Methods in Medicinal Chemistry	Lecture: 30 Laboratory: 30	Lecture: Exam Laboratory: Graded credit	Lecture: 2 Laboratory: 2	Obligatory in specialty
Analytical Methods in Drug Design and Technology	Lecture: 15 Laboratory: 30	Lecture: Graded credit Laboratory: Graded credit	Lecture: 2 Laboratory: 2	Obligatory in specialty
Crystallography and Structure of Solids	Lecture: 30 Classes: 15	Lecture: Graded credit Classes: Graded credit	Lecture: 2 Classes: 1	Obligatory in specialty
Isolation and Identification of Bioproducts	Laboratory: 30	Graded credit	2	Obligatory in specialty
Sum	**210**		**17**	

Semester 2

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Rational Drug Design	Lecture: 30	Graded credit	2	Obligatory

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Molecular Modeling	Lecture: 15 Laboratory: 30 Seminar: 15	Lecture: Exam Laboratory: Graded credit Seminar: Graded credit	Lecture: 2 Laboratory: 2 Seminar: 1	Obligatory
Retrieval of Scientific and Technical Information	Laboratory: 15	Graded credit	1	Obligatory
Managerial Course II	Lecture: 30	Graded credit	3	Obligatory group
The student chooses one subject				
Sociology for Engineers	Lecture: 30	Graded credit	3	Elective
Interpersonal Communication Skills	Lecture: 30	Graded credit	3	Elective
Principles of Entrepreneurship and Innovation	Lecture: 30	Graded credit	3	Elective
Principles of Business	Lecture: 30	Graded credit	3	Elective
Foreign Language 2.2	Classes: 60	Graded credit	3	Obligatory group
The student chooses classes from the offer of the Department of Foreign Languages				
Foreign Language 2.2	Classes: 60	Graded credit	3	Elective
Graduate Laboratory I	Diploma thesis: 60	Graded credit	6	Obligatory elective
Sum	**255**		**20**	

Specialty: Bioinformatics

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Advanced Programming and Numerical Methods	Laboratory: 45	Graded credit	3	Obligatory in specialty
Bionanotechnology	Lecture: 30 Seminar: 15	Lecture: Exam Seminar: Graded credit	Lecture: 2 Seminar: 1	Obligatory in specialty
Advanced Bioinformatics	Project: 45	Graded credit	3	Obligatory in specialty
Data Mining	Laboratory: 15	Graded credit	1	Obligatory in specialty
Sum	**150**		**10**	

Specialty: Medicinal Chemistry

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Metabolomics	Laboratory: 30	Graded credit	2	Obligatory in specialty
Modern Pharmaceuticals and Biopharmaceuticals	Lecture: 30 Laboratory: 30	Lecture: Exam Laboratory: Graded credit	Lecture: 2 Laboratory: 2	Obligatory in specialty
Medicinal Natural Products	Lecture: 15 Laboratory: 30	Lecture: Exam Laboratory: Graded credit	Lecture: 2 Laboratory: 2	Obligatory in specialty
Sum	**135**		**10**	

Semester 3

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Machine Learning for Chemistry and Biology	Lecture: 30 Laboratory: 30	Lecture: Exam Laboratory: Graded credit	Lecture: 2 Laboratory: 2	Obligatory
Graduate Laboratory II	Diploma thesis: 210	Graded credit	20	Obligatory elective
Graduation Seminar	Seminar: 15	Graded credit	2	Obligatory elective
Sum	**285**		**26**	

Specialty: Bioinformatics

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Computational Genomics	Lecture: 15 Laboratory: 15	Lecture: Exam Laboratory: Graded credit	Lecture: 1 Laboratory: 1	Obligatory in specialty
Molecular Engineering in Genomic Analyses	Laboratory: 45	Graded credit	2	Obligatory in specialty
Sum	**75**		**4**	

Specialty: Medicinal Chemistry

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Inorganic Drugs	Lecture: 15	Graded credit	1	Obligatory in specialty
Multistep Organic Synthesis	Laboratory: 60	Graded credit	3	Obligatory in specialty
Sum	**75**		**4**	

Syllabuses

Wrocław University of Science and Technology

Theoretical Chemistry

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.31PC.04745.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory
Study form full-time studies	**Block** Subjects of basic education - chemistry
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 2 ECTS, Exam • Laboratory: 30 h, 2 ECTS, Graded credit • Classes: 15 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	The student recognizes and explains the basic problems and shortcomings of classical physics in the description of atomic and molecular systems. Can define the postulates of non-relativistic quantum mechanics.	K2_BSS_W01, K2_BSS_W07, K2_BSS_W08
PEU_W02	The student formulates the Hamiltonian and the Schrödinger equation for model systems and for any atomic or molecular system. Knows the solutions of this equation for model systems (particle in a potential box, harmonic oscillator, hydrogen-like atom).	K2_BSS_W01, K2_BSS_W07, K2_BSS_W08, K2_BSS_W11

PEU_W03	The student recognizes and explains the basic approximations used in the description of the electronic structure of molecular systems: the Born-Oppenheimer approximation and the fundamentals of the variational and perturbational methods, and the basics of the molecular orbital theory.	K2_BSS_W01, K2_BSS_W07, K2_BSS_W08
PEU_W04	The student recognizes, explains and knows the limitations and possible applications of the most important contemporary methods of electronic structure investigation: in particular the (multi-configuration) self-consistent field method ((MC)SCF), configuration interaction (CI), many-body perturbation theory (MBPT), coupled cluster method (CC) and density functional theory (DFT).	K2_BSS_W01, K2_BSS_W02, K2_BSS_W07, K2_BSS_W08, K2_BSS_W11, K2_BSS_W17
PEU_W05	Characterizes and explains basic photochemical and photophysical processes, in particular possible mechanisms of radiative and non-radiative deactivation of photoexcited molecular systems (Jałoński diagram).	K2_BSS_W01, K2_BSS_W02, K2_BSS_W07, K2_BSS_W08, K2_BSS_W11, K2_BSS_W17
In terms of skills		
PEU_U01	The student is able to plan and perform calculations of the electronic structure of molecular systems using selected methods of density functional theory or wave function theory and interpret their results. In particular, s/he is able to determine the equilibrium structure of molecules and the geometry of the transition state, the harmonic vibrational frequencies and the vertical spectrum of electronic states.	K2_BSS_U02, K2_BSS_U03, K2_BSS_U04, K2_BSS_U05, K2_BSS_U09, K2_BSS_U12
PEU_U02	The student is able to predict and interpret the results of spectroscopic measurements based on calculations using molecular quantum mechanics methods.	K2_BSS_U02, K2_BSS_U03, K2_BSS_U04, K2_BSS_U05, K2_BSS_U09, K2_BSS_U12
PEU_U03	The student is able to determine the mechanisms of chemical reactions based on calculations using quantum chemistry methods.	K2_BSS_U02, K2_BSS_U03, K2_BSS_U04, K2_BSS_U05, K2_BSS_U09, K2_BSS_U12
In terms of social competences		
PEU_K01	Is able to critically evaluate the knowledge possessed and the content received and to recognize the importance of knowledge in solving problems within the field of study and related sciences; recognizes the need to seek expert opinion in the event of difficulties in solving problems.	K2_BSS_K01, K2_BSS_K08

Program content ensuring learning outcomes

The aim of the lecture, supplemented by exercises and a computer laboratory, is to familiarize the audience with the fundamentals of molecular quantum mechanics and modern electronic structure methods, as well as the possibilities of practical application of these methods for the interpretation and support of experimental research.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30

Laboratory	30
Classes	15
Preparaton for classes	16
Self-study of class topics	30
Preparation of a report/summary/presentation/paper	15
Prepararation for an exam/credit	10
Credit/Exam	4
Student workload	**Hours** 150

Wrocław University of Science and Technology

Molecular Dynamics

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Bioinformatics	**Subject code** W3BSSBIIS.31PM.04754.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Subjects of basic education - mathematics
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 4 ECTS, Graded credit • Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Student knows the principles of hypothesis formulation, model building and theory formulation in the context of the concepts of biotechnology and chemistry development.	K2_BSS_W03
PEU_W02	Student has an expanded knowledge of the structure of matter and its mathematical description. Explains the laws of structure identification.	K2_BSS_W07
PEU_W03	Student knows the concepts of mechanics and molecular dynamics.	K2_BSS_W09
PEU_W04	Student has knowledge of mathematics, numerical and computational methods to the extent necessary for molecular modeling and correlating the obtained results with experimental and observational data.	K2_BSS_W11

PEU_W05	Student has an in-depth knowledge of science, life sciences, and engineering and technology that allows him to use the methods and concepts necessary to describe materials, chemical or biotechnological processes.	K2_BSS_W18
In terms of skills		
PEU_U01	Student selects and is able to use appropriate methods, techniques and research tools within the relevant field of study necessary to clarify the problem posed.	K2_BSS_U02
PEU_U02	Student uses computer software to process results and statistically analyze experimental data.	K2_BSS_U03
PEU_U03	Student is able to present the results of his own research in the form of an independently prepared written paper.	K2_BSS_U06
PEU_U04	Student can apply methods of molecular mechanics and dynamics to solve chemical problems and use algorithms of differentiation, integration and trajectory analysis.	K2_BSS_U10
In terms of social competences		
PEU_K01	Student is ready to critically evaluate the knowledge he possesses and the content he receives.	K2_BSS_K01
PEU_K02	Student is ready to recognize the importance of knowledge in solving problems in the field of the studied major and related sciences; he recognizes the need to consult experts in case of difficulties in solving problems.	K2_BSS_K08

Program content ensuring learning outcomes

The lecture on molecular dynamics is designed to familiarize students with the basic knowledge of statistical thermodynamics,
force field design, molecular dynamics calculation scheme, algorithms used in molecular dynamics simulations.

The computer laboratory is designed to familiarize students with performing basic calculations of molecular dynamics simulations.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Laboratory	30
Conducting literature research	15
Preparation of a report/summary/presentation/paper	45
Preparaton for classes	15
Prepararation for an exam/credit	15
Student workload	**Hours** 150

Wrocław University of Science and Technology

Introductory Statistics

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
Medicinal Chemistry

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSMDCS.31PM.04763.25

Lecture languages
English

Mandatoriness
Obligatory in specialty

Block
Subjects of basic education - mathematics

Semester	Activities, hours, ECTS and examination
Semester 1	• Classes: 15 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	The student is able to apply basic knowledge of descriptive statistics to analyze experimental data.	K2_BSS_U03
PEU_U02	The student is able to use various methods of data analysis using statistics.	K2_BSS_U03
PEU_U03	Student is able to solve basic problems from the descriptive statistics field and is able to present experimental data sets in an appropriate way.	K2_BSS_U03

Program content ensuring learning outcomes

1. Acquainting the student with the basics of descriptive statistics and possibilities of its practical usage.
2. Acquainting the student with possibilities of mathematical models utilization in analysis and interpretation of data.

Calculation of ECTS points

Activity form	Activity hours
Classes	15
Self-study of class topics	5
Self-development of practical skills	15
Preparation of a report/summary/presentation/paper	15
Student workload	**Hours** 50

Wrocław University of Science and Technology

Bioinformatics

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
Bioinformatics

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSBIIS.31PS.04755.25

Lecture languages
English

Mandatoriness
Obligatory in specialty

Block
Specialty subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 3 ECTS, Exam • Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	The student lists examples of available sequence, gene, genome, biological structure databases, as well as databases of biological, biochemical, and medical information; describes the types of information stored in each of them; presents the syntax of complex queries for the most important databases and explains the expected results of such queries.	K2_BSS_W14
PEU_W02	The student lists different measures of sequence similarity, compares their applicability, advantages, and disadvantages, explains how similarity is calculated, lists and compares sequence alignment methods, defines the statistical significance of similarity measures, and explains what it depends on. They explain the concept of homology and describe the relationship between homology and similarity; they also list and explain the basic types of homology.	K2_BSS_W14

PEU_W03	The student explains the concept of multiple sequence alignments (MSA), describes methods for calculating them, their computational complexity, and limitations. They explain the applications of MSA in the analysis of biological sequence evolution, homology recognition, representation of families and domains, annotation, and others. The student lists and characterizes various methods of phylogenetic analysis, the concept of evolutionary distance, and different methods for estimating it. They explain the basic assumptions of Bayesian statistics, Markov chains, and their applications in bioinformatics. The student describes the statistical evaluation of phylogenetic results using the bootstrap method as an example.	K2_BSS_W14
PEU_W04	The student explains the problem of theoretically predicting the structures of biological macromolecules, compares available methods for such predictions, and lists their advantages and limitations. They also list available databases of structures predicted by non-experimental methods and explain the significance of prediction reliability indicators in these databases.	K2_BSS_W14
PEU_W05	The student lists examples of tools for high-throughput experimental analyses used in bioinformatics, explains how they work, and provides examples of their applications. They also list examples of software tools for automating data processing and analysis.	K2_BSS_W14
In terms of skills		
PEU_U01	The student searches for biological sequences and structures, as well as biochemical and medical information in available databases by queries targeting textual and numerical descriptions; selects databases appropriate for the sought information, and uses complex queries and logical operators to filter out irrelevant results. They categorize, analyze, and aggregate the retrieved information.	K2_BSS_U11
PEU_U02	The student searches for sequences and structures of biopolymers by similarity and interprets the homology of search results based on the statistical significance of their similarity. They create similarity profiles and use them to find homologs with very low sequence similarity. The student utilizes cross-comparison tools to search for, e.g., genes encoding given or homologous proteins or to recognize the function of nucleic acid sequences.	K2_BSS_U11
PEU_U03	The student calculates, verifies, and visualizes multiple sequence alignments and uses them to create similarity profiles, perform comparative analysis, and analyze the evolution of sequences. They assess the reliability of the results using statistical methods.	K2_BSS_U11
PEU_U04	The student creates models of biomolecular structures predicted by computational methods or artificial intelligence, evaluates the quality and reliability of the obtained models, and visualizes the biomolecular models.	K2_BSS_U11

Program content ensuring learning outcomes

1. Utilizing databases of biological sequences and information related to genes, genomes, proteins, protein families, and biomolecular structures;
2. Understanding the concepts of homology and sequence similarity, various measures of similarity, their statistical significance and interpretation, to the extent necessary for comparative analysis of biological sequences;
3. Searching for homologous sequences, calculating and using similarity profiles, and analyzing relationships between sequences in homolog families;
4. Predicting protein structure and function, and assessing the quality of non-experimental biomolecular models;
5. Automating searches in bioinformatics databases as well as typical bioinformatics calculations and analyses using

custom scripts.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Laboratory	30
Prepararation for an exam/credit	11
Preparaton for classes	30
Preparation of a report/summary/presentation/paper	20
Credit/Exam	4
Student workload	**Hours** 125

Wrocław University of Science and Technology

Metabolomics

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Medicinal Chemistry	**Subject code** W3BSSMDCS.33PS.04764.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 15 h, 2 ECTS, Graded credit

Semester	Activities, hours, ECTS and examination
Semester 2	• Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	knows what an metabolomics is and knows the scope of its applicability	K2_BSS_W02, K2_BSS_W06, K2_BSS_W13, K2_BSS_W14
PEU_W02	knows what chemometry is and knows the basic methods of data analysis	K2_BSS_W02, K2_BSS_W06, K2_BSS_W13, K2_BSS_W14
PEU_W03	knows how to use databases	K2_BSS_W02, K2_BSS_W06, K2_BSS_W13, K2_BSS_W14

PEU_W04	knows the NMR and MS measurement methods and knows how they can be used in metabolomic studies	K2_BSS_W02, K2_BSS_W06, K2_BSS_W13, K2_BSS_W14
PEU_W05	knows modern trends in research analytics: proteins, nucleic acids and low-molecular metabolites	K2_BSS_W02, K2_BSS_W06, K2_BSS_W13, K2_BSS_W14
In terms of skills		
PEU_U01	can read chemical graphs PCA, OPLS, PLS and other analytical graphs in the field of chemometrics and statistics	K2_BSS_U03
PEU_U02	can assign the appropriate procedure for sample preparation to the appropriate measurement method	K2_BSS_U03
PEU_U03	can construct complex questions in factographic databases and find and analyze professional literature	K2_BSS_U03, K2_BSS_U15
PEU_U04	can look for relationships between biochemical pathways based on metabolomic data	K2_BSS_U03
PEU_U05	can find currently implemented grants on a given topic and can plan any metabolomics research carried out by means of NMR spectroscopy and MS mass spectrometry	K2_BSS_U03
In terms of social competences		
PEU_K01	student is able to work in a group, performing various roles including group leader	K2_BSS_K01, K2_BSS_K06
PEU_K02	student is ready to critically evaluate his/her knowledge and received content	K2_BSS_K01, K2_BSS_K06

Program content ensuring learning outcomes

General information - metabolomics, tools, application
Metabolomics in systems biology
NMR nuclear magnetic resonance spectroscopy, MS mass spectrometry - major tools in metabolomics
Types and methods of sample preparation for metabolomic studies, protocols
Analysis of metabolites
Statistical analysis
Multidimensional analysis of PCA, PLS-DA, OPLS-DA data
Determination of metabolic pathways, interpretation of data
Analysis of metabolomics flows
Application of metabolomics in medical diagnostics

Calculation of ECTS points

Semester 1

Activity form	**Activity hours**
Lecture	15
Preparaton for classes	10
Self-study of class topics	10

Prepararation for an exam/credit	15
Student workload	**Hours** 50

Semester 2

Activity form	**Activity hours**
Laboratory	30
Preparaton for classes	10
Conducting literature research	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Medicinal and Biological Chemistry

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.31PK.04746.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Elective
Study form full-time studies	**Block** Major-specific subjects
Education profile general academic profile	

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Has knowledge of development trends and new achievements in the field of study. Knows th concepts and principles of intellectual property protection, patent and copyright protection in the context of the work being prepared diploma.	K2_BSS_W02
PEU_W02	Knows the methods and tools used for conducting a literature review in the field of a specific scientific research problem. Possesses knowledge of the fundamental principles of planning and conducting scientific research.	K2_BSS_W02
PEU_W03	Possesses structured and theoretically based knowledge of advanced methods of synthesis, identification and characterization of biomolecules and organization of a research laboratory.	K2_BSS_W02
In terms of social competences		
PEU_K01	Understands the connections between various areas of chemical sciences and/or technical and their practical aspects.	K2_BSS_K01

PEU_K02	Is ready to critically evaluate the knowledge possessed and the content received.	K2_BSS_K01

Program content ensuring learning outcomes

- Introduction to Biological and Medicinal Chemistry: The Role of Chemistry in Therapeutic Design
- Structure and Function of Macromolecules in Drug Design
- Enzymes as Therapeutic Targets
- Pharmacokinetics and Pharmacodynamics
- Drug Chemistry and Their Design
- Modern Research Methods in Therapy Design
- The Role of Chemistry in the Treatment of Viral Diseases
- Cancer Biochemistry and Anticancer Therapies: Classic and New Approaches
- Neurodegenerative Diseases and Neurological Therapies
- Immunotherapy in the Treatment of Autoimmune Diseases
- Biotechnology in Advanced Therapies: CAR-T and Biological Therapies
- Biochemistry of Metabolic Diseases and Metabolic Therapies
- Environmental Chemistry, Toxicology and Drug Safety
- Innovations in Drug Design: Future Prospects
- Practical Aspects of Therapy Design

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparation of a project	20
Student workload	**Hours** 50

Wrocław University of Science and Technology

Methodology of Experimental Research

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.31PK.04747.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Elective
Study form full-time studies	**Block** Major-specific subjects
Education profile general academic profile	

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Knows the basic aspects of ethics in science and research.	K2_BSS_W02
PEU_W02	Knows the basic types of scientific methods.	K2_BSS_W02
PEU_W03	Knows the principles of formulating hypotheses, building models and formulating theories in the context of the concept of the development of biotechnology and chemistry.	K2_BSS_W02
PEU_W04	Knows how to properly conduct experimental notes and write a research report	K2_BSS_W02
PEU_W05	Knows the basic research methods used in chemistry and biochemistry	K2_BSS_W02
In terms of social competences		
PEU_K01	Is able to work in a group	K2_BSS_K01

PEU_K02	Is able to understand the needs of other team members	K2_BSS_K01
PEU_K03	Is able to use empathy in creative designing	K2_BSS_K01

Program content ensuring learning outcomes

This course provides a comprehensive overview of the fundamental principles and methodologies used in experimental research. It begins by exploring basic scientific concepts and the various types of research methods, with a focus on their application in chemistry. Students will learn the process of constructing scientific laws and models, as well as techniques for interpreting and analyzing experimental data.
A key component of the course is understanding measurement errors, types of uncertainty, and strategies to minimize their impact on research outcomes. Participants will also gain practical skills in writing experimental reports and maintaining effective laboratory notes.
The course addresses the process of hypothesis testing, emphasizing critical thinking and analytical reasoning. Ethical considerations in science and research are thoroughly discussed, fostering a responsible and professional approach to experimentation.
Students are introduced to the design thinking methodology, including its stages: empathy, ideation, prototyping, and implementation. The course highlights the relationship between innovation and creativity, equipping students with tools to approach problem-solving systematically and creatively.
By the end of the course, participants will possess a solid foundation in experimental research methodology, enabling them to design, execute, and analyze experiments effectively while adhering to scientific and ethical standards.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparation of a project	10
Preparation of a report/summary/presentation/paper	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Bioprocess Project

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.31PK.04748.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Elective
Study form full-time studies	**Block** Major-specific subjects
Education profile general academic profile	

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	The student formulates kinetic equations of enzymatic reactions and microbial fermentation	K2_BSS_W02
PEU_W02	The student explains the principles of bioreactor design and calculates their parameters	K2_BSS_W02
PEU_W03	The student explains the basics of bioprocess design	K2_BSS_W02
PEU_W04	The student explains the separation processes and defines the principles of selected devices and apparatus	K2_BSS_W02
In terms of social competences		
PEU_K01	The student identifies problems and is ready to critically evaluate the design of a bioreactor	K2_BSS_K01
PEU_K02	The student identifies problems and is ready to critically evaluate separation processes	K2_BSS_K01

Program content ensuring learning outcomes

1. Familiarization with the bioreactor design
2. Familiarization with the basics of downstream process design
3. Cognition of separation processes and operation of selected equipment and apparatus

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparaton for classes	6
Preparation of a report/summary/presentation/paper	6
Prepararation for an exam/credit	6
Credit/Exam	2
Student workload	**Hours** 50

Wrocław University of Science and Technology

Advanced Polymers for Chemical and Medical Applications

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
-

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSS.31PK.04749.25

Lecture languages
English

Mandatoriness
Elective

Block
Major-specific subjects

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	has gained knowledge of special polymerization methods for formation of designed polymeric materials	K2_BSS_W02
PEU_W02	knows relations between polymerization processes, polymer morphologies, structure and resulting properties	K2_BSS_W02
PEU_W03	can list and describe main requirements for polymeric materials according to particular applications in the field of medicine and chemistry	K2_BSS_W02
PEU_W04	is able to describe main groups of advanced polymers applied in modern chemistry and medicine	K2_BSS_W02
PEU_W05	knows the potential of advanced polymeric materials in various fields as wello as their importance in green technologies	K2_BSS_W02
PEU_W06	knows the differences between polymers and other types of materials used in medicine and chemistry.	K2_BSS_W02

In terms of social competences		
PEU_K01	identifies problems related to the lecture topic and is able to work in a group to solve them	K2_BSS_K01

Program content ensuring learning outcomes

During the entire lecture, students will be provided with general knowledge about special polymerization methods as well as potential in preparation of precisely designed materials for medicine and chemistry. They will be acquainted with the relations between polymerization processes and the structure, morphology and resulting properties of polymers, as well as with the main requirements for polymeric materials according to designed applications. The aim of this will be to expand knowledge about the latest achievements in the field of advanced polymer materials produced for the needs of medicine and chemistry.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparaton for classes	10
Preparation of a report/summary/presentation/paper	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Networks and Workstations with UNIX System

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Bioinformatics	**Subject code** W3BSSBIIS.31PS.04756.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	

Semester	Activities, hours, ECTS and examination
Semester 1	• Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	Student recognizes unix mechanisms, builds the system from absolute minimum and and tailors to the needs, by creation or modification of proper configuration files or scripts.	K2_BSS_U13

Program content ensuring learning outcomes

Learning the mechanisms of unix system, and rules of computer network based on the internet protocol, by building the system in the environment controlled by QEMU program.
Developing skills for using unix systems at unassisted administration level.

Calculation of ECTS points

Activity form	Activity hours

Laboratory	30
Prepararation for an exam/credit	10
Preparaton for classes	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Spectroscopic Methods in Medicinal Chemistry

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Medicinal Chemistry	**Subject code** W3BSSMDCS.31PS.04765.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 2 ECTS, Exam • Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Possesses knowledge of spectroscopic methods of analysis. Possesses knowledge of the application of spectroscopy in analysis. Possesses knowledge of the application of spectroscopic methods in medical diagnostics.	K2_BSS_W02, K2_BSS_W06, K2_BSS_W13
PEU_W02	Possesses knowledge of methods for interpreting one-dimensional and two-dimensional nuclear magnetic resonance (NMR) spectra, as well as FT-IR and mass spectrometry spectra. Possesses knowledge of selected applications of mass and NMR spectrometry.	K2_BSS_W02, K2_BSS_W06, K2_BSS_W13
In terms of skills		
PEU_U01	Is able to prepare material for analysis. Is able to assess what methods to solve the current problem. Is able to analyze spectroscopic data.	K2_BSS_U02, K2_BSS_U08
In terms of social competences		

PEU_K01	Understands the connections between different areas of chemical and/or technical sciences and their practical aspects.	K2_BSS_K08

Program content ensuring learning outcomes

Introduction to spectroscopic methiods, basic knowledge of NMR, IR, Raman and UV-Vis spectroscopy and mass spectrometry, ability of the analysis and interpretation of spectra

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Laboratory	30
Self-study of class topics	16
Preparaton for classes	10
Credit/Exam	4
Self-development of practical skills	10
Student workload	**Hours** 100

Wrocław University of Science and Technology

Applied Informatics

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Bioinformatics	**Subject code** W3BSSBIIS.31PS.04757.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Laboratory: 60 h, 4 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	Student is familiar with basic commands of the Unix system	K2_BSS_U11, K2_BSS_U13
PEU_U02	Student knows the basic concepts of developing a computer program	K2_BSS_U11, K2_BSS_U13
PEU_U03	Student knows the organization of data in the databases	K2_BSS_U11, K2_BSS_U13
In terms of social competences		
PEU_K01	Student is capable of teamwork	K2_BSS_K08

Program content ensuring learning outcomes

1. Familiarizing students with basics of Unix environment

2. Familiarizing students with concepts of procedural and object-oriented programming
3. Basic management of databases

Calculation of ECTS points

Activity form	**Activity hours**
Laboratory	60
Self-study of class topics	20
Prepararation for an exam/credit	20
Student workload	**Hours** 100

Wrocław University of Science and Technology

Analytical Methods in Drug Design and Technology

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Medicinal Chemistry	**Subject code** W3BSSMDCS.31PS.04766.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 15 h, 2 ECTS, Graded credit • Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	A student has knowledge on good laboratory practice (GLP) rules, good manufacture practice (GMP) rules, and validation procedures necessary to be used in analytical methods.	K2_BSS_W02
PEU_W02	A student has knowledge about the modern chromatographic, spectroscopic, electrochemical and mixed analytical techniques and their applications in drug design and technological process of drugs production.	K2_BSS_W06
PEU_W03	The student knows the advantages and disadvantages of analytical techniques and knows what it means to assess the sensitivity level of each of them.	K2_BSS_W02, K2_BSS_W06
In terms of skills		

PEU_U01	A student has skills of use chromatographic techniques for separation of a mixture of different compounds, to detect them, do interpretation of the results and prepare the report according to GLP.	K2_BSS_U08
PEU_U02	The student has the skills to use various types of spectrometric devices and is able to prepare samples for analysis using various methods.	K2_BSS_U03, K2_BSS_U08
PEU_U03	A student has skills to do the analysis of the biologically active compounds using electrochemical methods, do interpretation of the results and prepare the report according to GLP.	K2_BSS_U01, K2_BSS_U03, K2_BSS_U08
PEU_U04	A student has skills to detect the biologically active compounds in a drug formulation using physical and physicochemical methods.	K2_BSS_U08

Program content ensuring learning outcomes

1. To acquaint student with the theoretical and practical aspects of good laboratory practice (GLP) and good manufacture practice (GMP).
2. Gaining of the knowledge on the modern chromatographic techniques and their applications in drug design and technological process of drugs production.
3. Acquaintance with the different technological concepts of application of spectroscopic methods in drugs design and quality control in the production system.
4. Expanding the knowledge in the field of electrochemical methods applications in the design of biologically active compounds and the production procedures of them.
5. Acquaintance with the different concepts in the field of mixed analytical methods.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	15
Laboratory	30
Prepararation for an exam/credit	15
Preparaton for classes	18
Preparation of a report/summary/presentation/paper	20
Credit/Exam	2
Student workload	**Hours** 100

Wrocław University of Science and Technology

Crystallography and Structure of Solids

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Medicinal Chemistry	**Subject code** W3BSSMDCS.31PS.04767.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 2 ECTS, Graded credit • Classes: 15 h, 1 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Knowledge of the structure and symmetry of crystals	K2_BSS_W07
PEU_W02	Knowledge of the international symbols and graphical representation of space groups and the international symbols of crystal classes	K2_BSS_W07
PEU_W03	Knowledge of the relationships between a diffraction pattern and crystal structure	K2_BSS_W07, K2_BSS_W18
PEU_W04	Knowledge of directions of development of crystallography	K2_BSS_W07, K2_BSS_W18
In terms of skills		
PEU_U01	Ability to study scientific literature on crystal structures and evaluate crystal data	K2_BSS_U01, K2_BSS_U02

In terms of social competences		
PEU_K01	Ability to take part in discussions on crystallographic structural studies	K2_BSS_K01

Program content ensuring learning outcomes

The historical and current definitions of crystals and crystallography. The internal structure of crystals. A crystal lattice, row lines, lattice planes, Miller symbols, a unit cell and cell types. The mosaic structure of real crystals, dislocations. The internal symmetry of crystals. Symmetry elements and operations. Relationships between the internal and external symmetry of crystals. Crystal systems vs symmetry. Crystal systems and cell parameters. The conventional choice of unit cells. The Bravais unit cells. Space groups: international symbols and graphical representations. An asymmetric unit cell. Relationships between the symbol of a space group and the symbol of a point group (crystal class). The types of point groups. Examples of crystal structures. Crystallographic databases. X-rays: properties and sources. Synchrotron radiation: sources of the first, second, third and fourth generations and properties. Synchrotron crystallographic studies. The directions and intensities of diffracted beams. Factors influencing the directions and intensities. The phase problem. Diffraction pattern vs internal structure and symmetry of crystals. Neutronography and electronography vs roentgenography. Crystallographic information files (cif). Nanocrystals. The quantitative and qualitative definition. The internal structure of nanocrystals vs macrocrystals. Defects. External appearance. Diffraction in nanocrystals vs diffraction in microcrystalline materials. The broadening and shifting of peaks in powder diffraction patterns. Apparent lattice parameters: determination and influencing factors. Properties. Synchrotron crystallographic studies of nanocrystals. Quasi crystals: 1D, 2D and 3D-dimensional. Internal and external structure. Diffraction. Properties. Crystallographic data in scientific papers.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Classes	15
Preparaton for classes	10
Prepararation for an exam/credit	18
Credit/Exam	2
Student workload	**Hours** 75

Wrocław University of Science and Technology

Isolation and Identification of Bioproducts

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Medicinal Chemistry	**Subject code** W3BSSMDCS.31PS.04768.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	knows the classification of chromatographic methods and the principles of chromatographic separation.	K2_BSS_W05
PEU_W02	knows the types of applications of chromatographic techniques in various fields of science.	K2_BSS_W05
PEU_W03	understands the operating principle of analytical equipment.	K2_BSS_W05
In terms of skills		
PEU_U01	can perform analyses using analytical equipment.	K2_BSS_U02
PEU_U02	can conduct a scientific experiment.	K2_BSS_U02
PEU_U03	can determine the concentration of organic compounds in an unknown sample using analytical equipment.	K2_BSS_U02

PEU_U04	can prepare a report from the experiment in the form of a scientific article.	K2_BSS_U02, K2_BSS_U03
PEU_U05	can plan a scientific experiment.	K2_BSS_U02, K2_BSS_U03
In terms of social competences		
PEU_K01	The student is open to teamwork, respects workplace safety rules and standards in the laboratory, adheres to guidelines regarding quality and ethics, and takes on challenges focused on solving problems for the common good.	K2_BSS_K08

Program content ensuring learning outcomes

Familiarization with the classification of chromatographic methods.
Familiarization with the operation and software of gas chromatography.
Understanding the impact of chromatographic experiment parameters on the separation of organic compounds.
Familiarization with issues related to qualitative and quantitative analysis.
Learning methods for identifying compounds released into the environment.
Introduction to the basics of thin-layer chromatography.

Calculation of ECTS points

Activity form	**Activity hours**
Laboratory	30
Preparation of a project	10
Preparation of a report/summary/presentation/paper	8
Credit/Exam	2
Student workload	**Hours** 50

Wrocław University of Science and Technology

Mediation and Negotation

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
-

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSS.31HS.04570.25

Lecture languages
English

Mandatoriness
Elective

Block
Subjects from the fields of humanities or social sciences

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 15 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	The student has knowledge in the scope of mediation and negotiation	K2_BSS_W16
In terms of social competences		
PEU_K01	The student is able to interact and work in a group, taking various roles in it and is able to think critically and argue your position	K2_BSS_K02
PEU_K02	The student has knowledge in the scope of mediation and negotiation	K2_BSS_K03, K2_BSS_K07

Program content ensuring learning outcomes

1. To familiarize students with knowledge of the theory of negotiation
2. Mastering the skills of independent negotiation in economic and social structures

3. Mastering the skills of building negotiation strategies, crisis management and management conflicting.

Calculation of ECTS points

Activity form	Activity hours
Lecture	15
Self-study of class topics	10
Self-development of practical skills	15
Prepararation for an exam/credit	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Soft Skills for Engineers

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.31HS.04571.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Elective
Study form full-time studies	**Block** Subjects from the fields of humanities or social sciences
Education profile general academic profile	

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 15 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	It describes the economic, legal, and ethical conditions and consequences related to professional activities and identifies key issues concerning technical safety.	K2_BSS_W16
In terms of social competences		
PEU_K01	Open to entrepreneurial thinking and action, with an awareness of the importance of working for the public interest. Values and supports initiatives that contribute to the common good.	K2_BSS_K02
PEU_K02	Actively identifies social and economic problems, takes on challenges related to their resolution, and is prepared to undertake diverse initiatives for the socio-economic environment.	K2_BSS_K03

PEU_K03	Aware of the social role of a technical university graduate, understanding the importance of professional and ethical responsibility in engineering work. Accepts the necessity of upholding the ethos of the engineering profession, ensuring high standards and adherence to ethical and professional principles.	K2_BSS_K07

Program content ensuring learning outcomes

The subject curriculum covers issues related to soft skills that complement their technical expertise. The subject emphasizes communication, leadership, teamwork, problem-solving, and emotional intelligence in both personal and professional settings. By the end of the course, participants will be able to enhance their effectiveness in collaborative work environments, leadership roles, and client interactions.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	15
Preparaton for classes	25
Prepararation for an exam/credit	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Foreign Language 2.1

Educational subject description sheet

Basic information

Field of study
lektoraty

Speciality
-

Organizational unit
Wrocław University of Science and Technology

Study level
second degree

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
PWRSJOS.97JO.02684.25

Lecture languages
English

Mandatoriness
Elective

Block
Foreign languages

Semesters	Activities, hours, ECTS and examination
Semester 1, Semester 2, Semester 3	• Classes: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	Student has knowledge, skills and competences consistent with the requirements specified for the minimum B2 level according to the Common European Framework of Reference for Languages; knows, understands and uses linguistic means (grammatical, lexical and stylistic) from academic, specialist and technical languages used in the field of study and in the academic and professional environment; communicates in an intercultural and professional environment; understands and has the ability to analyze foreign-language specialist texts; improves their skills in the area of specialized and academic languages.	SJO_S2_U01

Program content ensuring learning outcomes

B2 plus English, French, Spanish, GermanC1 plus English languageGeneral educational content

Formation and deepening of communicative competence in academic and professional settings.
Interaction appropriate to the appropriate level of linguistic competence, such as the student's own profile for academic and professional purposes. Deepening creative, receptive and interactive competence in a team.
Language in communication in specialized and professional fields in the modern world. Verbal and non-verbal communication - functioning freely in an intercultural environment, conducting discourse, polemics, analysis of specialized texts.

Calculation of ECTS points

Activity form	**Activity hours**
Classes	30
Preparaton for classes	30
Student workload	**Hours** 60

Wrocław University of Science and Technology

Graduation Proseminar

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.31PK.04577.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory elective
Study form full-time studies	**Block** Major-specific subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Seminar: 15 h, 1 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	The student is able to choose a thesis topic based on lecturers' presentations.	K2_BSS_U08
In terms of social competences		
PEU_K01	Student is ready to critically evaluate the knowledge he possesses and the content he receives.	K2_BSS_K01
PEU_K02	Student is aware of the social role of a technical college graduate.	K2_BSS_K07

Program content ensuring learning outcomes

To acquaint the student with the research offer and potential implementation of the master's thesis proposed by the lecturers of the Biosciences course.

Calculation of ECTS points

Activity form	Activity hours
Seminar	15
Conducting literature research	10
Student workload	**Hours** 25

Wrocław University of Science and Technology

Advanced Programming and Numerical Methods

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Bioinformatics	**Subject code** W3BSSBIIS.32PS.04758.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Laboratory: 45 h, 3 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Student is familiar with methods of efficient code development	K2_BSS_W17
PEU_W02	Student knows the common sorting algorithms	K2_BSS_W17
PEU_W03	Student understands the basics of code optimization	K2_BSS_W17
In terms of skills		
PEU_U01	Student is able to apply a random number generator in Monte Carlo algorithms	K2_BSS_U11, K2_BSS_U13
PEU_U02	Student is able to design and implement an algorithm for different algorithms for function analysis	K2_BSS_U11, K2_BSS_U13
PEU_U03	Student is able to develop the code for numerical integration of Newton equations of motion	K2_BSS_U11, K2_BSS_U13
In terms of social competences		

PEU_K01	Student is able to work in team	K2_BSS_K04

Program content ensuring learning outcomes

1. Random number generation
2. Function analysis
3. Molecular Dynamics Algorithms

Calculation of ECTS points

Activity form	**Activity hours**
Laboratory	45
Preparation of a project	15
Preparation of a report/summary/presentation/paper	15
Student workload	**Hours** 75

Wrocław University of Science and Technology

Bionanotechnology

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Bioinformatics	**Subject code** W3BSSBIIS.32PS.04759.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 30 h, 2 ECTS, Exam • Seminar: 15 h, 1 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Student knows the basic concepts of nanobiotechnology and bionanotechnology.	K2_BSS_W07, K2_BSS_W13, K2_BSS_W18
PEU_W02	He knows the basic concepts, models and methods of molecular mechanics and dynamics.	K2_BSS_W07, K2_BSS_W09, K2_BSS_W11, K2_BSS_W13
In terms of skills		
PEU_U01	Can present the objectives and results of scientific work in the form of an oral presentation using modern multimedia techniques.	K2_BSS_U07
In terms of social competences		
PEU_K01	Student is aware of the social role of a technical college graduate.	K2_BSS_K07

Program content ensuring learning outcomes

Lectures to familiarize the student with the basic conceptual principles of bionanotechnology in the context of biomolecule design.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Seminar	15
Conducting literature research	15
Preparation of a report/summary/presentation/paper	11
Credit/Exam	4
Student workload	**Hours** 75

Wrocław University of Science and Technology

Advanced Bioinformatics

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Bioinformatics	**Subject code** W3BSSBIIS.32PS.04760.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Project: 45 h, 3 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	Students prepare configure and test system images with software packages and services required to run bioinformatics related computation, data processing and analysis on remote computing facilities (“cloud computing”).	K2_BSS_U11, K2_BSS_U13
PEU_U02	The student develops, documents, and archives programming solutions (algorithm code), descriptions of conducted analyses, and visualization of results using interactive notebooks, online repositories, and version control systems.	K2_BSS_U11, K2_BSS_U13
PEU_U03	The student analyzes the newest generation sequencing results, from the initial processing of experimental data to mapping the results onto a reference genome; they develop, visualize, and interpret the outcomes of such analyses.	K2_BSS_U11

PEU_U04	The student uses the GNU R package and Bioconductor libraries to process and analyze typical bioinformatics experimental datasets available in online databases, develops, and documents the results.	K2_BSS_U11, K2_BSS_U13
In terms of social competences		
PEU_K01	The student is capable of collaborating within a team on project execution, takes responsibility for their part of the work, and identifies and solves problems. They are open to discussion, accept constructive criticism, and defend their decisions and solutions.	K2_BSS_K04

Program content ensuring learning outcomes

1. Utilizing remote computational services such as Cloud Computing, as well as preparing and configuring software packages for deployment in such services;
2. Documenting and archiving the entire process of creating, testing, and developing specialized software for processing bioinformatics datasets using Jupyter notebooks, online repositories, and version control systems;
3. Analyzing NGS sequencing results: filtering low-quality reads (trimming), mapping reads to genomic positions, and analyzing and visualizing results;
4. Using the GNU R and Bioconductor packages to conduct bioinformatics analyses of experimental results.

Calculation of ECTS points

Activity form	**Activity hours**
Project	45
Preparaton for classes	10
Preparation of a project	15
Preparation of a report/summary/presentation/paper	5
Student workload	**Hours** 75

Wrocław University of Science and Technology

Data Mining

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Bioinformatics	**Subject code** W3BSSBIIS.32PS.02596.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Laboratory: 15 h, 1 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	Proficiency in the basic concepts of data mining, data visualization, data mining techniques and their application to real-world contexts.	K2_BSS_U02
PEU_U02	Modifies and adapts the stages of data exploration to new datasets.	K2_BSS_U02
In terms of social competences		
PEU_K01	Effective communication and integration of data-driven conclusions into decision-making processes.	K2_BSS_K05

Program content ensuring learning outcomes

1. Gain a foundational understanding of data mining.

2. Explanation of the steps in the data mining process.
3. Analyzing data using statistical and machine learning methods.
4. Presentation of methods for evaluating the quality of models.

Calculation of ECTS points

Activity form	**Activity hours**
Laboratory	15
Prepararation for an exam/credit	5
Preparaton for classes	5
Student workload	**Hours** 25

Wrocław University of Science and Technology

Modern Pharmaceuticals and Biopharmaceuticals

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Medicinal Chemistry	**Subject code** W3BSSMDCS.32PS.04769.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 30 h, 2 ECTS, Exam • Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	A student has knowledge on the distribution of medicines and medical products on the basic groups.	K2_BSS_W02, K2_BSS_W07
PEU_W02	A student has knowledge on the methods of obtaining biologically active substances and the elementary production processes units in the area of pharmaceutical technology and biopharmacy.	K2_BSS_W02, K2_BSS_W06, K2_BSS_W18
PEU_W03	A student can define the various forms of medicines and medical devices, and has knowledge on the technology of receiving them.	K2_BSS_W02, K2_BSS_W18
PEU_W04	A student has knowledge on the generally applicable operating in the pharmaceutical industry and related sectors quality standards, concerning the manufacturing process and the final product, taking into account REACH directive.	K2_BSS_W02, K2_BSS_W06, K2_BSS_W12, K2_BSS_W18
In terms of skills		

PEU_U01	A student has skills in the qualitative and quantitative analysis of a pharmaceutical formulation, due to the principles of proper samples preparation, precision and repetition in measurements and proper interpretation of the results.	K2_BSS_U02, K2_BSS_U05
PEU_U02	A student has the ability to prepare simple biopharmaceutical preparation.	K2_BSS_U02, K2_BSS_U05
PEU_U03	A student has skills in working in accordance with the principles of good laboratory practice (GLP), in the interpretation of the results of analyzes, error assessment, and the preparation of a laboratory report.	K2_BSS_U02, K2_BSS_U05
In terms of social competences		
PEU_K01	A student is able to interact in a group and to plan an experiment.	K2_BSS_K01, K2_BSS_K05, K2_BSS_K08
PEU_K02	A student is able to discuss the quality of an experimental result.	K2_BSS_K01, K2_BSS_K08
PEU_K03	A student works consciously and effectively in a sub-group to searches information and can subject them to critical analysis.	K2_BSS_K05, K2_BSS_K08

Program content ensuring learning outcomes

1. Acquaintance with the knowledge on the distribution of medicinal products and medical devices on basic groups, according to their mechanism of action on the human body.
2. Acquaintance with issues of the elementary production processes units in the area of pharmaceutical technology and biopharmacy.
3. Acquaintance with the generally applicable operating in the pharmaceutical industry and related sectors quality standards, concerning the manufacturing process and the final product, including the ways of managing waste and REACH requirements.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Laboratory	30
Self-study of class topics	16
Credit/Exam	4
Conducting empirical studies	10
Preparation of a report/summary/presentation/paper	10
Student workload	**Hours** 100

Wrocław University of Science and Technology

Medicinal Natural Products

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
Medicinal Chemistry

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSMDCS.32PS.04770.25

Lecture languages
English

Mandatoriness
Obligatory in specialty

Block
Specialty subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 15 h, 2 ECTS, Exam • Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Defines fundamental concepts in the fields of phytochemistry and pharmacognosy.	K2_BSS_W03, K2_BSS_W12, K2_BSS_W15, K2_BSS_W18
PEU_W02	Identifies groups of chemical compounds determining the medicinal properties of plant substances and preparations.	K2_BSS_W15, K2_BSS_W18
PEU_W03	Identifies the basic chemical structures of coumarins, flavonoids, terpenoids, and alkaloids, along with their actions and applications.	K2_BSS_W15, K2_BSS_W18
PEU_W04	Identifies the main biosynthetic pathways and building blocks of plant secondary metabolites.	K2_BSS_W03, K2_BSS_W15, K2_BSS_W18
PEU_W05	Characterizes methods for isolating biologically active compounds from plant material.	K2_BSS_W12, K2_BSS_W15

In terms of skills		
PEU_U01	Plans safe practices for working in an organic chemistry laboratory.	K2_BSS_U02
PEU_U02	Organizes the proper execution of a planned chemical experiment.	K2_BSS_U02
PEU_U03	Demonstrates the use of appropriate laboratory methods for the isolation, purification, and identification of a compound.	K2_BSS_U02
PEU_U04	Analyzes the obtained results, interprets them, draws correct conclusions, and prepares a written report of the conducted experiment.	K2_BSS_U02
In terms of social competences		
PEU_K01	Is capable of working in a team while conducting an experiment.	K2_BSS_K04
PEU_K02	Is responsible for effectively organizing their own work, critically assessing their knowledge, and evaluating the progress of the tasks being carried out.	K2_BSS_K04

Program content ensuring learning outcomes

Knowledge of key groups of active compounds present in plant material – their structure, properties, methods of isolation and identification, mechanism of action, activity, and sources.
Knowledge of methods for isolating and identifying biologically active compounds.
Ability to select appropriate isolation methods for specific plant materials.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	15
Laboratory	30
Preparaton for classes	12
Preparation of a report/summary/presentation/paper	7
Prepararation for an exam/credit	12
Credit/Exam	4
Self-study of class topics	20
Student workload	**Hours** 100

Wrocław University of Science and Technology

Rational Drug Design

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.32PK.04750.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory
Study form full-time studies	**Block** Major-specific subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	knows the basic principles of drug design	K2_BSS_W02, K2_BSS_W05, K2_BSS_W06, K2_BSS_W10, K2_BSS_W12, K2_BSS_W13, K2_BSS_W14, K2_BSS_W15, K2_BSS_W18
PEU_W02	defines different drug design techniques	K2_BSS_W06, K2_BSS_W10, K2_BSS_W12, K2_BSS_W13, K2_BSS_W14, K2_BSS_W15, K2_BSS_W18

PEU_W03	has basic knowledge of the costs and time horizon of drug design,	K2_BSS_W15
PEU_W04	understands the physiological and economic effects of medication.	K2_BSS_W14, K2_BSS_W15
In terms of social competences		
PEU_K01	identifies problems related to the design, distribution and use of drugs	K2_BSS_K01, K2_BSS_K06

Program content ensuring learning outcomes

the basics of drug design
the economic aspects of drug design
the computational methods in drug design

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Self-study of class topics	20
Student workload	**Hours** 50

Wrocław University of Science and Technology

Molecular Modeling

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.32PK.04751.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory
Study form full-time studies	**Block** Major-specific subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 15 h, 2 ECTS, Exam • Laboratory: 30 h, 2 ECTS, Graded credit • Seminar: 15 h, 1 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	The student lists and explains various coordinate systems used in molecular modeling, identifies the hybridization of atoms based on structural formulas, assigns molecular geometric parameters based on hybridization, presents the structure of organic molecules in the internal coordinate system, describes transformations between coordinate systems, determines the optimal geometry for intermolecular interactions, lists databases of biomolecular structures, explains basic concepts of molecular graphics, and provides examples of software used for visualization in molecular modeling.	K2_BSS_W08, K2_BSS_W11, K2_BSS_W17

PEU_W02	The student lists, characterizes, and compares the main groups of molecular modeling methods (empirical, semi-empirical, and non-empirical), describes the advantages, disadvantages, and applicability ranges of molecular mechanics and dynamics methods, semi-empirical quantum methods, density functional theory, as well as Hartree-Fock and post-HF methods. The student cites the postulates of quantum mechanics and defines the concepts of operators, eigenfunctions and eigenvalues, observables, the LCAO MO method, atomic and molecular orbitals, wavefunctions, antisymmetry, electron correlation, basis set, polarization and diffuse functions, HOMO and LUMO orbitals, and electronic excitations. They explain the process of calculating molecular orbitals and their energies using the Hückel method, describe the relationship between computational cost, the method used, and the size of the basis set, and provide examples of software used for molecular modeling with various methods.	K2_BSS_W08, K2_BSS_W09, K2_BSS_W11, K2_BSS_W14, K2_BSS_W17
PEU_W03	The student explains the concepts of interaction energy, the supermolecular method, and perturbation theory, listing quantum methods suitable and unsuitable for calculating interaction energy. The student lists the fundamental components of interaction energy and characterizes the basic properties of electrostatic, exchange, induction, and dispersion interactions, as well as their origins based on interaction theory. The student explains the concept of basis set superposition error (BSSE) and describes how to correct it. The student enumerates various components of interaction energy, describes their significance, and explains how they are addressed using molecular mechanics methods. The student identifies the potentially strongest possible interactions between given molecules and uses this to justify the structures of intermolecular complexes, defines the concept of a hydrogen bond, and selects computational methods appropriate for the accurate description of different types of interactions.	K2_BSS_W08, K2_BSS_W10, K2_BSS_W11, K2_BSS_W17
PEU_W04	The student defines and explains the concepts of local and global minima, transition states, geometry optimization, the Hessian matrix, and hybrid molecular modeling methods. They describe the applications of the Hessian matrix and explain how to distinguish between an energy minimum and a transition state. The student explains the concepts of a force field, docking, virtual screening, and the design of active compounds using receptor-based or ligand-based methods. They provide examples of software that implements the mentioned methods.	K2_BSS_W08, K2_BSS_W10, K2_BSS_W11, K2_BSS_W14, K2_BSS_W17
In terms of skills		
PEU_U01	The student creates three-dimensional models of molecular structures based on structural formulas using internal coordinates. They utilize specialized software for editing and visualizing molecular structures, geometry optimization, and calculating molecular physicochemical properties. The student designs, creates, tests, and applies parameterization of arbitrary chemical compounds necessary for modeling such compounds using molecular mechanics and dynamics methods.	K2_BSS_U10, K2_BSS_U12
PEU_U02	The student prepares complex molecular systems containing biological macromolecules for molecular dynamics simulations, performs such simulations, and analyzes and interprets their results. They calculate and interpret intermolecular interactions and structural changes during molecular dynamics, as well as prepare visualizations of the obtained results.	K2_BSS_U05, K2_BSS_U10

PEU_U03	The student applies hybrid modeling methods, combining molecular mechanics and quantum chemistry to model chemical reactions in biological systems, calculates energy profiles of reaction pathways, and analyzes and visualizes the results of such calculations.	K2_BSS_U05, K2_BSS_U10, K2_BSS_U12
PEU_U04	The student uses computational methods applicable to drug design, such as interaction energy calculations, docking, and virtual screening, compares results for different compounds, and designs modifications to optimize interactions with the receptor.	K2_BSS_U05, K2_BSS_U10, K2_BSS_U12
PEU_U05	The student compiles a literature review on the application of molecular methods in the latest scientific research, prepares a presentation, and provides an explanation and conclusions based on the referenced literature reports.	K2_BSS_U05, K2_BSS_U07

Program content ensuring learning outcomes

- Construction and visualization of models of molecular systems and transformations between various coordinate systems (cartesian, internal and crystallograhic)
- Databases of molecular structures
- The basics of molecular orbital theory
- The basics of the theory of intermolecular interactions
- The basics of computational molecular modeling methods: ab initio, DFT, semiempirical and empirical
- Applications of molecular modeling to predict properties of molecular systems, interactions, chemical reactions, dynamics, design of enzymes and biologically active compounds.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	15
Laboratory	30
Seminar	15
Preparaton for classes	30
Prepararation for an exam/credit	6
Preparation of a report/summary/presentation/paper	25
Credit/Exam	4
Student workload	**Hours** 125

Wrocław University of Science and Technology

Retrieval of Scientific and Technical Information

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.32PK.04752.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory
Study form full-time studies	**Block** Major-specific subjects
Education profile general academic profile	

Semester	Activities, hours, ECTS and examination
Semester 2	• Laboratory: 15 h, 1 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	The student lists reliable sources of scientific information.	K2_BSS_W14
PEU_W02	The student describes forms of intellectual property protection.	K2_BSS_W04
In terms of skills		
PEU_U01	Student is able to prepare a scientific article in accordance with formal and substantive requirements.	K2_BSS_U06
PEU_U02	The student is able to effectively retrieve scientific literature.	K2_BSS_U15
PEU_U03	The student is proficient in utilizing selected chemical and patent databases for research purposes.	K2_BSS_U15
PEU_U04	The student searches for sources of research funding and opportunities for career planning.	K2_BSS_U14
In terms of social competences		

PEU_K01	The student is able to critically evaluate the quality and credibility of scientific information, the impact of scientific research, and research trends.	K2_BSS_K01
PEU_K02	Student is able to follow the code of ethics in science and to respect the copyright policies.	K2_BSS_K05

Program content ensuring learning outcomes

- Introducing selected topics related to scientific literature
- Familiarizing students with literature databases
- Familiarizing students with factographic databases in the fields of chemistry and biotechnology
- Introducing students to research funding opportunities
- Exploring selected topics in ethics in science

Calculation of ECTS points

Activity form	**Activity hours**
Laboratory	15
Preparation of a report/summary/presentation/paper	10
Student workload	**Hours** 25

Wrocław University of Science and Technology

Sociology for Engineers

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.32HS.04573.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Elective
Study form full-time studies	**Block** Subjects from the fields of humanities or social sciences
Education profile general academic profile	

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 30 h, 3 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Describes concepts related to norms, values, and social principles concerning the functioning of society, organizations, and entrepreneurship. Possesses knowledge of social processes, including management and organizational structures. Identifies elements related to the functioning of organizations, enterprises, groups, and teams.	K2_BSS_W16, K2_BSS_W19
In terms of social competences		
PEU_K01	Understands the need for critical and entrepreneurial thinking and action, and is also aware of the necessity to act in the public interest.	K2_BSS_K02
PEU_K02	Understands the need for organization, taking initiatives, inspiring others, and engaging in activities that benefit the socio-economic environment.	K2_BSS_K03

PEU_K03	Is aware of the social role of a technical university graduate and the necessity to uphold the ethos of the engineering profession.	K2_BSS_K07

Program content ensuring learning outcomes

The aim of the course is to provide knowledge about the mechanisms of social life, their essence, and their impact on the functioning of organizations, enabling students to understand the interdependencies among individuals, groups, and social structures. During the course, students also gain knowledge of social and professional roles and their social determinants, which facilitates a deeper understanding of human behavioral dynamics in various organizational and social contexts. An important aspect of the course is the development of critical thinking and analytical skills in relation to social phenomena occurring in both organizational and social environments. Consequently, students are prepared for conscious management of teams and organizations, taking into account social and cultural diversity as well as the significance of social norms and values.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparaton for classes	15
Prepararation for an exam/credit	15
Self-study of class topics	15
Student workload	**Hours** 75

Wrocław University of Science and Technology

Interpersonal Communication Skills

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
-

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSS.32HS.04574.25

Lecture languages
English

Mandatoriness
Elective

Block
Subjects from the fields of humanities or social sciences

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 30 h, 3 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Understands the economic, legal and ethical conditions of professional activity. Knows and understands issues related to technical safety.	K2_BSS_W16
PEU_W02	The student knows the concepts related to entrepreneurship and enterprise functioning.	K2_BSS_W19
In terms of social competences		
PEU_K01	The student has knowledge in the scope of base of interpersonal communications	K2_BSS_K02
PEU_K02	The student has basic knowledge concerning variety of communication and self-presentation techniques	K2_BSS_K03
PEU_K03	Verbal and non verbal communication and self-presentation skills, active listening.	K2_BSS_K07

Program content ensuring learning outcomes

Understanding of interpersonal communication process and acquiring knowledge how to communicate more effectively with other people.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Prepararation for an exam/credit	10
Self-development of practical skills	20
Preparaton for classes	5
Self-study of class topics	10
Student workload	**Hours** 75

Wrocław University of Science and Technology

Principles of Entrepreneurship and Innovation

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
-

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSS.32HS.04575.25

Lecture languages
English

Mandatoriness
Elective

Block
Subjects from the fields of humanities or social sciences

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 30 h, 3 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Characterizes the main concepts and ideas related to entrepreneurship and the functioning of enterprises, particularly those concerning entrepreneurship, innovation, and organizational structures.	K2_BSS_W16, K2_BSS_W19
In terms of social competences		
PEU_K01	Demonstrates a readiness for entrepreneurial thinking and action and is aware of the need to work for the public interest and the socio-economic environment.	K2_BSS_K02, K2_BSS_K03
PEU_K02	Is aware of the social role of a technical university graduate and the necessity of upholding the ethos of the engineering profession in activities undertaken both in professional work and beyond.	K2_BSS_K07

Program content ensuring learning outcomes

The aim of the course is to introduce students to the fundamental concepts of entrepreneurship, with a particular focus on the functioning of small and medium-sized enterprises, which constitute a vital part of the economy. Additionally, the course aims to provide an introduction to the topic of innovation, emphasizing innovative entrepreneurship as a key factor in the development of modern organizations. As a result, students will gain knowledge enabling them to understand the mechanisms of running a business and the importance of innovation in creating a competitive advantage.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparaton for classes	15
Prepararation for an exam/credit	15
Self-study of class topics	15
Student workload	**Hours** 75

Wrocław University of Science and Technology

Principles of Business

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality -	**Subject code** W3BSSS.32HS.04576.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Elective
Study form full-time studies	**Block** Subjects from the fields of humanities or social sciences
Education profile general academic profile	

Semester	Activities, hours, ECTS and examination
Semester 2	• Lecture: 30 h, 3 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Has a general knowledge of the principles of establishment and operation of enterprises in various organisational and legal forms and of selected aspects of their management.	K2_BSS_W16, K2_BSS_W19
In terms of social competences		
PEU_K01	He/she is ready to think and act in an entrepreneurial way: he/she is able to propose and present a business idea (business plan) set in the context of existing technical and non-technical conditions, as well as assess its impact on the environment, while cooperating within forms of collective work organisation.	K2_BSS_K02, K2_BSS_K03, K2_BSS_K07

Program content ensuring learning outcomes

The objective of the course is to disseminate knowledge regarding the processes of establishing and managing an enterprise, with a particular focus on the sole proprietorship of individuals and the development of a business plan for a

small business. Additionally, the course aims to cultivate social competencies, namely the capacity to act in a creative and entrepreneurial manner, as well as to effectively determine priorities for the implementation of a task defined by oneself or others.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Prepararation for an exam/credit	15
Preparation of a report/summary/presentation/paper	30
Student workload	**Hours** 75

Wrocław University of Science and Technology

Foreign Language 2.2

Educational subject description sheet

Basic information

Field of study
lektoraty

Speciality
-

Organizational unit
Wrocław University of Science and Technology

Study level
second degree

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
PWRSJOS.97JO.02690.25

Lecture languages
English

Mandatoriness
Elective

Block
Foreign languages

Semesters	Activities, hours, ECTS and examination
Semester 1, Semester 2, Semester 3	• Classes: 60 h, 3 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	Student has knowledge, skills and competences consistent with the requirements specified for the appropriate language level; knows, understands and uses linguistic means (grammatical, lexical and stylistic) defined at a certain level from everyday life with selected elements of academic, specialist and technical language used in the field of study and in the academic and professional environment; communicates in a family, social and intercultural environment, practicing communication skills; appreciates the need to improve their skills in effective communication, develops competences in the area of communication language, basics of specialist and academic language	SJO_S2_U01

Program content ensuring learning outcomes

A1; A2; B1 French, Spanish, Japanese, German, Polish as a foreign language, Russian
General educational content
Formation and deepening of communicative competence in a family, social and intercultural environment and for a specific level for academic and professional needs.
Interaction appropriate to the appropriate level of language competence, e.g., the student's own profile and interests; presenting oneself, one's interests and ideas in environmental, academic and professional contexts. Developing creative, receptive and interactive competence in a group.
Language in communication in the modern world. Verbal and non-verbal communication - sensitivity to cultural differences, starting a conversation, joining in a discussion, moving on to the next points, summarizing statements, using characteristic phrases and expressions for a certain language level; taking part in various forms of interaction.

Calculation of ECTS points

Activity form	**Activity hours**
Classes	60
Preparaton for classes	30
Student workload	**Hours** 90

Wrocław University of Science and Technology

Graduate Laboratory I

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
-

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSS.32PK.04585.25

Lecture languages
English

Mandatoriness
Obligatory elective

Block
Major-specific subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 2	• Diploma thesis: 60 h, 6 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	conducts analysis of the professional literature and prepares a literature review in the form of a report	K2_BSS_U02, K2_BSS_U05
PEU_U02	develops a research plan, determines the purpose and scope of the diploma thesis, as well as simulation or experimental or computational methods necessary in the implementation of the diploma thesis	K2_BSS_U02
PEU_U03	carries out simulations or experiments or calculations in order to implement the thesis plan	K2_BSS_U02
In terms of social competences		
PEU_K01	respects copyright when preparing a literature review	K2_BSS_K01, K2_BSS_K05

PEU_K02	takes care of the quality of the diploma thesis, being aware of the need to properly prepare for the role of a technical university graduate and engineer on the labor market	K2_BSS_K01, K2_BSS_K07

Program content ensuring learning outcomes

- Methods of selecting and analysing sources of knowledge, including scientific literature
- Time management and management of the diploma project
- Principles of planning/designing and conducting research work
- Analysis of results and writing reports

Calculation of ECTS points

Activity form	**Activity hours**
Diploma thesis	60
Preparation of a report/summary/presentation/paper	30
Conducting literature research	40
Self-study of class topics	20
Student workload	**Hours** 150

Wrocław University of Science and Technology

Computational Genomics

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
Bioinformatics

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSBIIS.34PS.04761.25

Lecture languages
English

Mandatoriness
Obligatory in specialty

Block
Specialty subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 3	• Lecture: 15 h, 1 ECTS, Exam • Laboratory: 15 h, 1 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	The graduate has knowledge of the content and organization of genomic databases.	K2_BSS_W14
PEU_W02	The graduate has knowledge of the methods used for genome mapping, sequencing, assembly, and annotation.	K2_BSS_W02
PEU_W03	The graduate has knowledge of tools used for analyzing and comparing genomic sequences.	K2_BSS_W14, K2_BSS_W17
PEU_W04	The graduate has knowledge of methods used in transcriptomics and their applications.	K2_BSS_W14, K2_BSS_W17
In terms of skills		
PEU_U01	The graduate has the ability to select appropriate methods and tools depending on the research problem.	K2_BSS_U01

PEU_U02	The graduate possesses basic skills in quality control of sequencing data and is able to perform genome assembly using this data.	K2_BSS_U01
PEU_U03	The graduate is able to conduct basic analysis of transcriptomic data and visualize the results.	K2_BSS_U01
In terms of social competences		
PEU_K01	The graduate is aware of the ethical aspects related to genomic research and the challenges posed by data protection.	K2_BSS_K07

Program content ensuring learning outcomes

The course covers the organization, analysis, and processing of genomic information, focusing on databases, genome assembly, and structural, functional, and comparative genomics. Next-generation techniques and ethical and legal aspects of genomic research will also be discussed. Students will gain practical experience in genome annotation, transcriptomic analysis, and genome assembly tools during laboratory classes.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	15
Laboratory	15
Prepararation for an exam/credit	8
Preparation of a report/summary/presentation/paper	8
Credit/Exam	4
Student workload	**Hours** 50

Wrocław University of Science and Technology

Molecular Engineering in Genomic Analyses

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
Bioinformatics

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSBIIS.34PS.04762.25

Lecture languages
English

Mandatoriness
Obligatory in specialty

Block
Specialty subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 3	• Laboratory: 45 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Describes the basic molecular tools and techniques used for obtaining and analyzing DNA molecules	K2_BSS_W06
PEU_W02	Presents the techniques for isolation, amplification, and biochemical/biophysical description of DNA	K2_BSS_W06
PEU_W03	Describes techniques used for analyzing gene and genome sequences, as well as techniques for analyzing the expression and function of genes/genomes	K2_BSS_W06
PEU_W04	Presents the potential applications of genetic engineering in biotechnology, medicine, agriculture, archaeology, and other fields.	K2_BSS_W06
PEU_W05	Describes methods for editing DNA sequences	K2_BSS_W06
In terms of skills		

PEU_U01	Performs the isolation of genetic material from various sources	K2_BSS_U02, K2_BSS_U05, K2_BSS_U08
PEU_U02	Plans a restriction mixture and performs restriction digestion	K2_BSS_U08
PEU_U03	Performs agarose gel electrophoresis and interprets the obtained results	K2_BSS_U02, K2_BSS_U05, K2_BSS_U08
PEU_U04	Plans a PCR program for amplifying a specific gene fragment, designs PCR primers to allow the amplification of a specific fragment	K2_BSS_U02, K2_BSS_U08
PEU_U05	Uses bioinformatics tools to compare genomic sequences	K2_BSS_U03, K2_BSS_U08

Program content ensuring learning outcomes

Students attending the classes will become familiar with DNA analysis techniques used in biotechnology, medicine, agriculture, and archaeology. They will acquire skills in genetic material isolation. They will learn methods for detecting polymorphisms within gene sequences, techniques for analyzing the structure of genes/genomes, and for analyzing the expression and function of genes/genomes and their products.

Calculation of ECTS points

Activity form	**Activity hours**
Laboratory	45
Preparation of a report/summary/presentation/paper	5
Student workload	**Hours** 50

Wrocław University of Science and Technology

Inorganic Drugs

Educational subject description sheet

Basic information

Field of study Biosciences	**Education cycle** 2025/2026
Speciality Medicinal Chemistry	**Subject code** W3BSSMDCS.34PS.04771.25
Organizational unit Faculty of Chemistry	**Lecture languages** English
Study level second degree 3 semesters	**Mandatoriness** Obligatory in specialty
Study form full-time studies	**Block** Specialty subjects
Education profile general academic profile	**Subject related to scientific research** Yes

Semester	Activities, hours, ECTS and examination
Semester 3	• Lecture: 15 h, 1 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Student has general knowledge about metal-based inorganic drugs and metal-based diagnostic agents and knows the basic concepts in the field of inorganic medicinal chemistry.	K2_BSS_W02, K2_BSS_W03
PEU_W02	Student knows the structure of commonly used inorganic drugs and their physicochemical properties, reactivity, and mechanism of their action.	K2_BSS_W02, K2_BSS_W03
PEU_W03	Student has general knowledge about current development directions and the latest discoveries regarding the use of inorganic compounds in therapy and diagnostics.	K2_BSS_W02, K2_BSS_W03
PEU_W04	Student can distinguish particular groups of inorganic drugs and determine their use and therapeutic effect.	K2_BSS_W02, K2_BSS_W03

Program content ensuring learning outcomes

1. Medicinal inorganic chemistry: state of the art. Classification of metal-based drugs according to their mechanisms of action (essential elements, therapeutic agents, radiopharmaceuticals, metallomics, chelation therapy, enzyme mimics, contrast agents, protein/enzyme regulators). Design of therapeutic and diagnostic agents.
2. The concept of bond theory in medicinal inorganic chemistry: nomenclature, coordination geometry, chelating ligands, isomerism, kinetic and thermodynamic stability.
3. Metal compounds as therapeutic agents. (antibacterial and antiviral agents, antiparasitic drugs, antiarthritic drugs, antimalarial drugs, treatment of diabetes and obesity, redox-active metal-based mediators).
4. Metal-related metabolic disorders. (controversial drugs, heavy-metal poisoning, chelation therapy).
5. Medical diagnostics with the use of inorganic complexes and radioisotopes (MRI, MRA, PET, SPECT).
6. Discovery of cisplatin, synthesis, its mechanism of anticancer activity and the path to obtaining next generations of drugs based on platinum.
7. Search for non-platinum anticancer drugs with the interesting biological properties (drugs based on: Pd, Ti, Ga, As, Ru, Bi, V, Au).

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	15
Prepararation for an exam/credit	10
Student workload	**Hours** 25

Wrocław University of Science and Technology

Multistep Organic Synthesis

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
Medicinal Chemistry

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSMDCS.34PS.04772.25

Lecture languages
English

Mandatoriness
Obligatory in specialty

Block
Specialty subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 3	• Laboratory: 60 h, 3 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	Can follow a literature recipe, select and assemble appropriate equipment, and identify and characterize the obtained products.	K2_BSS_U02, K2_BSS_U04
PEU_U02	Is able to use scientific literature and professional databases to plan synthesis.	K2_BSS_U02, K2_BSS_U04
PEU_U03	Is able to select conditions for various transformations and plan methods of isolating and purifying products.	K2_BSS_U04
PEU_U04	Is able to measure basic physicochemical constants, interpret spectroscopic spectra of organic compounds and is able to independently interpret the results	K2_BSS_U04, K2_BSS_U05
In terms of social competences		
PEU_K01	is responsible for preparing the experiment and is able to discuss the results	K2_BSS_K08

Program content ensuring learning outcomes

Students gain proficiency in laboratory work using advanced experimental techniques of organic synthesis.
Ability to practically use various transformation methods in multi-step synthesis – creation of new C-C bonds, transformations on functional groups
Conducting a complex synthetic sequence based on literature data.

Calculation of ECTS points

Activity form	**Activity hours**
Laboratory	60
Preparaton for classes	5
Conducting literature research	5
Preparation of a report/summary/presentation/paper	5
Student workload	**Hours** 75

Wrocław University of Science and Technology

Machine Learning for Chemistry and Biology

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
-

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSS.34PK.04753.25

Lecture languages
English

Mandatoriness
Obligatory

Block
Major-specific subjects

Semester	Activities, hours, ECTS and examination
Semester 3	• Lecture: 30 h, 2 ECTS, Exam • Laboratory: 30 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Recognizes and lists the basic strategies and algorithms of supervised and unsupervised learning.	K2_BSS_W14
PEU_W02	Lists and explains common applications of machine learning methods in chemistry and biology.	K2_BSS_W01, K2_BSS_W14
PEU_W03	Is able to assess the strengths, weaknesses and limitations of individual machine learning methods in applications to various problems in the field of computational biology	K2_BSS_W01, K2_BSS_W09
PEU_W04	Has knowledge of good practices in training machine learning models to avoid overtraining and identify potential shortcomings in the training data set	K2_BSS_W01, K2_BSS_W14

PEU_W05	Lists and explains various forms of representation of the structure of bioorganic molecules, including commonly used geometry formats (xyz, pdb, zmat, smiles, smarts, sdf) as well as representations dedicated to machine learning	K2_BSS_W08
PEU_W06	Knows the formats and representations of data that can be used to train machine learning models	K2_BSS_W01, K2_BSS_W08
In terms of skills		
PEU_U01	Is able to effectively select and prepare a representative data set in the appropriate format for a given machine learning method	K2_BSS_U01, K2_BSS_U11
PEU_U02	Can apply supervised learning models for data classification	K2_BSS_U01, K2_BSS_U02
PEU_U03	Can apply unsupervised learning models for data clustering	K2_BSS_U01, K2_BSS_U02
PEU_U04	Can conceptually/schematically describe an algorithm to solve a given research problem or data analysis problem	K2_BSS_U01, K2_BSS_U11
PEU_U05	Can implement an algorithm to solve a given research problem or data analysis problem using the Python scripting language	K2_BSS_U01, K2_BSS_U02, K2_BSS_U04
PEU_U06	Can evaluate machine learning models and interpret the results they offer	K2_BSS_U01, K2_BSS_U04, K2_BSS_U11
In terms of social competences		
PEU_K01	Students are able to work in a group, performing various roles, including group leader	K2_BSS_K04
PEU_K02	Students are aware of the social role of an MSc in Bioinformatics	K2_BSS_K02
PEU_K03	Students are ready to critically evaluate his knowledge and the received content	K2_BSS_K01, K2_BSS_K05

Program content ensuring learning outcomes

1. Familiarizing students with the basics of machine learning and deep learning methods.
2. Familiarizing students with the possible applications of machine learning models in chemistry and biology.
3. Acquiring the ability to identify and apply the most appropriate machine learning method to solve a given research problem and analyze data.
4. Acquiring the ability to evaluate trained models and interpret the results.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Laboratory	30
Preparation of a project	15
Prepararation for an exam/credit	11

Preparation of a report/summary/presentation/paper	10
Credit/Exam	4
Student workload	**Hours** 100

Wrocław University of Science and Technology

Graduate Laboratory II

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
-

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSS.34PK.04591.25

Lecture languages
English

Mandatoriness
Obligatory elective

Block
Major-specific subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 3	• Diploma thesis: 210 h, 20 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	analyzes the professional literature and prepares a literature review as part of a diploma thesis	K2_BSS_U05
PEU_U02	conducts research work, including simulations or experiments or calculations, and then develops and interprets the results in order to implement the thesis plan	K2_BSS_U02, K2_BSS_U05
PEU_U03	prepares a manuscript of a diploma thesis	K2_BSS_U05, K2_BSS_U06
In terms of social competences		
PEU_K01	respects copyright when preparing a literature review	K2_BSS_K01, K2_BSS_K05
PEU_K02	takes care of the quality of the diploma thesis, being aware of the need to properly prepare for the role of a technical university graduate and engineer on the labor market	K2_BSS_K01, K2_BSS_K07

Program content ensuring learning outcomes

Methods of selecting and analysing sources of knowledge, including scientific literature
Time management and management of the diploma project
Principles of planning/designing and conducting research work
Analysis of results and writing reports

Calculation of ECTS points

Activity form	**Activity hours**
Diploma thesis	210
Preparation of the thesis	100
Self-study of class topics	50
Conducting literature research	100
Preparation of a report/summary/presentation/paper	40
Student workload	**Hours** 500

Wrocław University of Science and Technology

Graduation Seminar

Educational subject description sheet

Basic information

Field of study
Biosciences

Speciality
-

Organizational unit
Faculty of Chemistry

Study level
second degree 3 semesters

Study form
full-time studies

Education profile
general academic profile

Education cycle
2025/2026

Subject code
W3BSSS.34PK.04592.25

Lecture languages
English

Mandatoriness
Obligatory elective

Block
Major-specific subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 3	• Seminar: 15 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of skills		
PEU_U01	Student is able to develop research results, critically analyze them and formulate conclusions.	K2_BSS_U05
PEU_U02	Student can present the objectives and results of scientific work in the form of an oral presentation using modern information and communication techniques.	K2_BSS_U07
In terms of social competences		
PEU_K01	Student is open to critical reflection on his knowledge and analysis of the content he absorbs.	K2_BSS_K01, K2_BSS_K06, K2_BSS_K08
PEU_K02	Student is aware of the social role of a technical college graduate.	K2_BSS_K07

PEU_K03	Student is ready to recognize the importance of knowledge in solving problems in the field of the studied major and related sciences; he recognizes the need to consult experts in case of difficulties in solving problems.	K2_BSS_K06, K2_BSS_K08

Program content ensuring learning outcomes

The purpose of the class is to acquire the ability to orally and in writing present the objectives and results of work, and to get acquainted with the form of public discussion including defense of one's own position.

Calculation of ECTS points

Activity form	**Activity hours**
Seminar	15
Preparation of a report/summary/presentation/paper	35
Student workload	**Hours** 50