Wrocław University of Science and Technology

Study programme

Organizational unit:	Faculty of Chemistry
Field of study:	Advanced Nano and Biomaterials - MONABIPHOT
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:	Advanced Nano and Biomaterials - MONABIPHOT
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:	1125
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 engineering and technical sciences, Field of the exact and natural sciences

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

Discipline	Percentage
Material Engineering	60%
Chemical science	40%

Main discipline: Material Engineering

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

The alumnus has theoretical knowledge and skills enabling him to solve issues related to the design and characterization of modern materials, including nanomaterials, biomaterials and materials interacting with light. He/she has in-depth practical and theoretical knowledge of the field of advanced nano and biomaterials, he/she represents. Has the ability to interpret and quantitatively describe basic physicochemical phenomena, conduct laboratory and research work, and manage teams and organize the work of such teams. He/she fluently speaks specialized language in the field of research on bio and nanomaterials as well as liquid crystals and polymers. He/she is prepared to start studies at the Doctoral School. The alumnus knows the basics of programming and uses the Internet efficiently.

Possibility to apply for admission to the Doctoral School, postgraduate studies.

Currentness of the study programme

Concept and goals of education

The Advanced Nano and Biomaterials - MONABIPHOT Master's degree program provides comprehensive knowledge (both general and specialized) and skills in the area of materials engineering and chemical sciences. The studies are interdisciplinary in nature and are intended to provide candidates with extensive knowledge on various classes of materials, from polymers, through metallic materials and biomaterials, to nanomaterials and modern functional materials. The education is also aimed at familiarizing the candidate with appropriate research techniques (including microscopic and spectroscopic), techniques for materials' characterization and methods of determining their important physicochemical and mechanical parameters. Therefore, the basic aim of the studies is to provide students with balanced knowledge and familiarize them with the latest trends in science and technology, which is ensured by qualified scientific staff. The concept of studies is also based on the possibility of individualizing them through various thematic elective courses, including managerial courses providing business and interpersonal knowledge and skills. Many of the courses focus on developing skills in solving research, material and technical problems, or planning experiments. Great importance is attached to practical classes, which are related to the facilities of the departments and institutes where students carry out their diploma research. Thanks to education at Advanced Nano and Biomaterials - MONABIPHOT Master's studies, the candidate obtains the necessary qualifications to work in the international environment and R&D departments, e.g. of companies designing new materials desired in various industries or research centers.

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

The labor market needs in the field of Advanced Nano and Biomaterials - MONABIPHOT 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) Knows methods of producing metallic, polymeric and biomaterials. Understands the influence of various additives on the properties of manufactured materials, (2) Has basic knowledge of the selection and adjustment of a mathematical model to experimental data., (3) Is able to assess the behavior of nanomaterials and biomaterials as well as polymers in various conditions, (4) Is able to design experiments for nanomaterials, polymeric materials and biomaterials. (5) Is able to independently perform material tests using advanced techniques, and is able to analyze and interpret the obtained results. The expected learning outcomes are in line with the current needs of the sector of design, production and processing of modern materials used in various industries. The learning outcomes are tailored in such a way that the graduate is ready to start working in companies dealing with quality control and characterization of manufactured/processed modern organic materials, liquid crystals, nanomaterials, biomaterials and polymeric materials.

Other important factors determining the validity of the study programme

The Advanced Nano and Biomaterials - MONABIPHOT program has a long tradition and is based on the experience of the Faculty of Chemistry in supervising interdisciplinary and international studies. This study program is consistent with the expertise, experience, and scientific activities of the teaching staff representing natural sciences as well as field of engineering and technology, mainly in the disciplines such as materials engineering and chemical sciences. The unique perspective of experts from various fields on the same issues ensured the creation of a comprehensive and multidimensional study program. The scope and content of the courses are subjected to the updates aimed not only at regular modernization of the entire program, but also at making it more appealing to the candidates. The offer is supervised by an experienced committee, and in many cases the classes are conducted by scientists supervising research grants as well as young researchers (both before and after habilitation). Thus, the program is presented with passion and expertise that can be demonstrated only by the people who work every day in the covered topics. The classes encourage candidates to strongly focus on the ability to learn independently, solve research problems and to exhibit readiness to engage in various scientific topics. Hence, the courses are aimed at educating competent and versatile specialists, ready to think critically, seek original solutions, and take on the role of leaders. The study program has been shaped to respond to the growing market needs in terms of specialized materials, to address the complexity of contemporary research problems in the discipline of materials engineering, and the growing role of innovative material characterization techniques.

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 Advanced Nano and Biomaterials-Monabiphot 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 innovative chemical processes and material technologies, (5) developing social competences, with particular emphasis on the development of skills teamwork, (6) developing the ability to work using the project method.

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_ANB_W01	Has in-depth knowledge of the composition, method of synthesis and characterization of nanomaterials and biomaterials. Has knowledge of the applications of nanomaterials and biomaterials as well as the selection of the appropriate method for characterizing this type of materials.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_ANB_W02	Knows methods of producing metallic, polymeric and biomaterials. Understands the impact of various additives on the properties of manufactured materials.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_ANB_W03	Has structured knowledge of the physical fundamentals of the interaction of electric fields, magnetic fields and electromagnetic waves with a liquid crystal. Has knowledge of the classification of liquid crystals in terms of their structure, symmetry, factor causing the formation of mesophases and spatial structures.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_ANB_W04	Has in-depth knowledge of modern methods of imaging materials using various microscopic techniques.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_ANB_W05	Has basic knowledge of selecting and fitting a mathematical model to experimental data.	P7U_W, P7S_WG	
K2_ANB_W06	Knows the factors determining the mechanical and functional properties of the main engineering materials: metals, alloys, polymers and nanomaterials, knows their structure, examples of applications and the impact of additives on the properties of these materials.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_ANB_W07	Knows issues of the construction of lasers and other light sources and the generation of electromagnetic radiation in selected spectral ranges. Knows the effects of EM radiation on matter.	P7U_W, P7S_WG	P7S_WG_INŻ
K2_ANB_W08	Has structured, theoretically based general knowledge covering key issues in the field of spectroscopy. Knows the light sources used in spectroscopy. Knows new trends in spectroscopy.	P7U_W, P7S_WG	
K2_ANB_W09	Knows the concepts and principles of intellectual property protection, patent protection and copyright.	P7U_W, P7S_WK	
K2_ANB_W10	Has knowledge about authorized inference methods.	P7U_W, P7S_WK	
K2_ANB_W11	Knows the basic concepts of entrepreneurship and the functioning of an enterprise. Has basic knowledge of management processes and related organizational structures. Knows the basic elements of organizing a business.	P7U_W, P7S_WK	P7S_WK_INŻ
K2_ANB_W12	Has in-depth knowledge of the technology of combining materials using physical and chemical methods.	P7U_W, P7S_WG	P7S_WK_INŻ
K2_ANB_W13	Has knowledge of the chemical and physical characteristics of materials and their impact on their functional properties.	P7U_W, P7S_WG	
K2_ANB_W14	Understands the connection between the technology of obtaining materials and composites and their structure and properties.	P7U_W, P7S_WG	
K2_ANB_W15	Has general knowledge of research conducted in modern materials engineering and nanomaterials engineering.	P7U_W, P7S_WG	

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_ANB_W16	Lists and explains advanced processes in creating new materials and current trends in their development.	P7U_W, P7S_WG	
K2_ANB_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_ANB_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
Skills			
K2_ANB_U01	Is able to assess the behavior of nanomaterials, biomaterials and polymers in various conditions.	P7U_U, P7S_UW	P7S_UW_INŻ
K2_ANB_U02	Is able to design experiments for nanomaterials, polymeric materials and biomaterials.	P7U_U, P7S_UW, P7S_UK	P7S_UW_INŻ
K2_ANB_U03	Is able to conduct literature research on a specific scientific and research problem. Has basic skills in planning and conducting scientific research.	P7U_U, P7S_UK, P7S_UU	
K2_ANB_U04	Is able to conduct scientific experiments, develop and interpret their results and relate them to appropriate theories or scientific hypotheses. Is able to determine directions for further learning and implement the self-education process. Is able to apply the principles of safe work in a chemical laboratory.	P7U_U, P7S_UW, P7S_UK, P7S_UU	P7S_UW_INŻ
K2_ANB_U05	Is able to present the goals and results of his scientific work in the form of an oral presentation, using modern information and communication techniques. Is able to prepare, in Polish or a foreign language, a scientific study presenting the results of his/her own scientific research.	P7U_U, P7S_UW, P7S_UK	P7S_UW_INŻ
K2_ANB_U06	Has linguistic resources appropriate for a specialized language and is able to use the specialized language in all linguistic activities to communicate in a professional environment in the field of study, understands foreign language texts in his field of study and is able to interpret them.	P7U_U, P7S_UW, P7S_UK	
K2_ANB_U07	Applies microscopic techniques for qualitative and quantitative interpretation of chemical, physical and biological phenomena.	P7U_U, P7S_UW, P7S_UK	P7S_UW_INŻ
K2_ANB_U08	Is able to think critically and argue his position.	P7U_U, P7S_UK	
K2_ANB_U09	Is able to identify the priorities of his actions, both individually and when working in a group.	P7U_U, P7S_UW, P7S_UO	
K2_ANB_U10	Is able to independently plan and implement continuous training and guides others in this area.	P7U_U, P7S_UU	
K2_ANB_U11	Is able to determine the chemical, physicochemical and mechanical properties of materials and nanostructures.	P7U_U, P7S_UW, P7S_UK	
K2_ANB_U12	Uses information technologies to solve tasks, including engineering ones. Selects and applies mathematical and IT methods/tools in planning, designing, optimizing and analyzing experiments, objects and chemical processes.	P7U_U, P7S_UW	P7S_UW_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_ANB_U13	Is able to investigate photochemical phenomena occurring in nano and biomaterials.	P7U_U, P7S_UW, P7S_UK	P7S_UW_INŻ
K2_ANB_U14	Is able to conduct a research experiment in the field of liquid crystals.	P7U_U, P7S_UW, P7S_UK	
K2_ANB_U15	Is able to independently develop and present the state of knowledge based on scientific publications.	P7U_U, P7S_UW, P7S_UK	
K2_ANB_U16	Is able to independently perform material tests using advanced techniques, and is able to analyze and interpret the obtained results.	P7U_U, P7S_UW, P7S_UK	P7S_UW_INŻ
Social competence			
K2_ANB_K01	Is ready to critically evaluate his knowledge and received content.	P7U_K, P7S_KK	
K2_ANB_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_ANB_K03	Understands the need to take initiatives, inspire and organize activities for the benefit of the socio-economic environment.	P7U_K, P7S_KO	
K2_ANB_K04	Cooperates responsibly in the group, taking on various roles, including managerial ones.	P7U_K, P7S_KR	
K2_ANB_K05	Is ready to comply with the principles of professional ethics and respect the law, including copyright.	P7U_K, P7S_KR	
K2_ANB_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_ANB_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_ANB_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

Advanced Nano and Biomaterials - MONABIPHOT

Name	Value
Total ECTS	90
Total number of hours of classes	1125
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)	67/90 (74.44%)
Number of ECTS points allocated to classes developing practical skills (including laboratory, project) (P)	42.2
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)	46.4
Percentage of ECTS for elective courses	43/90 (47.78%)
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
The number of ECTS points that a student will receive by completing classes in basic sciences (mathematics, physics/chemistry)	4

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
Seminar	Multimedia presentations conducted and prepared individually or in groups; case study analysis, class participation, paper
Classes	Credit - oral, written; short test, input task, evaluation of the sub-tasks;
Diploma thesis	Evaluation of work in the preparation of a diploma thesis; diploma examination
Laboratory	Preparation of laboratory reports; oral statements, class participation; short test, input task, evaluation of the sub-tasks
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 (study programme) ends with a master thesis presentation and the diploma examination.

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 Advanced Nano and Biomaterials-Monabiphot 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 Advanced Nano and Biomaterials-Monabiphot 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

Advanced Nano and Biomaterials - MONABIPHOT

Semester 1

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Mathematical Methods in Planning and Analysis of Experiment	Laboratory: 30	Graded credit	2	Obligatory
Liquid Crystals for Photonics	Lecture: 30 Laboratory: 15	Lecture: Exam Laboratory: Graded credit	Lecture: 2 Laboratory: 1	Obligatory
Modern Polymers	Lecture: 30	Graded credit	2	Obligatory
Bioorganic Chemistry	Lecture: 30	Exam	3	Obligatory
Biophotonics	Lecture: 15 Seminar: 30	Lecture: Graded credit Seminar: Graded credit	Lecture: 2 Seminar: 2	Obligatory
Modern Spectroscopy	Lecture: 30	Exam	2	Obligatory
Fluorescence Spectroscopy and Bioimaging	Lecture: 30 Classes: 15	Lecture: Graded credit Classes: Graded credit	Lecture: 2 Classes: 1	Obligatory
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
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

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Principles of Business	Lecture: 30	Graded credit	3	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
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
Graduation Proseminar	Seminar: 15	Graded credit	1	Obligatory elective
Sum	**405**		**30**	

Semester 2

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Advanced Functional Materials	Lecture: 30 Seminar: 30	Lecture: Exam Seminar: Graded credit	Lecture: 2 Seminar: 2	Obligatory
Advanced Research Methods in the Engineering of Materials	Lecture: 30 Classes: 15 Laboratory: 15	Lecture: Exam Classes: Graded credit Laboratory: Graded credit	Lecture: 2 Classes: 1 Laboratory: 2	Obligatory
Organic Electronics	Lecture: 15 Seminar: 15	Lecture: Graded credit Seminar: Graded credit	Lecture: 1 Seminar: 1	Obligatory
Nanomaterials	Lecture: 30 Seminar: 15	Lecture: Exam Seminar: Graded credit	Lecture: 2 Seminar: 1	Obligatory
Nanoscale Physics	Lecture: 30 Laboratory: 15	Lecture: Graded credit Laboratory: Graded credit	Lecture: 2 Laboratory: 2	Obligatory
Nonlinear Optics for Chemists (L)	Laboratory: 15	Graded credit	2	Obligatory
Laser and Microscopic Techniques in Materials Analysis	Lecture: 30	Graded credit	2	Obligatory
Graduate Laboratory I	Diploma thesis: 60	Graded credit	6	Obligatory elective

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Elective Course	Lecture: 30	Graded credit	2	Obligatory group
The student chooses one subject				
Nonlinear Optics for Chemists	Lecture: 30	Graded credit	2	Elective
Biomaterials	Lecture: 30	Graded credit	2	Elective
Metalic Materials	Lecture: 30	Graded credit	2	Elective
Basics Molecular Dynamics	Lecture: 30	Graded credit	2	Elective
Sum	**375**		**30**	

Semester 3

Subject	Number of hours	Form of verification	ECTS points	Mandatoriness
Elective Course	Lecture: 30	Graded credit	2	Obligatory group
The student chooses one subject				
Nonlinear Optics for Chemists	Lecture: 30	Graded credit	2	Elective
Biomaterials	Lecture: 30	Graded credit	2	Elective
Metalic Materials	Lecture: 30	Graded credit	2	Elective
Basics Molecular Dynamics	Lecture: 30	Graded credit	2	Elective
Advanced Functional Materials	Laboratory: 90	Graded credit	6	Obligatory
Graduate Laboratory II	Diploma thesis: 210	Graded credit	20	Obligatory elective
Graduation Seminar	Seminar: 15	Graded credit	2	Obligatory elective
Sum	**345**		**30**	

Syllabuses

Wrocław University of Science and Technology

Mathematical Methods in Planning and Analysis of Experiment

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.31PM.04562.25
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 - mathematics
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 knowledge		
PEU_W01	Knows the principles of designing scientific experiments	K2_ANB_W05, K2_ANB_W10, K2_ANB_W17
PEU_W02	Understands what statistical analysis of scientific data is about	K2_ANB_W05, K2_ANB_W10, K2_ANB_W17
PEU_W03	Knows the basic tools for computer data analysis	K2_ANB_W05, K2_ANB_W10, K2_ANB_W17
PEU_W04	Understands the mathematical transformations used in data analysis	K2_ANB_W05, K2_ANB_W10, K2_ANB_W17

PEU_W05	Knows the methods of signal filtration	K2_ANB_W05, K2_ANB_W10, K2_ANB_W17
In terms of skills		
PEU_U01	Is able to choose a research method suitable for a particular issue	K2_ANB_U06, K2_ANB_U08, K2_ANB_U12
PEU_U02	Is able to choose the correct tool for data analysis and perform it	K2_ANB_U06, K2_ANB_U08, K2_ANB_U12

Program content ensuring learning outcomes

The program content refers to issues related to procedures for analyzing experimental data.

Calculation of ECTS points

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

Wrocław University of Science and Technology

Liquid Crystals for Photonics

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31PK.04563.25

Lecture languages
English

Mandatoriness
Obligatory

Block
Major-specific subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 2 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	Knows the principles of classification of liquid crystals in view of their structure, symmetry, origin of mesophase and macroscopic organization in bulk.	K2_ANB_W03, K2_ANB_W15
PEU_W02	Understands the liquid crystallinity and physical consequences of this state	K2_ANB_W03, K2_ANB_W15
PEU_W03	Knows in depth optical and dielectric properties of liquid crystals	K2_ANB_W03, K2_ANB_W15
PEU_W04	Knows and is able to identify various mesophases used for different functions like information displaying, processing and dynamic storage.	K2_ANB_W03, K2_ANB_W15
PEU_W05	Knows the advanced technologies of liquid crystal panels fabrication. He knows and understands the functioning of LC in photonics and knows the advantages and limits of these materials.	K2_ANB_W03, K2_ANB_W15

In terms of skills		
PEU_U01	Is able to make LC panels and characterize their optical properties.	K2_ANB_U04, K2_ANB_U11, K2_ANB_U14
PEU_U02	Understands the need of a scientific search based on scientific literature in her/his future professional work.	K2_ANB_U04, K2_ANB_U11, K2_ANB_U14
In terms of social competences		
PEU_K01	Takes responsibility for the tasks assigned during teamwork, cares for the work environment, undertakes different functions as a team member, and supports other team members.	K2_ANB_K04

Program content ensuring learning outcomes

The program content of the course refers to issues related to the chemical structure, interactions, and physical properties of liquid crystals, as well as the physicochemical properties of various mesophases, such as nematic, smectic, chiral nematic, and chiral ferroelectric liquid crystals. Additionally, it covers topics related to liquid crystal optics and their applications in display technology, optical filters, and light modulators, as well as modern photonic devices based on liquid crystals.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Laboratory	15
Preparaton for classes	15
Prepararation for an exam/credit	7
Credit/Exam	4
Preparation of a report/summary/presentation/paper	4
Student workload	**Hours** 75

Wrocław University of Science and Technology

Modern Polymers

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.31PK.04564.25
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 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 the knowledge of polymer structure and its chemical and physicochemical properties. Student is able to describe the relationships between structure of polymers and their properties.	K2_ANB_W01, K2_ANB_W15, K2_ANB_W18
PEU_W02	Knows the types of intra- and intermolecular interactions in polymers and their role in the macroscopic properties of polymers	K2_ANB_W01, K2_ANB_W15, K2_ANB_W18
PEU_W03	Is able to identify the factors influencing behaviour of polymers and use them in practice	K2_ANB_W01, K2_ANB_W15, K2_ANB_W18

Program content ensuring learning outcomes

The program content of the course relates to polymers and their structure, chemical composition, and physicochemical properties. An essential aspect of the course is understanding the influence of structure and intra- and intermolecular

interactions on the macroscopic properties of produced polymers and their applications in various branches of chemistry, technology, and chemical engineering. The curriculum also includes topics concerning factors affecting polymer behavior, enabling their practical applications, as well as issues related to planning polymer synthesis and modifications to impart desired properties to the material.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparaton for classes	18
Credit/Exam	2
Student workload	**Hours** 50

Wrocław University of Science and Technology

Bioorganic Chemistry

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31PK.04565.25

Lecture languages
English

Mandatoriness
Obligatory

Block
Major-specific subjects

Subject related to scientific research
Yes

Semester	Activities, hours, ECTS and examination
Semester 1	• Lecture: 30 h, 3 ECTS, Exam

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Defines bioorganic chemistry and knows the scope of its applicability.	K2_ANB_W13, K2_ANB_W14, K2_ANB_W15
PEU_W02	Knows the use of the discussed individual groups of compounds in bioorganic chemistry	K2_ANB_W13, K2_ANB_W14, K2_ANB_W15
PEU_W03	Distinguishes the types of interactions between molecules and knows what compounds create particular interactions	K2_ANB_W13, K2_ANB_W14, K2_ANB_W15

Program content ensuring learning outcomes

Issues of bioorganic chemistry, including the topics of biochemical process mimetics, molecular receptors, as well as the structure, properties, and use of individual groups of compounds utilized in bioorganic chemistry.

Practical possibilities of using individual groups of compounds as enzymatic mimetics and molecular receptors.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparaton for classes	10
Conducting literature research	10
Self-study of class topics	10
Prepararation for an exam/credit	11
Credit/Exam	4
Student workload	**Hours** 75

Wrocław University of Science and Technology

Biophotonics

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31PK.04566.25

Lecture languages
English

Mandatoriness
Obligatory

Block
Major-specific subjects

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

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Has structured, theoretically based general knowledge covering key issues in the field of biophotonics	K2_ANB_W07, K2_ANB_W13
PEU_W02	Knows new methods of synthesizing materials for biophotonics	K2_ANB_W07, K2_ANB_W13
PEU_W03	Knows modern methods of material characterization for biophotonics	K2_ANB_W07, K2_ANB_W13
PEU_W04	Knows and understands selected applications of materials for biophotonics	K2_ANB_W07, K2_ANB_W13
In terms of skills		
PEU_U01	Is able to classify, name and define biophotics. Searches for information in the field of biophotonics from available sources.	K2_ANB_U05, K2_ANB_U06, K2_ANB_U08

PEU_U02	Uses the latest literature on biophotonics.	K2_ANB_U05, K2_ANB_U06, K2_ANB_U08

Program content ensuring learning outcomes

Synthesis, characterization, and application of materials for biophotonics.
Issues of modern biophotonics.
Materials used in biophotonics.
Discussion of the development and limitations of biophotonics.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	15
Seminar	30
Conducting literature research	20
Preparation of a report/summary/presentation/paper	18
Self-study of class topics	15
Credit/Exam	2
Student workload	**Hours** 100

Wrocław University of Science and Technology

Modern Spectroscopy

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31PC.04567.25

Lecture languages
English

Mandatoriness
Obligatory

Block
Subjects of basic education - chemistry

Subject related to scientific research
Yes

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

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Knows the basic definitions of spectroscopy, especially optical spectroscopy	K2_ANB_W07, K2_ANB_W08
PEU_W02	Knows the modern setups applied in spectroscopic measurements	K2_ANB_W07, K2_ANB_W08
PEU_W03	Knows new trends in spectroscopy	K2_ANB_W07, K2_ANB_W08

Program content ensuring learning outcomes

The program content of the course covers topics related to modern spectroscopy and the principles of operation of contemporary spectroscopic systems and techniques used for material analysis and property investigation. It also includes current trends in material characterization using advanced spectroscopic techniques and fosters awareness of applying appropriate methods in research practice.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Prepararation for an exam/credit	16
Credit/Exam	4
Student workload	**Hours** 50

Wrocław University of Science and Technology

Fluorescence Spectroscopy and Bioimaging

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31PK.04568.25

Lecture languages
English

Mandatoriness
Obligatory

Block
Major-specific subjects

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	Understands the fundamentals of fluorescence spectroscopy, including the principles of fluorescence generation and detection, parameters such as quantum yield, lifetime, and Stokes shift. The student comprehends the mechanisms of electromagnetic radiation interaction with matter and their practical implications.	K2_ANB_W07, K2_ANB_W13
PEU_W02	Is familiar with various measurement techniques used in fluorescence spectroscopy and bioimaging, including the principles of lasers and other light sources employed in fluorescence microscopy and their applications in different spectral ranges.	K2_ANB_W07, K2_ANB_W13
PEU_W03	Understands the relationship between the chemical structure of materials and their fluorescence properties, including the impact of the chemical and physical characteristics of fluorophores on their applications in biology and medicine.	K2_ANB_W07, K2_ANB_W13

PEU_W04	Has advanced knowledge of the use of fluorescence spectroscopy in the analysis of biomaterials and nanomaterials, including the influence of their physicochemical parameters on functionality and effectiveness in diagnostics and therapy.	K2_ANB_W07, K2_ANB_W13
In terms of skills		
PEU_U01	Can apply microscopic techniques for fluorescence imaging to perform qualitative and quantitative analyses of biological and chemical phenomena, such as biomolecule localization and cellular processes.	K2_ANB_U07, K2_ANB_U12
PEU_U02	Utilizes information technologies for experimental data analysis related to fluorescence, including biofluorescent image processing and interpretation of fluorescence parameters using appropriate mathematical and computational tools.	K2_ANB_U07, K2_ANB_U12, K2_ANB_U16
PEU_U03	Is able to independently plan and conduct experiments using spectroscopic and fluorescence imaging techniques, as well as analyze and interpret results considering the influence of material parameters on their fluorescence properties.	K2_ANB_U12

Program content ensuring learning outcomes

The program content covers the basics of fluorescence spectroscopy, including the principles of fluorescence, excitation and emission processes, fluorescence parameters such as quantum yield and lifetime, as well as the importance of the Stokes shift. Students will learn about measurement techniques used in fluorescence spectroscopy, including spectrofluorometry, time- and spatially-resolved fluorescence techniques, and various types of fluorescence microscopy, such as confocal and super-resolution. The course also explores the applications of fluorophores and fluorescent probes, including organic, inorganic, and nanomaterials, as well as probes used in biology and medicine, emphasizing their mechanisms and selectivity.
The course addresses biofluorescence imaging techniques, including sample preparation for biological imaging, staining strategies such as immunofluorescence techniques and genetically encoded fluorophores, and image analysis using appropriate data processing techniques. Students will learn advanced techniques and applications, such as Förster Resonance Energy Transfer (FRET) and its practical use, along with issues related to photobleaching and photostimulation and methods to mitigate these challenges. Real-time imaging of biological processes is also discussed.
The course emphasizes practical applications in biomaterials and nanomaterials research, including the characterization of these materials using fluorescence techniques and the use of fluorescence spectroscopy in medical diagnostics and therap

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Classes	15
Preparaton for classes	10
Prepararation for an exam/credit	10
Preparation of a project	10
Student workload	**Hours** 75

Wrocław University of Science and Technology

Mediation and Negotation

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.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 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_ANB_K02
PEU_K02	The student has knowledge in the scope of mediation and negotiation	K2_ANB_K03, K2_ANB_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 Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.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 social competences		
PEU_K01	Is 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_ANB_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_ANB_K03
PEU_K03	Is 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_ANB_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
Self-study of class topics	20
Preparaton for classes	5
Prepararation for an exam/credit	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Sociology for Engineers

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31HS.04573.25

Lecture languages
English

Mandatoriness
Elective

Block
Subjects from the fields of humanities or social sciences

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

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	It characterizes concepts related to entrepreneurship, business operations, management processes, and associated organizational structures. It lists the elements of organizing economic activity.	K2_ANB_W11
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_ANB_K02
PEU_K02	Understands the need for organization, taking initiatives, inspiring others, and engaging in activities that benefit the socio-economic environment.	K2_ANB_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_ANB_K07

Program content ensuring learning outcomes

The subject curriculum covers issues related to the mechanisms of social life, their essence, and their influence on the functioning of organizations, enabling an understanding of the relationships between 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
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31HS.04574.25

Lecture languages
English

Mandatoriness
Elective

Block
Subjects from the fields of humanities or social sciences

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

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	The student has basic knowledge of management processes and related organizational structures.	K2_ANB_W11
In terms of social competences		
PEU_K01	The student has knowledge in the scope of base of interpersonal communications	K2_ANB_K02
PEU_K02	The student has basic knowledge concerning variety of communication and self-presentation techniques	K2_ANB_K03
PEU_K03	Verbal and non verbal communication and self-presentation skills, active listening.	K2_ANB_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
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31HS.04575.25

Lecture languages
English

Mandatoriness
Elective

Block
Subjects from the fields of humanities or social sciences

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

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	It characterizes concepts related to entrepreneurship, the functioning of an enterprise, as well as management processes and their associated organizational structures. It identifies the elements of organizing economic activity.	K2_ANB_W11
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_ANB_K02, K2_ANB_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_ANB_K07

Program content ensuring learning outcomes

The subject curriculum covers issues related to 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 introduces to the topic of innovation, emphasizing innovative entrepreneurship as a key factor in the development of modern organizations. As a result, program enables 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 Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.31HS.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 1	• 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_ANB_W11
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_ANB_K02, K2_ANB_K03, K2_ANB_K07

Program content ensuring learning outcomes

The program content includes knowledge about 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 cultivates 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 2.1

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

Foreign Language 2.2

Educational subject description sheet

Basic information

Field of study lektoraty	**Education cycle** 2025/2026
Speciality -	**Subject code** PWRSJOS.97JO.02690.25
Organizational unit Wrocław University of Science and Technology	**Lecture languages** English
Study level second degree	**Mandatoriness** Elective
Study form full-time studies	**Block** Foreign languages
Education profile general academic profile	

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

Graduation Proseminar

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.31PK.04577.25

Lecture languages
English

Mandatoriness
Obligatory elective

Block
Major-specific subjects

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	Takes part in discussions on research topics presented during classes	K2_ANB_U08, K2_ANB_U15
PEU_U02	Prepares a concise report on the topics of his/her chosen diploma theses	K2_ANB_U08, K2_ANB_U15
In terms of social competences		
PEU_K01	Identifies research problems related to the topics of the diploma theses offered by various research teams during classes	K2_ANB_K01, K2_ANB_K07

Program content ensuring learning outcomes

Fundamental research issues for research groups of departments/institutes related to the field of study.
Presentation of proposed topics of diploma theses and supervisors of diploma theses (in connection with the research topic).
Principles of using scientific literature and other sources of knowledge.

Methodology of selecting and organizing knowledge in terms of a specific research topic.
Techniques of public discussion, answers to questions regarding the discussed topic, taking into account the defense of one's own position.

Calculation of ECTS points

Activity form	**Activity hours**
Seminar	15
Preparaton for classes	5
Conducting literature research	5
Student workload	**Hours** 25

Wrocław University of Science and Technology

Advanced Functional Materials

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.36PK.04578.25
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, Exam • Seminar: 30 h, 2 ECTS, Graded credit

Semester	**Activities, hours, ECTS and examination**
Semester 3	• Laboratory: 90 h, 6 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Has general knowledge in the field of research carried out in modern material engineering	K2_ANB_W02, K2_ANB_W04, K2_ANB_W06, K2_ANB_W12, K2_ANB_W15, K2_ANB_W16, K2_ANB_W18

PEU_W02	Has knowledge about the synthesis, properties and investigation of photorefractive, photochromic, thermo-, electro- and solvatochromic, magnetic and ferroelectric materials, organic and inorganic semiconductors, carbon-based compounds and materials, energy storage materials, optical fibers and photonic crystals, modern materials used in medicine, metamaterials, superconductors, porous materials, ceramics, luminescent dyes.	K2_ANB_W16
In terms of skills		
PEU_U01	Is able to independently develop and present the state of knowledge on the basis of scientific publications	K2_ANB_U01, K2_ANB_U04, K2_ANB_U05, K2_ANB_U06, K2_ANB_U07, K2_ANB_U08, K2_ANB_U09, K2_ANB_U10, K2_ANB_U12, K2_ANB_U13, K2_ANB_U15
PEU_U02	Is able to independently perform material tests with advanced techniques	K2_ANB_U16
PEU_U03	Is able to analyze and interpret the obtained results	K2_ANB_U12, K2_ANB_U16
In terms of social competences		
PEU_K01	Understands the need to inform the public about the need to achieve the goals of sustainable development in technologies for the production of chemicals, fuels, energy and environmental protection.	K2_ANB_K07
PEU_K02	Is able to work in a group, performing various roles including group leader	K2_ANB_K04, K2_ANB_K07
PEU_K03	Is aware of the social role of the engineer	K2_ANB_K07
PEU_K04	Is ready to critically evaluate his/her knowledge and received content	K2_ANB_K07
PEU_K05	Takes responsibility for the tasks assigned during teamwork, cares for the work environment, undertakes different functions as a team member, and supports other team members.	K2_ANB_K04

Program content ensuring learning outcomes

- Classification and properties of materials used in modern materials engineering.
- Methods of synthesis of advanced materials of various types.
- Methods and research and measurement techniques used in modern materials engineering.
- Characterization of modern materials and systems that contain them.
- Current state of knowledge on advanced functional materials based on scientific publications.

Calculation of ECTS points

Semester 2

Activity form	Activity hours

Lecture	30
Seminar	30
Conducting literature research	10
Preparaton for classes	10
Credit/Exam	4
Self-study of class topics	8
Prepararation for an exam/credit	6
Preparation of a report/summary/presentation/paper	2
Student workload	**Hours** 100

Semester 3

Activity form	**Activity hours**
Laboratory	90
Preparaton for classes	10
Preparation of a report/summary/presentation/paper	30
Self-study of class topics	10
Conducting literature research	10
Student workload	**Hours** 150

Wrocław University of Science and Technology

Advanced Research Methods in the Engineering of Materials

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.32PK.04579.25
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, Exam • Classes: 15 h, 1 ECTS, Graded credit • Laboratory: 15 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Has theoretical knowledge about XPS / AES methods and equipment working in ultra high vacuum. Has the knowledge of the research possibilities of determining the surface chemical composition by XPS and AES. Possesses knowledge in the analysis of organic and inorganic substances using spectroscopic techniques.	K2_ANB_W07, K2_ANB_W14
PEU_W02	Has the knowledge of electron microscopy (SEM) and X-ray microanalysis (EDS), as well as the system of orientation and phase detection based on backscattered electron diffraction (EBSD). Knows the structural analysis by X-ray diffraction (XRD) in the analysis of metals and their alloys.	K2_ANB_W07, K2_ANB_W14

PEU_W03	Has the knowledge of the method of determining the mechanical properties of materials based on the measurements of microhardness and adhesion, as well as on the method of determining geometric parameters of the surface.	K2_ANB_W14
PEU_W04	Has the knowledge of laboratory techniques for testing the corrosion resistance and electrochemical activity of materials. The student has a basic knowledge of electrochemical impedance spectroscopy (EIS). Knows the impedance spectroscopy to determine the material properties of dielectric materials.	K2_ANB_W14
In terms of skills		
PEU_U01	Is able to qualitatively and quantitatively characterize the tested surface of a solid body, is able to record the surface profile of the tested material and determine the most important geometric parameters. Is able to interpret the nature of damage to the coating material during scratch test measurements, is able to measure the thickness of the coating/thin layer and determine its microhardness.	K2_ANB_U02, K2_ANB_U11, K2_ANB_U16
PEU_U02	Is able to perform basic operations on XPS spectra and use online XPS and AES databases for qualitative interpretation of XPS and AES spectra.	K2_ANB_U02, K2_ANB_U11, K2_ANB_U13
PEU_U03	Is able to select the appropriate operating parameters of the scanning microscope (SEM) and microanalysis (EDS) for the material being examined and use the EDS and EBSD databases. Is able to interpret an XRD diffraction pattern. Is able to use analytical techniques, e.g. GC-MS or ICP-OES to determine elements or organic compounds.	K2_ANB_U02, K2_ANB_U11, K2_ANB_U16
PEU_U04	Is able to perform a DC polarization measurement and is able to determine the basic electrical quantities characterizing the corrosion process, is able to perform a measurement using the EIS technique, analyze and interpret the simplest impedance spectrum and propose an electrical equivalent circuit. Is able to determine the electrocatalytic properties of the electrode material	K2_ANB_U02, K2_ANB_U11, K2_ANB_U16
In terms of social competences		
PEU_K01	Is ready to apply the acquired knowledge to solve research problems.	K2_ANB_K08
PEU_K02	Understands the need to use expert knowledge when interpreting obtained research results.	K2_ANB_K08

Program content ensuring learning outcomes

1. Importance of solid surface in nanotechnology.
2. Modern and advanced techniques of surface research, morphology and structure of engineering materials.
3. Selection of an appropriate method of determining: surface composition, surface topography, adhesion and hardness to the material being tested.
4. Interaction of the surface of the material with the corrosive environment.
5. Application of standards in making measurements and their statistical treatment.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30

Classes	15
Laboratory	15
Preparaton for classes	14
Preparation of a report/summary/presentation/paper	14
Conducting literature research	7
Self-study of class topics	10
Prepararation for an exam/credit	16
Credit/Exam	4
Student workload	**Hours** 125

Wrocław University of Science and Technology

Organic Electronics

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.32PK.04580.25
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, 1 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	knows the types and basic properties of typical organic electronic materials	K2_ANB_W13
PEU_W02	knows the basics of the description of conductivity and electronic excitation in organic materials	K2_ANB_W07, K2_ANB_W13, K2_ANB_W15
PEU_W03	knows the principles of operation of diodes, transistors and photovoltaic devices	K2_ANB_W07, K2_ANB_W13, K2_ANB_W15
PEU_W04	knows the methods of fabrication and characterization of organic electronic devices	K2_ANB_W13, K2_ANB_W15
In terms of skills		

PEU_U01	is able to interpret, elaborate and present a range of actual knowledge based on original scientific literature	K2_ANB_U05, K2_ANB_U06, K2_ANB_U08

Program content ensuring learning outcomes

The student learns the basics of organic electronic devices, their structure and applications. Learns the mechanism of electrical conduction in organic materials. Prepares and discusses a presentation on a selected topic in the field of organic electronics.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	15
Seminar	15
Preparation of a report/summary/presentation/paper	7
Prepararation for an exam/credit	8
Credit/Exam	2
Conducting literature research	3
Student workload	**Hours** 50

Wrocław University of Science and Technology

Nanomaterials

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.32PK.04581.25

Lecture languages
English

Mandatoriness
Obligatory

Block
Major-specific subjects

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	Knows the differences in the properties of nanomaterials and bulk materials	K2_ANB_W06
PEU_W02	Knows the methods of the synthesis of nanomaterials, lithographic techniques used to produce nanomaterials, methods of characterization of nanomaterials – structural investigations and optical spectroscopies and microscopies of a single nanoparticle, nanomanipulation	K2_ANB_W13
PEU_W03	Knows properties and applications of plasmonic nanomaterials, metal nanoparticles, quantum dots, carbon nanomaterials, lanthanide-doped nanomaterials, 2D nanomaterials, nanofibers and composite nanomaterials	K2_ANB_W06, K2_ANB_W13, K2_ANB_W15

PEU_W04	Knows the processes in self-assembly of nanomaterials, methods of bioconjugation and functionalization of nanomaterials, knows and understands the dangers of the applications of nanomaterials	K2_ANB_W13, K2_ANB_W15
In terms of skills		
PEU_U01	Can name and define concepts in the field of nanomaterials and search for information on nanomaterials from available sources. Can name methods of synthesis of colloidal nanomaterials. Can name and compare the physical methods of synthesis of nanomaterials.	K2_ANB_U05, K2_ANB_U06, K2_ANB_U08
PEU_U02	Can recognize, name and define the properties and applications of various nanomaterials: plasmonic nanoparticles, quantum dots, carbon nanomaterials, materials doped with lanthanides	K2_ANB_U05, K2_ANB_U06, K2_ANB_U08
PEU_U03	Can identify the dangers and prospects of nanomaterials applications	K2_ANB_U05, K2_ANB_U06, K2_ANB_U08
PEU_U04	Can present the goals and results of his scientific work in the form of an oral presentation on nanomaterials	K2_ANB_U05, K2_ANB_U06, K2_ANB_U08
In terms of social competences		
PEU_K01	Is ready to critically evaluate his/her knowledge and received content	K2_ANB_K07

Program content ensuring learning outcomes

Information about nanomaterials compared to solid materials, general methods of obtaining nanomaterials, colloidal nanoparticles, Physical techniques for nanomaterials preparation, characterization of nanomaterials - structural studies and spectroscopy and optical microscopy of a single nanoparticle, Plasmonic nanoparticles: synthesis, properties and applications, Quantum dots: synthesis, properties , applications, Carbon nanomaterials: synthesis, properties, application, 2D nanomaterials (TMD, graphene, etc.), Lanthanide-doped nanomaterials: synthesis, properties, application, Bio-inspired nanomaterials, Self-assembly of nanoparticles, Functionalization of nanomaterials, bioconjugation, Prospects, challenges and threats in nanomaterial applications. Nanotoxicology.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Seminar	15
Preparation of a report/summary/presentation/paper	10
Conducting literature research	5
Prepararation for an exam/credit	11
Credit/Exam	4
Student workload	**Hours** 75

Wrocław University of Science and Technology

Nanoscale Physics

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.32PK.04582.25
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 • Laboratory: 15 h, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Knows different experimental techniques used for inorganic nanostructures analysis.	K2_ANB_W04, K2_ANB_W06, K2_ANB_W12
PEU_W02	Knows modern theories/technologies related with semiconducting nanomaterials	K2_ANB_W04, K2_ANB_W06, K2_ANB_W12
PEU_W03	Understands the principles of the experimental methods used in nanostructures investigations.	K2_ANB_W04, K2_ANB_W06, K2_ANB_W12
In terms of skills		

PEU_U01	Can apply different experimental techniques to analyze semiconducting nanomaterials.	K2_ANB_U04, K2_ANB_U09, K2_ANB_U13, K2_ANB_U16
PEU_U02	Is able to analyze and critically evaluate experimental results obtained for spectroscopic data obtained for semiconducting nanomaterials.	K2_ANB_U04, K2_ANB_U09, K2_ANB_U13, K2_ANB_U16
In terms of social competences		
PEU_K01	Understands the need to inform the public about the need to achieve the goals of sustainable development in technologies for the production of new materials, energy and environmental protection.	K2_ANB_K05
PEU_K02	Is able to work in a group, performing various roles including group leader.	K2_ANB_K04, K2_ANB_K05
PEU_K03	Is aware of the social role of the engineer.	K2_ANB_K05
PEU_K04	Is ready to critically evaluate his/her knowledge and received content.	K2_ANB_K05

Program content ensuring learning outcomes

The program content of the course covers topics related to experimental techniques used for the analysis of inorganic nanostructures, the theory and technology of semiconductor nanomaterials, as well as experimental methods applied in nanostructure research.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Laboratory	15
Preparation of a report/summary/presentation/paper	15
Preparaton for classes	13
Prepararation for an exam/credit	15
Self-study of class topics	10
Credit/Exam	2
Student workload	**Hours** 100

Wrocław University of Science and Technology

Nonlinear Optics for Chemists (L)

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.32PK.04583.25
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, 2 ECTS, Graded credit

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Has systematized knowledge within the physical basis of optical field interaction with matter.	K2_ANB_W07
PEU_W02	Understands the physics of nonlinear light interaction with matter at the microscopic and macroscopic levels	K2_ANB_W07
PEU_W03	Knows and recognizes nonlinear optical phenomena of second and third order	K2_ANB_W07
PEU_W04	Knows and understands measurement methods used to evaluation of nonlinear optical properties of optical materials	K2_ANB_W07
In terms of skills		
PEU_U01	Has the ability to propose optical material for fulfilling desired functionality of second and third nonlinear optical type.	K2_ANB_U04

PEU_U02	Has the ability to design measurement setup to measure fundamental nonlinear optical properties of a material	K2_ANB_U04
PEU_U03	Is able to perform chosen experiments in the field of nonlinear	K2_ANB_U04
In terms of social competences		
PEU_K01	Takes responsibility for the tasks assigned during teamwork, cares for the work environment, undertakes different functions as a team member, and supports other team members.	K2_ANB_K04

Program content ensuring learning outcomes

1. Fundamentals of the theory of nonlinear light interaction with matter.
2. Main nonlinear optical phenomena.
3. Main methods of study of matter using laser beams of short pulses and strong power.
4. Application of nonlinear optics achievements in science and technology.

Calculation of ECTS points

Activity form	**Activity hours**
Laboratory	15
Preparaton for classes	10
Conducting literature research	5
Preparation of a report/summary/presentation/paper	18
Credit/Exam	2
Student workload	**Hours** 50

Wrocław University of Science and Technology

Laser and Microscopic Techniques in Materials Analysis

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.32PK.04584.25
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 basics of optical microscopy	K2_ANB_W04, K2_ANB_W15
PEU_W02	Knows fluorescence microscopy methods	K2_ANB_W04, K2_ANB_W07, K2_ANB_W15
PEU_W03	Knows fluorescence lifetime microscopy methods	K2_ANB_W04, K2_ANB_W07, K2_ANB_W15
PEU_W04	Knows multiphoton microscopy methods	K2_ANB_W04, K2_ANB_W07, K2_ANB_W15
PEU_W05	Knows the basics of electron microscopy	K2_ANB_W04, K2_ANB_W15

PEU_W06	Knows scanning probe microscopy techniques (AFM, STM)	K2_ANB_W04, K2_ANB_W15
PEU_W07	Knows near-field microscopy techniques	K2_ANB_W04, K2_ANB_W15
PEU_W08	Knows the latest microscopic methods of imaging below the diffraction limit	K2_ANB_W04, K2_ANB_W15

Program content ensuring learning outcomes

Fundamentals of microscopy
Modern microscopic techniques
How to choose the right microscopic techniques for examining specific materials

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Self-study of class topics	18
Credit/Exam	2
Student workload	**Hours** 50

Wrocław University of Science and Technology

Graduate Laboratory I

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.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_ANB_U03
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_ANB_U03, K2_ANB_U09
PEU_U03	carries out simulations or experiments or calculations in order to implement the thesis plan	K2_ANB_U04
In terms of social competences		
PEU_K01	respects copyright when preparing a literature review	K2_ANB_K01, K2_ANB_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_ANB_K01, K2_ANB_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

Nonlinear Optics for Chemists

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.36PK.04587.25

Lecture languages
English

Mandatoriness
Elective

Block
Major-specific subjects

Subject related to scientific research
Yes

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

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Has systematized knowledge within the physical basis of optical field interaction with matter.	K2_ANB_W16
PEU_W02	Can understand the physics of nonlinear light interaction with matter at the microscopic and macroscopic levels	K2_ANB_W16
PEU_W03	Knows and recognizes nonlinear optical phenomena of second and third-order	K2_ANB_W16
PEU_W04	Knows and understands measurement methods used to evaluate nonlinear optical properties of optical materials	K2_ANB_W16
In terms of social competences		
PEU_K01	Is able to make a scientific search from literature and make an overview	K2_ANB_K08

PEU_K02	Has knowledge of importance and role of light in contemporary life and of materials interacting with light in nonlinear fashion for production of economic and useful for mankind devices	K2_ANB_K08

Program content ensuring learning outcomes

1. Fundamentals of the theory of nonlinear light interaction with matter.
2. Main nonlinear optical phenomena.
3. Main methods of study of matter using laser beams of short pulses and strong power.
4. Application of nonlinear optics achievements in science and technology.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparaton for classes	10
Prepararation for an exam/credit	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Biomaterials

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.36PK.04588.25

Lecture languages
English

Mandatoriness
Elective

Block
Major-specific subjects

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

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Has structured, theoretically based general knowledge covering key issues in the field of bioengineering	K2_ANB_W16
PEU_W02	Knows new methods of synthesizing biomaterials	K2_ANB_W16
PEU_W03	Knows modern methods of characterization of biomaterials	K2_ANB_W16
In terms of social competences		
PEU_K01	Demonstrates interest in biomaterials. Searches for information on biomaterials from available sources.	K2_ANB_K08
PEU_K02	Has language skills in the field of functionalization of biomaterials.	K2_ANB_K08
PEU_K03	Has language skills in the field of functionalization of biomaterials.	K2_ANB_K08

Program content ensuring learning outcomes

The student gains in-depth knowledge of the synthesis of functional biomaterials, including both traditional and modern methods of their production. They learn techniques for characterizing the physicochemical and biological properties of these materials, such as spectroscopy, microscopy or mechanical analysis. The acquired skills allow for the assessment of the usefulness of biomaterials in specific applications, including tissue engineering, regenerative medicine or drug delivery systems.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparation of a report/summary/presentation/paper	15
Conducting literature research	5
Student workload	**Hours** 50

Wrocław University of Science and Technology

Metalic Materials

Educational subject description sheet

Basic information

Field of study Advanced Nano and Biomaterials - MONABIPHOT	**Education cycle** 2025/2026
Speciality -	**Subject code** W3ANBS.36PK.04589.25
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	

Semesters	**Activities, hours, ECTS and examination**
Semester 2, Semester 3	• 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 groups of metals - construction and special alloys	K2_ANB_W16
PEU_W02	Knows the concept of microstructure and is able to explain how the method of obtaining metallic materials affects their microstructure and properties.	K2_ANB_W16
PEU_W03	Knows the basics of metallographic preparation and the method of microstructure evaluation	K2_ANB_W16
In terms of social competences		
PEU_K01	Is prepared to supplement and improve the acquired knowledge	K2_ANB_K08

Program content ensuring learning outcomes

1. Familiarizing with available metals, construction alloys and metallic special materials.

2. Familiarizing with methods of marking metals and alloys.
3. Indicating the relationship between the method of production, structure and properties of metallic materials and familiarizing students with basic techniques for producing and testing popular metallic materials.
4. Indicating the criteria that should be followed when selecting metallic materials.

Calculation of ECTS points

Activity form	**Activity hours**
Lecture	30
Preparaton for classes	4
Self-study of class topics	6
Prepararation for an exam/credit	10
Student workload	**Hours** 50

Wrocław University of Science and Technology

Basics Molecular Dynamics

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.36PK.04590.25

Lecture languages
English

Mandatoriness
Elective

Block
Major-specific subjects

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

Subject's learning outcomes

Subject's outcome	Content	Learning outcome
In terms of knowledge		
PEU_W01	Lists and explains advanced molecular dynamics method to investigate physio-chemical processes.	K2_ANB_W16
In terms of social competences		
PEU_K01	Appreciates the importance of knowledge of molecular dynamics in solving problems related to the field of study.	K2_ANB_K08

Program content ensuring learning outcomes

Statistical thermodynamics, force field design, molecular dynamics calculation scheme, algorithms used in molecular dynamics simulations.

Calculation of ECTS points

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

Wrocław University of Science and Technology

Graduate Laboratory II

Educational subject description sheet

Basic information

Field of study
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.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_ANB_U03
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_ANB_U04, K2_ANB_U10
PEU_U03	prepares a manuscript of a diploma thesis	K2_ANB_U04, K2_ANB_U09, K2_ANB_U10
In terms of social competences		
PEU_K01	respects copyright when preparing a literature review	K2_ANB_K01, K2_ANB_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_ANB_K01, K2_ANB_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
Advanced Nano and Biomaterials - MONABIPHOT

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
W3ANBS.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 knowledge		
PEU_W01	Knows reliable and adequate sources of knowledge and information appropriate for the topic of the diploma thesis.	K2_ANB_W09
PEU_W02	Knows how to appropriately cite literature according to copyright.	K2_ANB_W09
In terms of skills		
PEU_U01	Is able to prepare a literature review on the topic of the diploma thesis	K2_ANB_U05, K2_ANB_U08
PEU_U02	Is able to prepare a slide presentation of the literature part of the work and present it at a seminar.	K2_ANB_U05, K2_ANB_U08
PEU_U03	Is able to interpret the results obtained in experimental work based on his/her knowledge and literature reports and formulate conclusions	K2_ANB_U05, K2_ANB_U08

PEU_U04	Is able to prepare a presentation of the obtained research results, present it at a seminar and participate in the discussion	K2_ANB_U05, K2_ANB_U08
In terms of social competences		
PEU_K01	Is ready to solve substantive and technical problems that may arise while preparing a presentation at a seminar.	K2_ANB_K01, K2_ANB_K06, K2_ANB_K07, K2_ANB_K08

Program content ensuring learning outcomes

discussion of formal, technical and substantive issues related to the implementation of the master's thesis, the diploma process and the diploma examination,
students' presentations of the literature review, the purpose and scope of the work, the methodology of the work carried out, the results of research or design work carried out or theoretical/computational work carried out

Calculation of ECTS points

Activity form	**Activity hours**
Seminar	15
Preparaton for classes	5
Preparation of a report/summary/presentation/paper	15
Conducting literature research	10
Self-study of class topics	5
Student workload	**Hours** 50