Lodz University of Technology

Study programme

Faculty:	Faculty of Chemistry
Major:	Advanced Biobased and Bioinspired Materials (in English)
Level of study:	first-cycle programme (inżynier)
Form of study:	full-time studies
Academic year:	2026/27

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Basic information

Name of the field of study:	Advanced Biobased and Bioinspired Materials (in English)
Level of study:	first-cycle programme (inżynier)
Study profile:	general academic
Form of studies:	full-time studies
Duration of studies (number of semesters):	8
The number of ECTS points required to complete studies:	240
Total number of hours of classes:	3068
The number of ECTS points a student obtains as part of classes conducted with the direct participation of academic teachers or other persons conducting classes:	123
Professional title awarded to graduates:	inżynier
ISCED code:	0531
Language of study:	English

Assigning the course to the disciplines to which the learning outcomes relate

Discipline	Percentage share
Chemical science	100%

Learning outcomes (in relation to the PQF)

No.	Learning outcome code	Learning Outcome Content	Reference to the universal characteristics of the first level of PRK	Reference to the second-level characteristics of the PRK, taking into account the second-level characteristics enabling the acquisition of engineering competences
1	**1ABB1**	Knows and understands, at an advanced level, the laws of chemistry, mathematics and physics necessary for describing and interpreting physical and chemical phenomena in nature as well as in the processes of designing, manufacturing and analysing biobased and biomimetic materials, taking into account current developmental trends in the chemical sciences.	P6U_W	P6S_WG
2	**1ABB2**	Possesses advanced theoretical knowledge of the fundamentals of designing and manufacturing bio-based and biomimetic materials, including principles of raw-material selection, processing techniques, and methods for analysing structure and function.	P6U_W	P6S_WG
3	**1ABB3**	Possesses knowledge of programming, the use of algorithms, computer simulations and computer-aided engineering activities, as well as life-cycle analysis of products, systems and objects.	P6U_W	P6S_WG
4	**1ABB4**	Possesses advanced knowledge of biological and chemical mechanisms that form the basis for the design of biobased and biomimetic materials, including hierarchical structures occurring in nature and the principles of their reproduction in materials engineering.	P6U_W	P6S_WG
5	**1ABB5**	Has the knowledge necessary to understand the sociological, economic, legal, and other non-technical determinants of professional and business activity, and is familiar with the fundamental concepts and principles of industrial property protection and copyright law.	P6U_W	P6S_WK
6	**1ABB6**	Is able to design solutions, plan and conduct experiments, calculations and simulations, select appropriate research methods and tools, analyse the obtained data and interpret results in the context of defined research objectives, as well as critically evaluate existing technical solutions.	P6U_U	P6S_UW
7	**1ABB7**	Is able to work effectively in a team, taking on different roles, present results, participate in debate, and plan activities while considering systemic, non-technical and economic aspects.	P6U_U	P6S_UK, P6S_UO, P6S_UU
8	**1ABB8**	Can communicate effectively in English at a minimum C1 level and in another foreign language at the chosen proficiency level; formulate arguments supported by knowledge in chemistry, nanotechnology and chemical technology, with particular emphasis on biobased and biomimetic materials; and present, evaluate and discuss diverse viewpoints using advanced information and communication technologies.	P6U_U	P6S_UW, P6S_UK
9	**1ABB9**	Is ready to think and act creatively and entrepreneurially, take responsibility for engineering decisions, and operate in accordance with professional ethics.	P6U_K	P6S_KO, P6S_KR

No.	Learning outcome code	Learning Outcome Content	Reference to the universal characteristics of the first level of PRK	Reference to the second-level characteristics of the PRK, taking into account the second-level characteristics enabling the acquisition of engineering competences
10	**1ABB10**	Is ready to operate in multicultural and interdisciplinary environments, engaging in solving real-world problems and supporting diversity and sustainable development.	P6U_K	P6S_KK, P6S_KO

Matrix of course modules in relation to learning outcomes and curriculum content

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
1	Mathematics I	Elementary functions, differential and integral calculus of functions of one variable.										
2	Physics	The significance of physics, SI units and dimensional analysis, fundamentals of kinematics and dynamics of a material point, work, power and energy, kinetic and potential energy, field potential and equilibrium, the gravitational field with Newton’s law of gravitation and the superposition principle, conservative forces and the conservation of energy, collisions and rotational dynamics, vibrations and waves including the harmonic oscillator, damped and driven oscillations, resonance and standing waves, Huygens’ principle, sound waves and the Doppler effect, electrostatics with Coulomb’s law, Gauss’s law, electric potential and field intensity, current-generated magnetic fields, magnetic force and Ampère’s law, electromagnetic induction with Faraday’s and Lenz’s laws, the LC circuit, electromagnetic waves, interference, diffraction and polarization of light, and basics of geometric optics: reflection, refraction, mirrors, lenses and optical instruments.										
3	General and Inorganic Chemistry	Basic chemical definitions and symbols, compound nomenclature, empirical and structural formulas, chemical equations and laws, the structure of matter including atomic models, the nucleus, electrons, atomic and mass numbers, atomic and molar masses, isotopes, orbitals and quantum numbers, electron-filling rules, hybridization and molecular orbitals. Types of chemical bonds, their energies and influence on properties, multiple and delocalized bonds, electronegativity, oxidation states, and the periodic table with the periodic law. Acids and bases in the Brønsted–Lowry and Lewis concepts, aqueous equilibria, pH, hydrolysis, dissociation and its constants, reaction mechanisms, collision theory and activation energy. Properties and compounds of main-group and transition elements, methods of obtaining and using them, as well as basic chemical calculations: balancing equations, stoichiometric calculations, and expressing and converting concentrations.										
4	Information Technologies	Work in the Microsoft Office 365 environment, collaboration tools in Outlook, fundamentals of modern computer operation and task-processing environments, handling and basic configuration of MS Windows 10/11, local and access networks, the Internet and network services (HTTP, DNS), e-administration and e-business services, phishing threats and protection methods, and principles of personal data protection. The practical scope includes text editing, spreadsheet work, publishing and group collaboration in MS Office 365, data protection, basics of networking and cybersecurity, and using software for creating chemical formulas, reaction schemes and data analysis.										
5	Engineering Drawing	Technical drawing as a communication tool, types and arrangements of drawings, essential technical abbreviations and symbols, and the conventional rules for representing features and creating freehand sketches that consider form, proportions and line types. Pictorial projections and sketching in isometric and oblique systems. Orthographic projection with first- and third-angle methods, view placement and proper symbols. Dimensioning rules, including basic, location, functional and auxiliary dimensions, as well as dimensioning of repetitive features and angular positions, with examples of correct and incorrect notations. Concepts of tolerances, deviations and dimensional limits, principles of fits, and calculations of clearance and interference. Fundamental principles of machine technical drawing and an introduction to CAD software operation.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
6	Study Skills for University	Student-centered learning methods, including peer learning, problem-based approaches, flipped classroom and teamwork, along with note-taking techniques, study strategies, exam preparation and time management. Principles of communication and academic conduct, and the culture and ethics of university life in international and intercultural settings. Team building and effective collaboration, issues of plagiarism, and the use of the WIKAMP learning management system.										
7	Introduction to Data Analysis	Measurement errors, basic statistical concepts, probability distributions and methods of parameter estimation with confidence intervals form the basis of data analysis. Linear and nonlinear regression, goodness-of-fit assessment, error propagation and hypothesis testing, including the chi-square test, enable quantitative evaluation of relationships and model verification. Practical data analysis includes computer-based processing of results using spreadsheets and dedicated software.										
8	C1 Business Communication for Engineers 1	Selected lexical and grammatical structures; topics relevant to the academic and professional environments of university graduates; improving receptive and productive language skills; developing essential soft skills required in the workplace.										
9	C2 Business Communication for Engineers 1	Selected lexical and grammatical structures; topics relevant to the academic and professional environments of university graduates; improving receptive and productive language skills; developing essential soft skills required in the workplace.								x		
10	Mathematics II	Ordinary differential equations, random variable, statistical inference.										
11	Learning, Reporting and Presenting	Practical knowledge of university organization, study principles, and the preparation of reports, theses and conference presentations. It includes training and practical exercises in presentation skills conducted under the guidance of a professional actor, with the acquired competencies assessed through individual student presentations. Introduction for PBL.										
12	Organic Chemistry	Forms of chemical formula notation, hybridization and resonance, the influence of molecular structure on properties, classes of organic compounds with their structure, nomenclature, properties, preparation methods, reactions, mechanisms and fundamentals of stereochemistry. The ability to independently write formulas, identify compound classes, predict properties, plan syntheses and formulate reaction mechanisms using stereochemical concepts. Practical laboratory techniques in organic chemistry, safe workspace organization, synthesis and purification of compounds, observation and documentation of experiments, and calculations of concentrations, stoichiometry and reaction yields.										
13	Computer-aided Design	The Creo interface, parametric solid modeling, part and assembly design, and creating sketch-based features using weak and strong dimensions. Material-adding and material-removing features, constraints, and fundamental operations on datum planes, including extruded, revolved and thin-walled solids, as well as Blend and Sweep functions. Assembly operations, geometry and dimension modifications, generating technical documentation with views and sections, engineering-calculation support, and defining mechanisms and their motion. 3D modeling in Creo using symmetry axes, additional datum planes and sketched features, assembly design, creation of 2D drawings and technical documentation, advanced blend and swept-blend features, and resolving regeneration issues.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
14	C1 Business Communication for Engineers 2	Selected lexical and grammatical structures; topics relevant to the academic and professional environments of university graduates; improving receptive and productive language skills; developing essential soft skills required in the workplace.										
15	C2 Business Communication for Engineers 2	Selected lexical and grammatical structures; topics relevant to the academic and professional environments of university graduates; improving receptive and productive language skills; developing essential soft skills required in the workplace.								x		
16	Introduction to Laboratory Work	Health and safety rules and DPL, basic laboratory equipment and principles of its use, measuring instruments and the construction and operation of spectrometers. Methods and techniques used in chemical analysis, measurement methods in physics and electrical engineering, and techniques for working with biological material, including sterilization methods and basic techniques for separating chemical compounds. Fundamentals of metrology, procedures for collecting and preparing a representative sample for analysis, and principles of maintaining a laboratory notebook, archiving results and preparing laboratory reports.						x				
17	Civic Knowledge and Engagement I	The development of social competences that go beyond the extra-curricular learning outcomes necessary for an informed and educated citizen of Poland, Europe and the world. To carry out various activities for the development of themselves and the University.					x					x
18	Fundamentals of Business and Quality Management	The concept of entrepreneurship, forms of conducting business activity, required registration documentation, the freedom of economic activity and financial possibilities based on a business plan, as well as reporting obligations and the rights and duties of an entrepreneur. Fundamentals of interpersonal communication, enterprise management systems, the concept and evolution of quality, the development of quality management systems, the basics of product and system certification, an introduction to TQM, the ISO 9000 and ISO 14000 standards with their scope, and the process of implementing, certifying and managing a quality system after certification. Principles of preparing a business plan and principles of developing documentation for quality management systems within the project.					x					
19	Smart Information Technologies	Introduction to programming and algorithmics, including the formulation of algorithms and the implementation of numerical algorithms for engineering problems in Python, together with program execution and diagnostics. Fundamentals of artificial intelligence and selected aspects of cybersecurity as complementary programming competencies.										
20	Physical Chemistry	Basic physicochemical concepts and quantities, states of matter, properties of ideal and real gases, principles of thermodynamics with internal energy, enthalpy, entropy, Gibbs and Helmholtz energy, chemical potential and phase and chemical equilibria, including phase diagrams of pure substances and solutions, chemical activity and colligative properties. Electrochemistry of equilibrium systems, oxidation and reduction processes, electrochemical cells, kinetics of elementary and complex reactions, activation energy, catalysis, surface phenomena, adsorption and colloidal systems. Physicochemical calculations including gas state equations, heat balance, state function changes, phase and chemical equilibria, ionic conductivity, cell potentials, activity coefficients, kinetic parameters and application of the Nernst equation, as well as experiments on thermal effects, reaction kinetics, electrochemical measurements and phase analysis.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
21	Analytical Methods	Modern analytical methods for examining various materials and advanced surface-analysis techniques, including approaches suited to samples with complex and heterogeneous matrices and current trends in the development of contemporary analytical methodologies. Methods of sampling and sample preparation, along with the optimization of analytical parameters and procedures. Identification of potential sources of error throughout the analytical process and strategies for their elimination.										
22	Electrotechnics and Introduction to Electronics	Properties of electrical and electronic components in DC and AC circuits, fundamentals of electrical measurements and basic methods of analysing linear electrical circuits, as well as the operating principles of selected electrotechnical and electronic devices with examples of their applications. Practical skills in assembling simple circuits, measuring current, voltage and resistance, operating an oscilloscope, and performing laboratory exercises involving DC and AC circuits, electrotechnical devices and electronic systems. Solving computational tasks related to the analysis of simple direct-current and alternating-current circuits.										
23	Advanced Data Analysis	Practical methods of data processing using computers, including work with spreadsheets and specialised data-analysis software. Analysis of complex experimental data such as spectroscopic, chromatographic and diffraction datasets, including baseline correction, assessment of its influence on spectral parameters and determination of line parameters using methods such as deconvolution, second-derivative analysis and GMRES. Evaluation of the impact of instrumental parameters on measurement quality, optimisation of experimental conditions and comparison of results obtained from different analytical techniques using appropriate representations. Approximation of experimental results with theoretical curves, including the analysis of titration curves, thermo-optical data and DSC and TG thermograms.										
24	Polymers	Classification of polymers, methods of polymer synthesis and modification, average molecular weights and their distribution, macromolecules with nonlinear architecture, control of polymer composition, topology and functionality, as well as polymer nanomaterials and nanocomposites. Polymer morphology in the condensed state, phase transitions including the glass transition, crystallization and melting, and the physical properties of polymers in the solid state. Polymer solutions and their applications in physicochemical studies and practice, cross-linked structures and polymer gels with their preparation methods, properties and uses, stimuli-responsive polymers, natural and biodegradable polymers, and the use of polymers in medicine. Laboratory synthesis and characterization of selected polymer materials.										
25	German A2 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
26	German B1 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
27	German B2 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
28	Spanish A2 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
29	Spanish B1 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
30	Spanish B2 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
31	French A2 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
32	French B1 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
33	French B2 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
34	Italian A1 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
35	Italian A2 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
36	German A1 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
37	Spanish A1 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
38	French A1 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
39	Polish A1 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
40	Polish A2 block I	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
41	Civic Knowledge and Engagement II	The development of social competences that go beyond the extra-curricular learning outcomes necessary for an informed and educated citizen of Poland, Europe and the world. To carry out various activities for the development of themselves and the University.					x					x
42	Spectroscopy	Types of spectroscopy and comparison of methods, selection rules for techniques and principles of vibrational, rotational, fluorescence and UV-Vis spectroscopy, molecular imaging including Raman and fluorescence, nuclear magnetic resonance and resonance of nuclei with different spin quantum numbers. Harmonic and anharmonic oscillator models, influence of molecular symmetry on vibration frequencies, characteristic vibrations, description of normal modes in classical and quantum terms, complementarity of IR and Raman and application of group theory in spectral analysis including SRS and SERS techniques. NMR principles, chemical shifts, spin couplings, 1H, 13C and 31P spectra, effects of symmetry and molecular dynamics, double resonance, decoupling, Overhauser effect, interpretation of 2D spectra and laboratory exercises including IR and Raman analysis, NMR interpretation, DEPT technique, 2D spectra analysis, concentration determination by Beer-Lambert law and electronic transitions based on Jablonski diagram.										
43	Biochemistry and Biophysics	Fundamental concepts of biochemistry and biophysics, cell structure and organelle functions, biologically important small molecules such as amino acids, nucleosides, fatty acids, sugars and phosphates, as well as macromolecules including proteins, nucleic acids, lipids and steroids. Macromolecular structure and function relationships, DNA and RNA, the genetic code, replication, transcription and translation, with selected applications in genetic engineering. Enzymes, their properties and catalytic fundamentals, membrane structure and transport mechanisms. Metabolic pathways, cellular energy sources, ATP synthesis, glycolysis and the Krebs cycle, basics of biological thermodynamics, information flow and the Gibbs equation. Muscle structure and function, sensory systems, blood-flow biophysics, effects of external fields, bioelectrochemistry and biomaterials. Laboratory practice includes protein and nucleic acid isolation and their separation by salting-out and electrophoresis.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
44	Nanomaterials	Fundamentals of nanoscience and nanotechnology, definitions and classification of nanomaterials, key challenges and current issues, surface physicochemistry and the stability of nanocrystals and nanoparticles. Methods of nanoparticle synthesis and modification, porous nanomaterials and size-dependent properties of metallic, semiconductor, oxide, carbon-based and polymeric nanomaterials. Environmental aspects of nanotechnology, biocompatibility and the circulation of nanoparticles in natural systems. Analytical methods for nanomaterials including STM, AFM, SEM, TEM, HR-TEM, spectrophotometric techniques, vibrational spectroscopy and scattering-based size analysis. Applications of nanoparticles and nanomaterials in medical diagnostics, targeted drug delivery, biomedical materials, construction chemistry, agrochemistry, textronics, electronics, optoelectronics, automotive and aerospace industries, and other technological fields.										
45	Calculation and Simulation Methods in Chemistry and Materials Science	Practical application of knowledge from lectures and laboratory classes to chemical and biochemical problems, including basic definitions of thermodynamic state descriptions and an introduction to simulations of chemical and biochemical systems, molecular dynamics, Monte Carlo methods and periodic boundary conditions. Simulation of chemical and biochemical reactions, calculation of PMF profiles and the use of umbrella sampling, together with related computational techniques such as docking and QM/MM approaches. Formats for representing molecular systems and principles of visualising and analysing results from computer simulations. Practical use of modern software for data representation and for visualising input and output data.										
46	German A2 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
47	German B1 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
48	German B2 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
49	Spanish A2 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
50	Spanish B1 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
51	Spanish B2 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
52	French A2 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
53	French B1 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
54	French B2 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
55	Italian A1 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
56	Italian A2 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
57	Polish A1 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
58	Polish A2 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										
59	German A1 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
60	Spanish A1 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.								x		
61	French A1 block II	Selected lexical and grammatical structures at different levels; topics relevant to academic mobility within the Erasmus+ programme; improvement of all language skills; development of the necessary interpersonal competences required in an international environment.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
62	Civic Knowledge and Engagement III	The development of social competences that go beyond the extra-curricular learning outcomes necessary for an informed and educated citizen of Poland, Europe and the world. To carry out various activities for the development of themselves and the University.					x					x
63	Synthesis and Physicochemical Properties of Polymer Components	Implementation of the project using the Problem-based Learning method, in which students, based on provided data, independently define the problem and determine the means necessary for its solution while becoming familiar with research methods and instrumentation used in specialised laboratories. The topics include the synthesis and spectroscopic analysis of esters, synthesis of polyamides and short peptides, production of nylons, and studies of biopolymers, including enzymatic hydrolysis of glycosidic bonds.										
64	Physicochemical Properties of Biobased Materials	The project is carried out using the Problem-based Learning (PBL) approach, in which students, based on provided data, independently define the problem and select the means needed to solve it. During the project they become familiar with research methods and equipment used in specialized laboratories. Proposed topics include: visualization of biomaterial surfaces, synthesis of catalysts based on natural zeolites, high-surface-area activated carbons from lignocellulosic materials, thermal decomposition of nature-inspired materials, identification of natural substances, isolation of compounds from biological sources, synthesis and spectroscopic analysis of esters, polyamides and the synthesis of short peptides and nylons, as well as biopolymers and enzymatic hydrolysis of glycosidic bonds.										
65	Modern Techniques in Biomaterials and Nanostructures Synthesis and Analysis I - Team Project	Team-based projects focused on the synthesis and modification of biomaterials and nanostructures. Application of advanced analytical and microscopic techniques in studies of biological and bioinspired materials. Investigation of physicochemical processes occurring in polymers, composites, and functional thin films.										
66	Modern Techniques in Biomaterials and Nanostructures Synthesis and Analysis II - Team Project	Analysis of synthesis, degradation, and transformation mechanisms of biomaterials and nanostructures under physical and chemical stimuli. Investigation of the structure, topology, and molecular organization of biomaterials, polymers, and functional thin films. Advanced interpretation of experimental data in projects focused on nanocomposites, biomolecules, and bioinspired materials.										
67	Biomaterials and Bio-Related Products	Project work carried out in groups, in which students analyse an assigned problem, search for and interpret information necessary to understand it, and prepare a document containing the problem analysis and a plan for experimental or computational work. The plan is then evaluated and revised, followed by the execution of laboratory or computational tasks with ongoing verification of results and the introduction of necessary adjustments. The final stage consists of preparing a comprehensive report and presenting the project to the other groups and the supervisor. Example project topics include:: hydrogels based on natural and synthetic polymers for biological applications, evaluation of cytochrome c and its derivatives in catalysis, oxidative stress and biomolecule degradation processes, synthesis of functionalised nanoparticles for cancer detection and drug delivery, microscopic techniques for biomaterial characterisation and isotopic authentication of products.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
68	History of Chemistry and Technology	The influence of alchemy and chemistry on the development of civilisation, the periodisation of the history of chemistry and the emergence of the chemical industry. The rationalisation of chemical thought, the development of the concepts of the atom and the element, the phlogiston theory and its revision, and the formulation of the law of conservation of mass. Polish chemistry in the time of Lavoisier, the transformation of chemistry into a quantitative science through the work of Dalton, Avogadro and Berzelius, and the establishment of Mendeleev’s periodic law. The growth of organic chemistry in the nineteenth century, the rise of stereochemistry and coordination chemistry, the beginnings of electrochemistry and thermochemistry, and the formation of solution chemistry. The expansion of industrial chemical synthesis, the evolution of environmental awareness, the emergence of nuclear chemistry, the impact of the world wars on the development of chemistry and environmental protection, and the post-war transformation of approaches to environmental stewardship.										
69	Polymer Composites Mimicking Nature	Issues related to the synthesis, properties, and selection of bioinspired composites and polymer materials for applications in various technological areas, implemented in the form of a project, in which each student is assigned a specific material topic to design. Exploring modern solutions based on biomimetic engineering, aimed at creating innovative polymer composites and technologies, such as coatings inspired by the structure of gecko paws, self-healing materials, materials with specific optical properties, self-cleaning coatings, lightweight wood-like composites, and new bioinspired nanocomposites.										
70	Emerging Technologies Inspired by Nature	Projects implemented using the Problem-Based Learning method include problem identification, defining the required knowledge, and selecting appropriate sources and tools, developing critical and analytical thinking. Designing optoelectronic devices from organic materials; synthesizing advanced materials for medical, structural, and electronic applications using bottom-up and top-down methods, nanostructure growth processes, chemical and physical techniques, and lithography; analyzing block, dendritic, star, and phospholipid copolymers; modeling electronic nanocomponents through current-voltage simulation; designing electronic and fluorescent biosensors with sensitivity and selectivity analysis; and nature-inspired hybrid materials.										
71	Tuning of Biobased Materials’ Applicabilities	A project based on the Problem-Based Learning method, involving work on a problem related to modulating the functional properties of biomaterials or materials derived from natural sources to improve performance in medicine, medical diagnostics, catalysis, biocatalysis and the development of new functional materials. Problem identification by students and determination of the required knowledge, sources and tools leading to an independent solution and its practical verification.										
72	Sustainable Methods of the Bio-based Materials Production	A project based on the problem-based learning method, involving the identification of a problem related to selecting synthesis methods for materials depending on their application and determining the necessary knowledge, materials, preparation methods, characterisation techniques and tools required to solve it. Confronting ideas with the literature, selecting an appropriate synthesis method, acquiring knowledge of characterisation techniques and choosing optimal methods for determining physicochemical properties. Developing synthesis methods for catalysts used in biomass conversion, analysing their structure and performing qualitative and quantitative characterisation, fostering critical and analytical thinking and the ability to use appropriate information sources.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
73	Labor Law and Protection of Intellectual Property	The history and general characteristics of labour law, including its sources, employment contracts, the employment relationship and its termination, rights and obligations of employees and employers, working time, leave, remuneration, dispute resolution, occupational health and safety, atypical forms of employment, parental rights, collective labour law and social insurance. Issues related to intellectual property, including definitions, Polish and EU regulations, copyright and related rights, the public domain, rights holders, permitted personal use, university-related copyright matters and criminal liability for infringements, including plagiarism. The impact of the cyber-revolution on copyright, modern technologies and piracy, the concept of free culture, and regulations concerning databases and industrial designs.					x					
74	Mobility Semester											
75	Internship	Practical training involving familiarisation with organisational structure, material management, production control, occupational safety, environmental management, and issues related to automation, process control and work organisation in an enterprise or research institute. Learning laboratory work, applied technologies, instrumentation, research standards, and the responsibilities of a chief technologist or research team leader, including their scope of duties and documentation. Solving problems according to the supervisor’s guidance and establishing professional contacts that may facilitate future employment.										
76	Standards and Regulations in Engineering	Exploring sources related to regulations and standards applicable to engineering techniques and manufactured products, including the ability to search for literature and online materials in specialised databases and critically assess their relevance. Developing skills in using technical standards and interpreting them within practical engineering contexts. Preparing an analysis of a standardisation-related problem assigned within the scope of engineering practice.										
77	Entrepreneurial Skills for Engineers	Business, soft, technical and managerial skills including leadership qualities, communication competencies and the abilities of an engineer-entrepreneur, complemented by financial aspects, customer needs and satisfaction, and the impact of engineering activities on business improvement, illustrated through examples of successful engineers. Stakeholder relations based on building trust, developing relationships and shaping influence. Project management carried out with consideration of economic factors and responsibility for operational effectiveness.										
78	Capstone Module	Implementation of interdisciplinary case-study project tasks, carried out in groups or individually and aligned with the Nanotechnology programme, requiring the use of knowledge and skills acquired in earlier stages of engineering studies as well as familiarity with project management principles and basic life-cycle analysis. Verification of learning outcomes through practical problem-solving and assessment of compliance with programme requirements. Preparation for the competency exam by mastering methodologies for solving problems similar to the case studies forming the basis of that examination.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
79	Bioresources, Bio-based Materials, Biodegradation	Classification, synthesis, application and development of biodegradable polymers, including polyhydroxyalkanoates, oxo-biodegradable polyolefins, aliphatic polyesters obtained via ring-opening polymerisation, biodegradable polyesteramides and natural-origin materials such as thermoplastic starch, sugar-based polymers, biodegradable protein nanoparticles, natural composites, fibres and lignocellulosic biomass used for functional biomaterial synthesis. Degradation mechanisms of polymers, including enzymatic breakdown and biodegradation, issues related to plastics and the natural environment, the role of degradable polymers in waste management, national and international standards for biodegradable materials, and the theory and structure of life-cycle assessment together with ISO 14040–14049 standards. Computer-aided methods for life-cycle assessment of products, material properties of biodegradable products and determination of typical characteristics of biodegradable materials.		x		x			x			
80	DT - Biomass Valorization and Influence of Bio-based Materials on Environment	Projects include the synthesis of catalysts for biomass conversion, modern technologies for producing biofuels and industrially relevant biochemicals, and the assessment of the environmental impact of natural-origin materials together with the design of nature-inspired adsorbents. Additional issues concern bio-waste management, including principles of storage, processing and recycling of biomaterials. Structural characterisation of biomaterials performed using XRD, ToF-SIMS, microscopic methods, BET, TPR, TPD, TPO and spectroscopic techniques enables the determination of functional groups, acid–base properties and corrosion susceptibility.										
81	DT - Functional Biobased Materials	Project involving work on issues related to the production and application of biomaterials or materials derived from natural resources with defined functions and performance properties in medicine, medical diagnostics, catalysis, biocatalysis and the development of new functional compounds and materials. Problem identification by students and determination of the required knowledge, sources and tools leading to an independently developed solution and its practical verification, supporting the development of critical and analytical thinking. Project seminars, experimental validation of the proposed solution, periodic progress assessment and final presentation of results.										
82	DT - New Instruments and Technologies for Biomaterials Modification and Characterization	The project involves working on a problem defined as: new instruments and technologies for the modification and characterization of biomaterials. 1. Hydrogel dressing for difficult-to-heal wounds - modification of natural polymers. 2. Natural polymers for dietary products. 3. Bioactive scaffolds for skin tissue regeneration. 4. New instruments for the characterization of biomaterials. 5. New instruments for the modification of biomaterials.										
83	DT - Advanced Polymer Biomaterials	This project involves defining and practically solving problems related to advanced polymeric biomaterials for medical applications, particularly functional biomaterials, encompassing a full spectrum of issues such as biofunctionality, biocompatibility, manufacturing and sterilization techniques, physicochemical properties, and functional properties. The work is carried out in small groups. The initial goal is to familiarize the group with the topic, searching for and defining a selected real-world problem within the topic. The group then attempts to diagnose the problem and prepare a work plan to solve it using available laboratory and/or computational techniques. Students then carry out the planned work using multiple methods, sharing information, analyzing and interpreting the results, and modifying the plan as needed. A final report is then prepared, focusing on whether the problem has been solved, and the presentation is discussed with other groups and tutors.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
84	DT - Applications of Smart Composites	The project involves working on a problem defined in the following areas: 1. Organic semiconductors for applications in electronic devices (collaboration with QWERTY); 2. Hydrogels for drug delivery; 3. Coatings for optical fibers; 4. Simulations of complex molecular materials; 5. Hybrid nanocomposites.										
85	Supramolecular Self-Organisation Inspired by Nature	Intermolecular interactions and host-guest systems, including definitions of self-assembly in soft matter, fundamentals of supramolecular chemistry, types of interactions, crown ethers, podands, cryptands, calixarenes, cyclodextrins, and mechanisms of ion binding and complex formation. Self-assembled systems and their applications, definitions and types of self-assembly, thermodynamic approaches, coordination compounds, catenanes, rotaxanes, supramolecular devices, monolayers, and various classes of liquid crystals and liquid crystalline polymers. Orientation on a substrate, ferroelectricity, and hierarchical processes leading to the formation of complex supramolecular structures.										
86	Self-assembling Bio-based Materials	The definition and classification of self-assembly and aggregation processes together with the factors governing them, including peptides and proteins as aggregation substrates, selected peptide and protein nanostructures, amyloids, collagen and structurally ordered polysaccharides and their aggregates such as chitin, alginates, hyaluronates and cellulose. Self-assembly of lipids and fats leading to the formation of new materials, including systems mimicking cellular membranes and walls, micelles, liposomes and vesicles, and the use of these phenomena in biomaterial design. Methods of biomaterial functionalisation, including functionalising and immobilising peptides and proteins, modifying polysaccharides and nucleotide-based biomaterials, creating pharmaceutically functionalised biomaterials and applying principles of supramolecular chemistry that exploit natural self-assembly mechanisms for supramolecule design.										
87	Interdisciplinary Project	Independent execution of a selected project by a small group of students with the option of consulting the project supervisor. Work based on Design Thinking, Flipped Learning and Problem-Based Learning techniques. Completion of the task using methods that foster creativity, collaboration and autonomous problem-solving.										
88	Monographic Lecture	The latest technical and technological achievements, industrial implementations and related problems.										
89	Diploma Project	Independent implementation by the student of research work constituting the basis for an engineering diploma thesis.										
90	Diploma Seminar	Presentation of research results forming the basis of an engineering diploma thesis. Competency examination.										
91	Diploma Thesis	The course involves the independent development of a topic forming the basis of the diploma thesis, including the definition of the objective, scope and rationale of the chosen problem, the analysis of relevant literature, and the preparation and execution of the experimental, analytical or project component. The student plans and documents the work, selects appropriate methods and tools, processes and interprets the results in relation to the defined objectives, and ultimately formulates conclusions and prepares a complete written thesis in accordance with editorial requirements and principles of academic integrity.										

No.	Course name	Program content	1ABB1	1ABB2	1ABB3	1ABB4	1ABB5	1ABB6	1ABB7	1ABB8	1ABB9	1ABB10
92	Frontiers in Chemical Technology	Modern chemical technology in the context of green chemistry, including atom economy, waste reduction and practical sustainable solutions, together with examples of advanced and multifunctional catalysts tailored to specific processes. An overview of current challenges in obtaining energy and fuels from fossil and renewable sources, modern petrochemical solutions, synthesis gas production, methanol and hydrocarbon synthesis, and the role of first-, second- and third-generation biomass. Hydrogen production from traditional and renewable sources, fuel-cell technologies and contemporary developments in chemical reactor design, including microreactors.										
93	Advanced Polymer Biomaterials	Natural and biodegradable polymers, bioconjugates, multifunctional polymeric materials, natural rubber as a biopolymer, natural fillers, properties and applications of biopolymers, EU regulations on polymer waste recycling, systematics of rubber waste, possibilities of its reprocessing, and the production of biopolymers from waste substrates, as well as the fundamentals of plasma processes, laser texturing, surface treatment techniques, and methods for assessing surface energy. Development of methods for the preparation, modification, and characterization of polymeric biomaterials in relation to lecture topics, including natural and biodegradable polymers, bioconjugates, fillers, recycling of polymer and rubber waste, and the use of waste substrates for biopolymer synthesis. Plasma and laser processes, surface techniques, and analysis of surface free energy and methods for assessing the surface condition of materials.										
94	Oxidative Modifications of Biomolecules and Biopolymers	The chemistry and biology of biologically relevant oxidants and selected reactive oxygen and nitrogen species, the concept of oxidative stress and physiological antioxidant defence mechanisms, as well as oxidative modifications of lipids, proteins, DNA and RNA together with their significance and detection methods. Biomarkers of oxidative stress used to assess disturbances in redox balance within organisms. Molecular probes designed for detecting reactive oxygen and nitrogen species and their applications in biological and biomedical research.										

ECTS - subjects

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
1	Mathematics I	7				7
2	Physics	6			6	6
3	General and Inorganic Chemistry	5			5	5
4	Information Technologies	3			3	3
5	Engineering Drawing	2			2	2
6	Study Skills for University	1	1			1
7	Introduction to Data Analysis	3			3	3
8	C1 Business Communication for Engineers 1	3		3		3
9	C2 Business Communication for Engineers 1	3		3		3
10	Mathematics II	7				7
11	Learning, Reporting and Presenting	2	2			2
12	Organic Chemistry	7			7	7
13	Computer-aided Design	3				3
14	C1 Business Communication for Engineers 2	2		2		2
15	C2 Business Communication for Engineers 2	2		2		2
16	Introduction to Laboratory Work	6				6
17	Civic Knowledge and Engagement I	1	1			1
18	Fundamentals of Business and Quality Management	2	2			2
19	Smart Information Technologies	4			4	4
20	Physical Chemistry	7			7	7

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
21	Analytical Methods	6			6	6
22	Electrotechnics and Introduction to Electronics	2			2	2
23	Advanced Data Analysis	3			3	3
24	Polymers	4			4	4
25	German A2 block I	3		3		3
26	German B1 block I	3		3		3
27	German B2 block I	3		3		3
28	Spanish A2 block I	3		3		3
29	Spanish B1 block I	3		3		3
30	Spanish B2 block I	3		3		3
31	French A2 block I	3		3		3
32	French B1 block I	3		3		3
33	French B2 block I	3		3		3
34	Italian A1 block I	3		3		3
35	Italian A2 block I	3		3		3
36	German A1 block I	3		3		3
37	Spanish A1 block I	3		3		3
38	French A1 block I	3		3		3
39	Polish A1 block I	3		3		3
40	Polish A2 block I	3		3		3
41	Civic Knowledge and Engagement II	1	1			1

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
42	Spectroscopy	5			5	5
43	Biochemistry and Biophysics	5			5	5
44	Nanomaterials	5			5	5
45	Calculation and Simulation Methods in Chemistry and Materials Science	2			2	2
46	German A2 block II	3		3		3
47	German B1 block II	3		3		3
48	German B2 block II	3		3		3
49	Spanish A2 block II	3		3		3
50	Spanish B1 block II	3		3		3
51	Spanish B2 block II	3		3		3
52	French A2 block II	3		3		3
53	French B1 block II	3		3		3
54	French B2 block II	3		3		3
55	Italian A1 block II	3		3		3
56	Italian A2 block II	3		3		3
57	Polish A1 block II	3		3		3
58	Polish A2 block II	3		3		3
59	German A1 block II	3		3		3
60	Spanish A1 block II	3		3		3
61	French A1 block II	3		3		3
62	Civic Knowledge and Engagement III	1	1			1

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
63	Synthesis and Physicochemical Properties of Polymer Components	3		3	3	3
64	Physicochemical Properties of Biobased Materials	3		3	3	3
65	Modern Techniques in Biomaterials and Nanostructures Synthesis and Analysis I - Team Project	6		6	6	6
66	Modern Techniques in Biomaterials and Nanostructures Synthesis and Analysis II - Team Project	6		6	6	6
67	Biomaterials and Bio-Related Products	7			7	7
68	History of Chemistry and Technology	1	1			1
69	Polymer Composites Mimicking Nature	5			5	5
70	Emerging Technologies Inspired by Nature	5			5	5
71	Tuning of Biobased Materials’ Applicabilities	5			5	5
72	Sustainable Methods of the Bio-based Materials Production	5			5	5
73	Labor Law and Protection of Intellectual Property	2	2			2
74	Mobility Semester	30		30		30
75	Internship	6				6
76	Standards and Regulations in Engineering	2				2
77	Entrepreneurial Skills for Engineers	2	2			2
78	Capstone Module	6		6	6	6
79	Bioresources, Bio-based Materials, Biodegradation	4			4	4
80	DT - Biomass Valorization and Influence of Bio-based Materials on Environment	4		4	4	4
81	DT - Functional Biobased Materials	4		4	4	4
82	DT - New Instruments and Technologies for Biomaterials Modification and Characterization	4		4	4	4
83	DT - Advanced Polymer Biomaterials	4		4	4	4

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
84	DT - Applications of Smart Composites	4		4	4	4
85	Supramolecular Self-Organisation Inspired by Nature	6		6	6	6
86	Self-assembling Bio-based Materials	6		6	6	6
87	Interdisciplinary Project	2		2	2	2
88	Monographic Lecture	2				2
89	Diploma Project	5		5	5	5
90	Diploma Seminar	3			3	3
91	Diploma Thesis	15		15	15	15
92	Frontiers in Chemical Technology	3		3	3	3
93	Advanced Polymer Biomaterials	3		3	3	3
94	Oxidative Modifications of Biomolecules and Biopolymers	3		3	3	3

ECTS indicators

Name	Value
The total number of ECTS credits that a student must obtain through elective courses (amounting to no less than 30% of the total ECTS credits required to obtain the qualification corresponding to the given level of study)	89/240 (37.08%)
The total number of ECTS credits to be earned by a student through courses in the fields of humanities or social sciences	13
The total number of ECTS credits that a student must obtain from courses related to research conducted at the university, amounting to more than 50% of the total ECTS credits required to graduate from a given level of study	153/240 (63.75%)

Methods of verifying and assessing learning outcomes

Learning outcomes are assessed systematically using diverse methods tailored to the nature of each course and its intended outcomes. These include:

Written and oral exams – assessing theoretical knowledge, analytical skills, and problem-solving abilities.
Quizzes and partial tests – enabling ongoing monitoring of progress.
Projects and laboratory work – verifying practical skills, research methods, data interpretation, and teamwork.
Presentations and seminars – assessing communication skills, argumentation, and presentation of research results.
Reports and documentation – evaluating data analysis and reporting skills.
Competency exam, diploma thesis, and defence – comprehensive verification of knowledge, skills, and social competencies.
Activity in discussions and participation in research projects – assessing engagement, independence, and teamwork abilities.
Detailed verification methods for each course are included in course syllabi.

Professional internships

Internship: 6 ECTS, duration 6 weeks

after the 4th semester – 2-week professional internship,
after the 6th semester – 4-week specialised internship.

Characteristics of the course

Graduate profile

Graduates of the ABIOM programme possess advanced knowledge in mathematics, physics, chemistry, biochemistry, materials science, and the fundamentals of materials engineering. They understand the complex relationships between the structure, composition, and properties of materials—including polymeric, biomimetic, and biobased materials—and their functionality, especially in engineering, biomedical, and high-tech applications. They are familiar with the basics of electrical engineering, electronics, information technologies, and computational methods used in the analysis and design of materials.

The graduates are able to conduct laboratory experiments involving the synthesis, modification, and evaluation of material properties, including biomaterials, polymers, and biomimetic and biobased composites. They can prepare samples, select measurement techniques, and apply modern analytical methods for nanostructure characterization. They are proficient in operating research equipment and digital tools supporting data analysis and modelling of material properties.

The graduates have engineering competencies including the design of technical solutions, risk assessment, application of engineering norms and standards, as well as the use of CAD tools and simulation methods. They understand the principles of sustainable development, can assess the environmental impact of biobased and biomimetic materials, and know the basics of biodegradation, biocompatibility, and material toxicity.

Thanks to project-based modules—including the Interdisciplinary Project, Capstone Module, and professional internship—the graduates can work in interdisciplinary teams, solve engineering problems, prepare technical documentation, and present project results. They also possess basic knowledge in entrepreneurship, quality management, labour law, and intellectual property protection, preparing them for functioning in a modern professional environment.

Because the programme is taught in English and includes a mandatory mobility module completed at foreign universities, the graduate is able to function in an international and multicultural work environment.

The relationship between the field of study and the university's strategy

The ABIOM programme aligns with the Strategy of Lodz University of Technology for 2025–2030, whose key objective is to develop an educational model preparing graduates for the dynamically changing needs of the socio-economic environment.

The ABIOM curriculum supports the following strategic goals of TUL:

Supporting scientific research addressing socio-economic challenges. ABIOM students participate in research projects linked to the industrial sector.
Developing mobility opportunities for staff, doctoral candidates, and students. ABIOM students and staff regularly take part in international exchanges; the mobility semester is an integral part of the programme.
Strengthening internationalisation in education. The programme is delivered in English and is popular among Erasmus+ students. Studies in the ABIOM program are available to international students.
Conducting socially and environmentally responsible research supporting a knowledge-based economy and interdisciplinary collaboration. Students can participate in industry-related research addressing societal and environmental needs. The programme is consulted with the Faculty Business Council to ensure alignment with labour-market expectations.
Modernising research infrastructure and ensuring its effective use. Students of the Faculty of Chemistry of Lodz University of Technology have access to specialized equipment and modern laboratories in the Alchemium building and other modern infrastructure belonging to the Faculty (including a technological hall dedicated to polymer and plastics technology, as well as biomaterials and nanomaterials laboratories).
Implementing clear and fair principles for hiring, remunerating, and promoting employees, while respecting tolerance and equality. The recruitment process for employees at the Faculty of Chemistry at Lodz University of Technology is based on the OTM-R policy – "Open, Transparent, and Merit-Based Recruitment Process."
Continuous improvement of academic teachers' competencies in modern teaching methods, the current state of knowledge, technological developments, and scientific trends. Academic teachers involved in teaching in the ABIOM program actively participate in numerous training courses, enhancing their qualifications, including in modern teaching methods. They learn modern teaching methods from international specialists visiting the Faculty of Chemistry, and participate in teaching at universities abroad.
Enhancing the educational offer in response to socio-economic challenges, with the Business Council actively shaping the curriculum.
Strengthening the talent management process by individualizing the education paths of students and doctoral students. Talented students can pursue studies according to an individual study program (IPS) or an individual organization of studies (IOS) and participate

in TUL's mentoring programs, such as E2TOP and “Uczelnie Przyszłości” (Universities of the Future).
Supporting the scientific development of undergraduate and graduate students, with an emphasis on interdisciplinarity and internationalization; increasing student participation in research conducted at the university and intensifying their practical experience outside the university. Students have the opportunity to participate in interdisciplinary research projects, for example, combining topics in chemistry, biology, medicine, materials science, and computer science. They can also participate in foreign trips and exchange programs (Erasmus+), internships in foreign laboratories, including as part of the mobile semester. Students also co-author scientific publications with international reach.
In summary, through these initiatives, the ABIOM programme fully aligns with the Strategy of Lodz University of Technology, offering high-quality education and preparing graduates for labour-market demands.

Educational objectives and employment and continuing education opportunities

The aim of the ABIOM programme is to prepare graduates for work as chemical engineers in the field of modern advanced materials, including biomaterials, polymeric materials, biomimetic materials, and modern chemical and materials technologies. The curriculum enables students to acquire the knowledge, skills, and social competencies necessary for engineering tasks, laboratory work, design, and analytical activities in an international environment.

Educational objectives are achieved through the development of:

· knowledge in mathematics, physics, chemistry, biochemistry, materials engineering, materials science, electrical engineering, and information technologies, essential for understanding the properties and functions of materials, including biomaterials, polymers, composites, and nanomaterials,

· experimental skills in synthesis, modification, and evaluation of material properties, analytical and physicochemical techniques, and laboratory equipment operation,

· analytical competencies enabling data analysis, use of statistical methods and digital tools, and critical interpretation of research results,

· engineering skills including technical design, application of engineering standards, CAD tools, simulation methods, IT technologies, and AI,

· project competencies developed through interdisciplinary projects, Capstone modules, and internships,

· environmental and ethical awareness related to sustainable development, biodegradation, recycling, upcycling, environmental impact, and responsible technology use,

· communication and language skills, including technical English, report writing, presentations, and project documentation,

· readiness for lifelong learning.

Career opportunities: Graduates are prepared to work in:

· research, control, and technological laboratories,

· companies specialising in advanced materials, biomaterials, polymers, composites, and nanomaterials,

· firms implementing biomimetic and bio-based technologies,

· sectors related to environmental protection, recycling, biotechnology, applied chemistry, and materials engineering,

· quality control, certification, and material-property assessment departments,

· technology startups and companies developing innovative materials and products,

· units involved in analysis, design, and implementation of new material technologies.

Thanks to strong language competencies, graduates are ready to work in international environments.

Further study opportunities: Graduates may continue their education:

· in second-cycle programmes in materials engineering, biomaterials, biotechnology, chemistry, nanotechnology, or related fields,

· in postgraduate studies related to advanced materials, bio-based technologies, quality management, environmental protection, materials design, or technological entrepreneurship,

· in international programmes, including English-language studies and mobility programmes.

Description of the process and outcome of consultations on the proposed study program with the socio-economic environment

Cooperation within the ABIOM programme is carried out through interactions with institutions and entities operating in the field of advanced materials, biomaterials, nanotechnology, and nature-inspired technologies. This includes exchanging information on current trends, industry needs, and technological development directions. Students can learn about real-world applications of advanced materials and analyse engineering problems reported by external partners, supporting the development of practical skills. Topics of projects and theses often relate to socio-economic challenges, fostering technological awareness, engineering responsibility, and competencies needed in professional environments related to advanced biomaterials and biomimetic technologies.

Description of competencies expected from a candidate applying for admission to studies

According to the Recruitment Resolution.

The unit organizing education

Faculty of Chemistry/CKM

Education program

Semester 1

Course	Number of hours	ECTS points	Form of verification	Obligatory
Mathematics I	Tutorials: 70 Lecture: 20	7	Exam	Obligatory
Physics	Tutorials: 30 Laboratory classes: 30 Lecture: 30	6	Exam	Obligatory
General and Inorganic Chemistry	Laboratory classes: 45 Lecture: 30	5	Exam	Obligatory
Information Technologies	Laboratory classes: 45	3	Graded assignment	Obligatory
Engineering Drawing	Tutorials: 20 Lecture: 10	2	Graded assignment	Obligatory
Study Skills for University	Tutorials: 30	1	Pass	Obligatory
Introduction to Data Analysis	Lecture: 15 Tutorials: 15	3	Graded assignment	Obligatory
Business Communication for Engineers 1		3	Graded assignment	Obligatory group
The student chooses one module from the group.				
C1 Business Communication for Engineers 1	Tutorials: 60	3	Graded assignment	Optional
C2 Business Communication for Engineers 1	Tutorials: 60	3	Graded assignment	Optional
Sum	**450**	**30**		

Semester 2

Course	Number of hours	ECTS points	Form of verification	Obligatory
Mathematics II	Tutorials: 35 Laboratory classes: 30 Lecture: 25	7	Exam	Obligatory
Learning, Reporting and Presenting	Seminar: 30	2	Graded assignment	Obligatory
Organic Chemistry	Tutorials: 25 Laboratory classes: 30 Lecture: 30	7	Exam	Obligatory
Computer-aided Design	Laboratory classes: 45	3	Graded assignment	Obligatory
Business Communication for Engineers 2		2	Exam	Obligatory group
The student chooses one module from the group.				
C1 Business Communication for Engineers 2	Tutorials: 30	2	Exam	Optional
C2 Business Communication for Engineers 2	Tutorials: 30	2	Exam	Optional
Introduction to Laboratory Work	Laboratory classes: 85	6	Graded assignment	Obligatory
Physical Education 1	Tutorials: 30	0	Pass	Obligatory
Civic Knowledge and Engagement I	Seminar: 3 Lecture: 3	1	Graded assignment	Obligatory
Fundamentals of Business and Quality Management	Project work: 10 Lecture: 20	2	Graded assignment	Obligatory
Sum	**431**	**30**		

Semester 3

Course	Number of hours	ECTS points	Form of verification	Obligatory
Smart Information Technologies	Laboratory classes: 45 E-learning: 15	4	Graded assignment	Obligatory

Course	Number of hours	ECTS points	Form of verification	Obligatory
Physical Chemistry	Tutorials: 30 Laboratory classes: 15 Lecture: 30	7	Exam	Obligatory
Analytical Methods	Tutorials: 10 Laboratory classes: 35 Project work: 10 Lecture: 20	6	Exam	Obligatory
Electrotechnics and Introduction to Electronics	Tutorials: 10 Laboratory classes: 10 Lecture: 10	2	Graded assignment	Obligatory
Advanced Data Analysis	Laboratory classes: 30	3	Graded assignment	Obligatory
Polymers	Laboratory classes: 30 Lecture: 30	4	Exam	Obligatory
Foreign Language Block I		3	Graded assignment	Obligatory group
The student chooses one module from the group.				
German A2 block I	Tutorials: 60	3	Graded assignment	Optional
German B1 block I	Tutorials: 60	3	Graded assignment	Optional
German B2 block I	Tutorials: 60	3	Graded assignment	Optional
Spanish A2 block I	Tutorials: 60	3	Graded assignment	Optional
Spanish B1 block I	Tutorials: 60	3	Graded assignment	Optional
Spanish B2 block I	Tutorials: 60	3	Graded assignment	Optional
French A2 block I	Tutorials: 60	3	Graded assignment	Optional
French B1 block I	Tutorials: 60	3	Graded assignment	Optional
French B2 block I	Tutorials: 60	3	Graded assignment	Optional
Italian A1 block I	Tutorials: 60	3	Graded assignment	Optional
Italian A2 block I	Tutorials: 60	3	Graded assignment	Optional
German A1 block I	Tutorials: 60	3	Graded assignment	Optional

Course	Number of hours	ECTS points	Form of verification	Obligatory
Spanish A1 block I	Tutorials: 60	3	Graded assignment	Optional
French A1 block I	Tutorials: 60	3	Graded assignment	Optional
Polish A1 block I	Tutorials: 60	3	Graded assignment	Optional
Polish A2 block I	Tutorials: 60	3	Graded assignment	Optional
Physical Education 2	Tutorials: 30	0	Pass	Obligatory
Civic Knowledge and Engagement II	Seminar: 3 Lecture: 3	1	Graded assignment	Obligatory
Sum	**426**	**30**		

Semester 4

Course	Number of hours	ECTS points	Form of verification	Obligatory
Spectroscopy	Laboratory classes: 30 Lecture: 30	5	Graded assignment	Obligatory
Biochemistry and Biophysics	Laboratory classes: 20 Lecture: 40	5	Exam	Obligatory
Nanomaterials	Laboratory classes: 30 Lecture: 30	5	Exam	Obligatory
Calculation and Simulation Methods in Chemistry and Materials Science	Laboratory classes: 20 Lecture: 10	2	Graded assignment	Obligatory
Foreign Language Block II		3	Graded assignment	Obligatory group
The student chooses one module from the group.				
German A2 block II	Tutorials: 60	3	Graded assignment	Optional
German B1 block II	Tutorials: 60	3	Graded assignment	Optional
German B2 block II	Tutorials: 60	3	Graded assignment	Optional
Spanish A2 block II	Tutorials: 60	3	Graded assignment	Optional

Course	Number of hours	ECTS points	Form of verification	Obligatory
Spanish B1 block II	Tutorials: 60	3	Graded assignment	Optional
Spanish B2 block II	Tutorials: 60	3	Graded assignment	Optional
French A2 block II	Tutorials: 60	3	Graded assignment	Optional
French B1 block II	Tutorials: 60	3	Graded assignment	Optional
French B2 block II	Tutorials: 60	3	Graded assignment	Optional
Italian A1 block II	Tutorials: 60	3	Graded assignment	Optional
Italian A2 block II	Tutorials: 60	3	Graded assignment	Optional
Polish A1 block II	Tutorials: 60	3	Graded assignment	Optional
Polish A2 block II	Tutorials: 60	3	Graded assignment	Optional
German A1 block II	Tutorials: 60	3	Graded assignment	Optional
Spanish A1 block II	Tutorials: 60	3	Graded assignment	Optional
French A1 block II	Tutorials: 60	3	Graded assignment	Optional
Physical Education 3	Tutorials: 30	0	Pass	Obligatory
Civic Knowledge and Engagement III	Seminar: 3 Lecture: 3	1	Graded assignment	Obligatory
Elective Course 1		3	Graded assignment	Obligatory group
The student chooses one course from the group.				
Synthesis and Physicochemical Properties of Polymer Components	Laboratory classes: 25 Project work: 20	3	Graded assignment	Optional
Physicochemical Properties of Biobased Materials	Laboratory classes: 25 Project work: 20	3	Graded assignment	Optional
Elective Course 2		6	Graded assignment	Obligatory group
The student chooses one course from the group.				
Modern Techniques in Biomaterials and Nanostructures Synthesis and Analysis I - Team Project	Project work: 60	6	Graded assignment	Optional

Course	Number of hours	ECTS points	Form of verification	Obligatory
Modern Techniques in Biomaterials and Nanostructures Synthesis and Analysis II - Team Project	Project work: 60	6	Graded assignment	Optional
Sum	**411**	**30**		

Semester 5

Course	Number of hours	ECTS points	Form of verification	Obligatory
Biomaterials and Bio-Related Products	Laboratory classes: 20 Project work: 60 Lecture: 15	7	Exam	Obligatory
History of Chemistry and Technology	Lecture: 15	1	Graded assignment	Obligatory
Polymer Composites Mimicking Nature	Project work: 60	5	Graded assignment	Obligatory
Emerging Technologies Inspired by Nature	Project work: 60	5	Graded assignment	Obligatory
Tuning of Biobased Materials’ Applicabilities	Project work: 60	5	Graded assignment	Obligatory
Sustainable Methods of the Bio-based Materials Production	Project work: 60	5	Graded assignment	Obligatory
Labor Law and Protection of Intellectual Property	Lecture: 30	2	Graded assignment	Obligatory
Sum	**380**	**30**		

Semester 6

Course	Number of hours	ECTS points	Form of verification	Obligatory
Mobility Semester	Total number of contact hours: 375	30	Graded assignment	Obligatory subjects to choose from
Sum	**375**	**30**		

Semester 7

Course	Number of hours	ECTS points	Form of verification	Obligatory
Internship	Internship: 0	6	Pass	Obligatory
Standards and Regulations in Engineering	Project work: 30	2	Graded assignment	Obligatory
Entrepreneurial Skills for Engineers	Project work: 15 Lecture: 15	2	Graded assignment	Obligatory
Capstone Module	Project work: 110	6	Graded assignment	Obligatory subjects to choose from
Bioresources, Bio-based Materials, Biodegradation	Project work: 40 Lecture: 20	4	Exam	Obligatory
Elective Course 3		4	Graded assignment	Obligatory group
The student chooses one course from the group.				
DT - Biomass Valorization and Influence of Bio-based Materials on Environment	Project work: 60	4	Graded assignment	Optional
DT - Functional Biobased Materials	Project work: 60	4	Graded assignment	Optional
DT - New Instruments and Technologies for Biomaterials Modification and Characterization	Project work: 60	4	Graded assignment	Optional
DT - Advanced Polymer Biomaterials	Project work: 60	4	Graded assignment	Optional
DT - Applications of Smart Composites	Project work: 60	4	Graded assignment	Optional
Elective Course 4		6	Exam	Obligatory group
The student chooses one course from the group.				
Supramolecular Self-Organisation Inspired by Nature	Project work: 40 Lecture: 20	6	Exam	Optional
Self-assembling Bio-based Materials	Project work: 40 Lecture: 20	6	Exam	Optional
Sum	**350**	**30**		

Semester 8

Course	Number of hours	ECTS points	Form of verification	Obligatory
Interdisciplinary Project	Project work: 30	2	Graded assignment	Obligatory
Monographic Lecture	Lecture: 30	2	Graded assignment	Obligatory
Diploma Project	Project work: 90	5	Graded assignment	Obligatory subjects to choose from
Diploma Seminar	Seminar: 15	3	Graded assignment + exam	Obligatory
Diploma Thesis	Diploma Thesis: 0	15	Pass	Obligatory subjects to choose from
Elective Course 5		3	Exam	Obligatory group
The student chooses one course from the group.				
Frontiers in Chemical Technology	Project work: 40 Lecture: 20	3	Exam	Optional
Advanced Polymer Biomaterials	Project work: 40 Lecture: 20	3	Exam	Optional
Oxidative Modifications of Biomolecules and Biopolymers	Project work: 40 Lecture: 20	3	Exam	Optional
Sum	**225**	**30**		