



Lodz University
of Technology

Study programme

Faculty:	Faculty of Biotechnology and Food Sciences
Major:	Industrial Biotechnology (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:	Industrial Biotechnology (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):	7
The number of ECTS points required to complete studies:	210
Total number of hours of classes:	2703
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:	108
Professional title awarded to graduates:	inżynier
ISCED code:	0711
Language of study:	English

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

Discipline	Percentage share
Food technology and nutrition	65%
Chemical engineering	25%
Chemical science	10%

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	1IBT1	Knows and understands advanced concepts, mechanisms and relationships in the field of industrial biotechnology, in particular those relating to the molecular and cellular basis of biological processes, their kinetics and the principles of modeling and optimization for the needs of the modern biotechnology industry.	P6U_W	P6S_WG
2	1IBT10	Is ready to perform professional roles of a biotechnology engineer responsibly, with respect for professional ethics and with due regard for safety, health, and environmental protection.	P6U_K	P6S_KR
3	1IBT2	Knows and understands the principles, methods, and tools necessary for the design, operation, scale-up, and optimization of industrial biotechnological processes.	P6U_W	P6S_WG, P6S_WG_inž
4	1IBT3	Knows and understands the systemic, economic, legal and ethical conditions of engineering activities in the biotechnology industry and the basic principles of creating and developing various forms of entrepreneurship.	P6U_W, P6U_U	P6S_WK, P6S_WK_inž, P6S_UW_inž
5	1IBT4	Is able to design, implement, and analyze biotechnological processes at laboratory and pilot scale, integrating interdisciplinary knowledge to solve engineering problems.	P6U_U	P6S_UW, P6S_UO, P6S_UW_inž
6	1IBT5	Is able to perform advanced laboratory work using microbiological, molecular biology, and process analytics techniques, in accordance with health and safety regulations and Good Laboratory Practice (GLP).	P6U_U	P6S_UW, P6S_UW_inž
7	1IBT6	Is able to use digital and bioinformatics tools to acquire, analyze, and interpret data in order to support technological decision-making.	P6U_U	P6S_UW, P6S_UU, P6S_UW_inž
8	1IBT7	Is able to communicate effectively in a professional environment using specialist terminology from biotechnology and process engineering, organize teamwork, and actively participate in technical discussions, including in a foreign language at the B2 level of the Common European Framework of Reference for Languages (CEFR).	P6U_U	P6S_UK, P6S_UO
9	1IBT8	Is ready to critically evaluate their knowledge and received information, address engineering problems responsibly, and seek expert opinion.	P6U_K, P6U_U	P6S_KK, P6S_UW_inž
10	1IBT9	Is ready to integrate sustainability criteria and environmental responsibility into decision-making processes and to think and act in an entrepreneurial manner, observing the principles of ethics and transparency in engineering practice in the biotechnology industry.	P6U_K	P6S_KO

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

No.	Course name	Program content	1IBT1	1IBT10	1IBT2	1IBT3	1IBT4	1IBT5	1IBT6	1IBT7	1IBT8	1IBT9
1	Mathematics I	Elements of logic. Elementary functions. Differential and integral calculus of functions of one variable with applications. Algebra: matrix calculus, systems of linear equations.	x						x		x	
2	Physics	Fundamentals of scientific methodology, dimensional analysis, and mathematical tools in physics. Introduction to kinematics and dynamics of a material point, conservation laws, oscillations and waves. Basics of electrostatics and magnetism including Maxwell's equations. Computational exercises for selected topics.	x						x		x	
3	Introduction to Industrial Biotechnology	The interdisciplinarity of industrial biotechnology – from traditional fermentations to modern processes using genetic engineering and bioinformatics; the colors of biotechnology, industrial applications and issues of ethics, regulations and career prospects in the biotech sector.	x	x			x				x	
4	General and Inorganic Chemistry	Fundamentals of general and inorganic chemistry: atomic structure, the periodic table, chemical bonding, stoichiometry, reactions in aqueous solutions, chemical equilibrium, acids and bases, and electrochemistry. Elements of inorganic chemistry relevant to bioprocesses. Basic laboratory techniques, synthesis, qualitative and quantitative analysis.	x					x			x	
5	Information Technology	Computer systems, data coding, software, networks, and security. Lab: Advanced MS Office tools (Word, Excel, PowerPoint), data analysis, regression, forecasting, VBA macros, graphics (Gimp), Linux systems, and open source applications. Practical applications in laboratory data processing.							x	x	x	
6	Engineering Drawing	Fundamentals of technical drawing: standards, symbols, axonometric and orthographic projections (European and American), cross-sections, dimensioning, tolerances. Sketching, reading and creating technical drawings, preparation for designing bioprocess equipment.		x	x				x			
7	C1 Business Communication for Engineers 1	Selected lexical and grammatical structures at C1 or C2 level; topics relevant to the academic and professional environments of university graduates; improving all language skills; developing key interpersonal skills required in the workplace.		x						x	x	
8	C2 Business Communication for Engineers 1	Selected lexical and grammatical structures at C1 or C2 level; topics relevant to the academic and professional environments of university graduates; improving all language skills; developing key interpersonal skills required in the workplace.		x						x	x	
9	Study Skills for University	Preparing students for conscious and effective learning. Familiarising them with basic tools and techniques necessary for the learning process and the principles of academic culture. Presenting the general concept of education in a given field of study, the structure of the programme and the research and educational infrastructure used in the education process.		x		x				x		

No.	Course name	Program content	1IBT1	1IBT10	1IBT2	1IBT3	1IBT4	1IBT5	1IBT6	1IBT7	1IBT8	1IBT9
10	Mathematics II	Differential and integral calculus of functions of multiple variables: partial derivatives, interpretation, extrema, double integrals, and applications. Ordinary differential equations: solving selected types of equations and their applications to modeling. Probability and statistics: descriptive statistics, random variables, estimation, and hypothesis testing.	x						x		x	
11	Modern Physics	Fundamentals of optics, quantum mechanics, atomic structure, nuclear physics, special theory of relativity, and cosmology. Phenomena: light as a wave/particle, the Schrödinger equation, radioactivity, fission, fusion, time dilation, length contraction, the Big Bang theory.	x						x		x	
12	Organic Chemistry for Bioprocesses	Selected elements of organic chemistry focused on bioprocesses: C hybridization, polarity, nucleophile/electrophile, acidity-baseness and pKa; stereochemistry (chirality, nancio-/diastereoisomerism); functional groups of biomolecules, key reaction mechanisms, review of selected heterocyclic compounds	x					x			x	
13	Cell Biology and Microbiology	Cell structure. Application of microscopic techniques – morphology, cell size, and microorganism abundance. Physiological characteristics and metabolic activity of selected groups of bacteria, yeasts, and molds. The importance of microorganisms in the natural environment and their use in biotechnological processes.	x					x			x	
14	Principles of Sustainable Engineering	Sustainability concepts, indicators and corporate responsibility in bio-based industries. Students analyse environmental technologies, renewable energy, climate policy, EIA/SEA and cost-benefit tools from a strategic, communication and market perspective.				x	x					x
15	Computer Aided Design	3D parametric design in Creo. Sketchpad, constraints, dimensioning. Solids: extrude, revolve, thin-walled, blend, sweep. Creating assemblies and mechanisms. Generating 2D documentation (views, sections, dimensioning). Individual final project – part and assembly model with technical drawing.			x				x		x	
16	C1 Business Communication for Engineers 2	Selected lexical and grammatical structures at C1 or C2 level; topics relevant to the academic and professional environments of university graduates; improving all language skills; developing key interpersonal skills required in the workplace.		x		x				x		
17	C2 Business Communication for Engineers 2	Selected lexical and grammatical structures at C1 or C2 level; topics relevant to the academic and professional environments of university graduates; improving all language skills; developing key interpersonal skills required in the workplace.		x		x				x		
18	Civic Knowledge and Engagement I	Developing social competences that go beyond the specific learning outcomes, necessary for a conscious, empathetic and educated citizen of Poland, Europe and the world. Implementing various activities aimed at personal development, the development of the University and local communities.				x				x	x	
19	Industrial Microbiology	Isolation, cultivation, and identification of microorganisms. Industrial strain improvement. Physiology and metabolic diversity of industrial bacteria, yeasts, and moulds. Products of industrial microbiology. Principles of fermentation in industrial biotechnology and bioprocess control. Controlled vs. spontaneous fermentations and microbial consortia. Starter culture selection.	x					x			x	x

No.	Course name	Program content	1BT1	1BT10	1BT2	1BT3	1BT4	1BT5	1BT6	1BT7	1BT8	1BT9
20	Biophysics with Elements of Physical Chemistry	Application of physicochemical and biophysical methods to describe phenomena occurring in biological systems and biotechnological processes; chemical kinetics, elements of biothermodynamics, interaction of electromagnetic radiation with matter, and description of intermolecular interactions.	x					x			x	
21	Bioprocess Engineering Fundamentals and Equipment	Principles of fluid mechanics and thermodynamics. Types of ideal bioreactors, mathematical description, and bioreactor balance. Kinetics of microbial growth and growth models. Membrane separation in bioprocess engineering. Cultivation of microalgae and photobioreactors. Basic equipment in biotechnology.			x		x				x	x
22	Biochemistry and Enzymology	Structure and properties of amino acids, peptides, proteins, sugars, lipids, and nucleic acids. Biocatalysis (kinetics, inhibition, coenzymes); Metabolism (glycolysis, Krebs cycle, respiratory chain, photosynthesis). Kinetics of enzymatic reactions and enzyme activity. Purification, immobilization, and applications of enzymes.	x					x		x	x	
23	Statistics and Data Visualisation	Descriptive statistics and visualization of experimental data. Estimation of population parameters. Testing statistical hypotheses regarding population parameters and distribution shapes. Analysis of single-variable correlation and regression, models reducible to linear models. Use of specialized computer software supporting statistical analysis.	x						x		x	
24	German A1 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
25	German A2 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
26	German B1 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
27	German B2 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
28	Spanish A1 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
29	Spanish A2 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	

No.	Course name	Program content	11BT1	11BT10	11BT2	11BT3	11BT4	11BT5	11BT6	11BT7	11BT8	11BT9
30	Spanish B1 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
31	Spanish B2 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
32	French A1 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
33	French A2 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
34	French B1 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
35	French B2 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
36	Italian A1 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
37	Italian A2 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
38	Polish A1 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	
39	Polish A2 block I	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing the necessary interpersonal skills required in an international environment.		x						x	x	

No.	Course name	Program content	1IBT1	1IBT10	1IBT2	1IBT3	1IBT4	1IBT5	1IBT6	1IBT7	1IBT8	1IBT9
40	Interdisciplinary Problem-Based Learning Project	The project was implemented in interdisciplinary teams. Problem-solving methodology: 6W, PEST, 5 Whys, Ishikawa diagram, SWOT. Teamwork – roles, group development stages. Project stages: problem analysis, solution search, prototyping, testing. Mid-term and final presentations. Project documentation.		x	x					x	x	
41	Civic Knowledge and Engagement II	Developing social competences that go beyond the specific learning outcomes, necessary for a conscious, empathetic and educated citizen of Poland, Europe and the world. Implementing various activities aimed at personal development, the development of the University and local communities. Assessment based on documented activity.				x				x	x	
42	Fermented Food and Beverages	Fermented beverage production technologies (beer, wine, spirits, soft drinks). Fermentation in baking, dairy, and vegetable processing. Laboratory production of fermented foods, analysis of raw materials and products, distillation, and rectification.	x				x	x			x	
43	Genetics and Molecular Biology	Structure and function of genes: replication, transcription, translation, mutations, genetic variation, recombinant DNA, RNA processing, oligonucleotide-based therapies. Metabolic pathways and integration, epigenetics, membrane and nuclear receptors, cell cycle, DNA repair, significance in biotechnology.	x							x	x	
44	Cell Culture Technologies and Immunotechniques	Types of in vitro animal cell cultures (primary, normal and continuous cell lines, transformed cells, stem cells, 3D cell cultures). Their use in basic research, as therapeutics and in industry, i.e., preclinical research; antibody production and engineering; 3D cell cultures for the production of animal-derived products.	x					x		x	x	
45	Environmental Biotechnology	Basic indicators of wastewater and soil contamination. Biological wastewater treatment, activated sludge process, trickling filtration. Anaerobic processing of wastewater and organic waste, biomethane and biohydrogen production. Composting. Bioremediation and phytoremediation.			x		x	x				x
46	Downstream Processing and Product Development	Downstream operations in biotechnology: biomass separation, cell lysis, clarification, concentration, and purification (filtration, centrifugation, ultrafiltration, chromatography). Product recovery and purity assessment. Fundamentals of bioproduct formulation and quality assessment, and upstream-downstream integration.			x		x				x	x
47	Civic Knowledge and Engagement III	Developing social competences that go beyond the specific learning outcomes, necessary for a conscious, empathetic and educated citizen of Poland, Europe and the world. Implementing various activities aimed at personal development, the development of the University and local communities.				x				x	x	
48	German A1 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
49	German A2 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	

No.	Course name	Program content	1IBT1	1IBT10	1IBT2	1IBT3	1IBT4	1IBT5	1IBT6	1IBT7	1IBT8	1IBT9
50	German B1 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
51	German B2 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
52	Spanish A1 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
53	Spanish A2 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
54	Spanish B1 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
55	Spanish B2 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
56	French A1 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
57	French A2 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
58	French B1 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
59	French B2 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	

No.	Course name	Program content	1IBT1	1IBT10	1IBT2	1IBT3	1IBT4	1IBT5	1IBT6	1IBT7	1IBT8	1IBT9
60	Italian A1 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
61	Italian A2 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
62	Polish A1 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
63	Polish A2 block II	Selected lexical and grammatical structures at different levels of proficiency; topics relevant to academic mobility within the Erasmus+ programme; improving all language skills; developing of the necessary interpersonal skills required in an international environment.		x						x	x	
64	Team Project	Team project: problem analysis, stakeholder identification, problem definition, solution development, prototyping, testing. Midterm and final presentations with question-and-answer sessions. Technical report. Weekly advisory meetings. Project documentation (schedules, meeting minutes).		x		x				x	x	
65	Bioreactor Engineering and Scale-up	Types of laboratory and industrial bioreactors, similarity criteria, scale-up strategies, modeling. Design: bioreactor selection, process parameters, scale-up simulations. Laboratory: laboratory-scale cultures, kLa determination, mixing, aeration; comparison of parameters at 1L and 5L scales, slurry-phase bioreactors			x		x				x	
66	Bioinformatics and Machine Learning Tools in Biotechnology	The scope of bioinformatics, an overview of on-line available bioinformatic databases available from NCBI, EBI and others. Commonly used software for retrieving and analysis of sequence data of proteins and genes. Methods for pairwise and multiple sequences alignment, tree building. Practical usage of freeware bioinformatic tools such as e.g. BLAST, or MEGA (theory of program function, general strategies of usage). Application of machine-learning based AlphaFold tool.	x						x		x	
67	Genetic Engineering	Tools in genetic engineering. Workflow of cloning experiment and details about essential molecular tools: cloning vectors, restriction enzymes, DNA ligase, polymerases, methods of DNA extraction from cells, DNA electrophoresis. Polymerase chain reaction (PCR) and cDNA synthesis - primers and optimization. Standard hosts for production of genetically engineered proteins and appropriate expression vectors. Techniques of transformation. Optimization of protein expression in a new host. Genome editing with CRIPR: advantages and limitation of the technique in different cellular models. Construction of mutants.	x					x			x	
68	Metabolic Engineering for Precision Fermentation	Precision fermentation and metabolic engineering used for functional food ingredients production to optimise post-translational modifications, increase the solubility of recombinant proteins, development of low-cost and stable formulations tailored to cell lines. Plant molecular farming to grow and "express" proteins, enzymes, and other bioactive compounds that can be extracted post-harvest.	x					x	x		x	

No.	Course name	Program content	1IBT1	1IBT10	1IBT2	1IBT3	1IBT4	1IBT5	1IBT6	1IBT7	1IBT8	1IBT9
69	Next-Generation Food Biotechnology	Biotechnology for development of modern functional food ingredients: plant and insect proteins, cultured meat, lipid- rich ingredients, vitamins, aminoacids, biocatalysts, bioactives, alternative carbohydrates, biopreservatives, sensory additives. Bioactives in superfoods, nutraceuticals and herbal products. Natural toxins in food, toxicology, ADME and legal aspects.	x					x	x			x
70	Quality, Regulatory and Process Validation	quality and safety control in industrial biotechnology and bioproduct manufacturing, including ISO, HACCP, GMP/GLP and GLOBAL G.A.P. Analytical methods, monitoring strategies, sampling, measurement accuracy and process validation in compliance with regulatory standards.		x		x			x		x	
71	Capstone Module: Entrepreneurship & Innovation in Biotechnology	Managing innovation projects, R&D financing, innovation analysis, and preparing technology proposals. Managing time, costs, risks, and teams. Intellectual property, standardization, quality systems, and product launch. Sustainability assessment and life cycle analysis (LCA) in industrial biotechnology.		x			x		x	x		
72	Mobility Semester											
73	Diploma Seminar	Techniques for writing and reporting on scientific papers, including literature related to the topic of the thesis. Methods of preparing scientific documentation, reporting the assumptions, scope, and method of solving the research problem. Presentation of research results and their critical evaluation. Discussions on the merits.				x	x			x	x	
74	Diploma Thesis	Analysis of the literature on the subject, development of a research concept, implementation of laboratory experiments, interpretation of the obtained data, and then preparation of the work in printed and electronic form.				x	x		x		x	
75	Biopolymers	Topics in biotechnology, biomaterials engineering and ecology, methods of biosynthesis and obtaining polymers of natural origin (in particular microbiological ones, e.g. cellulose, PLA, alginate), their properties and applications; methods of modifying biopolymers, their functionalization and applications in the food industry, medicine and tissue engineering.	x					x			x	
76	Internship	After the sixth semester, students complete a minimum of six weeks of internships in industrial plants or research laboratories. The detailed scope of the training takes into account the specific nature of the workplace and the intern's academic profile. In consultation with the intern's supervisor, the student develops a detailed internship program and submits it to the university internship supervisor for approval. The detailed program is attached to the Vocational Internship Referral.					x	x		x		
77	Elective Project	Implementation of an interdisciplinary case study project, combined with a study visit to a production facility. It includes analysis of actual technological processes, identification of problems, and development of solutions. The goal is to improve modular competencies and develop new skills in the field of industrial biotechnology.					x		x	x	x	
78	Design of Molecules in Red Biotechnology	Principles of recombinant protein production. Methods in structural biology (X-ray, cryoEM, NMR, others). Analysis of experimental structures or stucture models of proteins for rational design of molecular probes. High-throughput screening. In silico homology modeling and docking of small-molecule libraries. Methods of binding affinity determination. Drug design - from biological target to clinical trials. Recombinant protein expression and purification for crystallization and bioinformatic tools used in the design of molecular probes.	x	x					x			

No.	Course name	Program content	11BT1	11BT10	11BT2	11BT3	11BT4	11BT5	11BT6	11BT7	11BT8	11BT9
79	Industry 4.0 in Biotechnology	Study visits to selected fermentation industry facilities (e.g. breweries, wineries, bakeries, dairies, distilleries). Student presentations integrating observations from industrial practice with independent analysis of modern and emerging fermentation technologies. Innovations applied across various sectors of the fermentation industry.	x	x					x			
80	Omics in Biotechnology	Designing omics experiments using proteomics, metabolomics and transcriptomics, practical applications of MALDI-TOF MS, NGS sequencing and HPLC in the analysis of biological systems, diagnostics and scientific research, interpretation of results using bioinformatics and statistical tools.	x	x					x			

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	3				3
3	Introduction to Industrial Biotechnology	3			3	3
4	General and Inorganic Chemistry	8			8	8
5	Information Technology	3			3	3
6	Engineering Drawing	2				2
7	C1 Business Communication for Engineers 1	3		3		3
8	C2 Business Communication for Engineers 1	3		3		3
9	Study Skills for University	1	1			1
10	Mathematics II	7				7
11	Modern Physics	3				3
12	Organic Chemistry for Bioprocesses	6			6	6
13	Cell Biology and Microbiology	6			6	6
14	Principles of Sustainable Engineering	2			2	2
15	Computer Aided Design	3			3	3
16	C1 Business Communication for Engineers 2	2		2		2
17	C2 Business Communication for Engineers 2	2		2		2
18	Civic Knowledge and Engagement I	1	1	1		1
19	Industrial Microbiology	3			3	3
20	Biophysics with Elements of Physical Chemistry	3			3	3

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
21	Bioprocess Engineering Fundamentals and Equipment	4			4	4
22	Biochemistry and Enzymology	8			8	8
23	Statistics and Data Visualisation	3				3
24	German A1 block I	3		3		3
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 A1 block I	3		3		3
29	Spanish A2 block I	3		3		3
30	Spanish B1 block I	3		3		3
31	Spanish B2 block I	3		3		3
32	French A1 block I	3		3		3
33	French A2 block I	3		3		3
34	French B1 block I	3		3		3
35	French B2 block I	3		3		3
36	Italian A1 block I	3		3		3
37	Italian A2 block I	3		3		3
38	Polish A1 block I	3		3		3
39	Polish A2 block I	3		3		3
40	Interdisciplinary Problem-Based Learning Project	5				5
41	Civic Knowledge and Engagement II	1	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	Fermented Food and Beverages	4			4	4
43	Genetics and Molecular Biology	4			4	4
44	Cell Culture Technologies and Immunotechniques	3			3	3
45	Environmental Biotechnology	5			5	5
46	Downstream Processing and Product Development	4			4	4
47	Civic Knowledge and Engagement III	1	1	1		1
48	German A1 block II	3		3		3
49	German A2 block II	3		3		3
50	German B1 block II	3		3		3
51	German B2 block II	3		3		3
52	Spanish A1 block II	3		3		3
53	Spanish A2 block II	3		3		3
54	Spanish B1 block II	3		3		3
55	Spanish B2 block II	3		3		3
56	French A1 block II	3		3		3
57	French A2 block II	3		3		3
58	French B1 block II	3		3		3
59	French B2 block II	3		3		3
60	Italian A1 block II	3		3		3
61	Italian A2 block II	3		3		3
62	Polish A1 block II	3		3		3

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
63	Polish A2 block II	3		3		3
64	Team Project	12				12
65	Bioreactor Engineering and Scale-up	3			3	3
66	Bioinformatics and Machine Learning Tools in Biotechnology	3			3	3
67	Genetic Engineering	4			4	4
68	Metabolic Engineering for Precision Fermentation	3			3	3
69	Next-Generation Food Biotechnology	3			3	3
70	Quality, Regulatory and Process Validation	4	4		4	4
71	Capstone Module: Entrepreneurship & Innovation in Biotechnology	10			10	10
72	Mobility Semester	30		30		30
73	Diploma Seminar	3			3	3
74	Diploma Thesis	15	15		15	15
75	Biopolymers	2			2	2
76	Internship	6				6
77	Elective Project	2			2	2
78	Design of Molecules in Red Biotechnology	2		2	2	2
79	Industry 4.0 in Biotechnology	2		2	2	2
80	Omics in Biotechnology	2		2	2	2

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)	46/210 (21.9%)
The total number of ECTS credits to be earned by a student through courses in the fields of humanities or social sciences	23
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	117/210 (55.71%)

Methods of verifying and assessing learning outcomes

The verification of achieved learning outcomes requires the use of diverse assessment methods appropriate to the categories of knowledge, skills, and social competencies to which these outcomes pertain. The selection of suitable tools also depends on the specific nature of the subject and the format of the classes and is described in detail in the course syllabi. The achievement of the required learning outcomes is assessed through:

1. Written assignments (exams, quizzes, reports, essays, projects, posters, thesis, etc.);
2. Oral assessments (oral exams, public speaking, e.g., delivering a paper, presentation, etc.);
3. Practical and/or project-based tasks (both individual and group work);
4. Observation and evaluation of students' participation and activity during classes;
5. Self-assessment and peer evaluation (especially in the case of group projects);
6. Competency exams and final diploma examinations.

Verification can be formative (partial, conducted multiple times during the course) and/or summative (final grade assessment). The final verification result is given according to the currently applicable grading scale.

The course coordinator or instructor is required to present the course syllabus during the first class and to clearly define and formally communicate the assessment methods and conditions for verifying learning outcomes.

Professional internships

Duration: 6 weeks

ECTS credits: 6

Internships are carried out in accordance with the study program in a format adapted to the profile and specifics of the field of study, following the regulations set by the faculty and the university.

Specializations/degree paths offered within the study program

Characteristics of the course

Graduate profile

A graduate of the Industrial Biotechnology program possesses a well-established and interdisciplinary knowledge base encompassing both the natural sciences and process engineering. This enables them to understand, design, operate, and optimize complex biotechnological processes employed in modern industry. They integrate competencies in molecular and cellular biology with advanced engineering skills, allowing for the comprehensive analysis and integration of both upstream and downstream processes.

The graduate is capable of selecting, designing, and operating bioprocess equipment, performing material and energy balances, and identifying key technological parameters that influence process efficiency, stability, and economic viability. They are familiar with principles of process automation and monitoring, including the use of Process Analytical Technology (PAT), online sensors, and data management systems.

They possess practical laboratory skills, including working with microorganisms, conducting fermentation processes at various scales, and applying analytical techniques (chromatographic, spectroscopic, and immunochemical) to assess product quality and purity. The graduate is able to analyze and process biological and process data using digital tools (such as Python and R) and understands the fundamentals of bioinformatics and systems biology, including the interpretation of omics data in the context of the development, optimization, and scaling of bioproducts.

The graduate is knowledgeable about and adheres to principles of biosafety as well as quality regulations applicable in industry (such as GMP, GLP, and HACCP). They are capable of maintaining technological and quality documentation and of incorporating regulatory requirements, process risks, and life cycle assessment (LCA) considerations into technological and organizational decision-making.

They are prepared to work effectively in interdisciplinary and international environments. They communicate proficiently in English, both orally and in writing, prepare technical reports, and present results to production teams, research and development units, and external stakeholders.

The graduate is qualified to take up positions such as Junior Bioprocess Engineer, Fermentation Specialist, QC/Analytical Scientist, Junior R&D Scientist, or Bioprocess Technologist in companies within the pharmaceutical, food, biotechnology, and chemical sectors, as well as in research and development institutions. They also possess a solid foundation for pursuing second-cycle (Master's) studies and for engaging in continuous professional development.

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

The Industrial Biotechnology study program constitutes a strategic and direct response to the key objectives outlined in the mission and development strategy of Lodz University of Technology, particularly in the areas of internationalization, interdisciplinarity, educational innovation, and close cooperation with industry.

The program is designed in close alignment with the University's mission, promoting internationalization (English as the language of instruction and a mandatory mobility semester), interdisciplinarity (problem-based learning projects involving students from other technical disciplines), and strong links with industrial practice (modules in entrepreneurship and intellectual property, compulsory internships, and industry-collaborative projects). A strong emphasis on the development of digital competencies (including artificial intelligence, data science, and process modeling) as well as project-based skills (Capstone Project and team-based engineering projects) responds to the growing demand for graduates capable of implementing innovation. The implementation of this modern curriculum ensures the education of highly qualified engineers who combine in-depth biological knowledge with advanced process engineering skills, preparing them for careers in key sectors of the economy, including biotechnology, food production, pharmaceuticals, environmental technologies, and research and development institutions. The core objective of the program is to educate specialists capable not only of operating biotechnological processes but also of designing, optimizing, and scaling them using state-of-the-art tools, including digital modeling, data science, and principles of sustainable development (such as LCA and ESG).

The Industrial Biotechnology program directly supports the implementation of the "Development Strategy of the Łódź Voivodeship 2030" by educating specialists for its key priority areas. The curriculum addresses the needs of the region's smart specializations, particularly in biotechnology and pharmaceuticals, advanced food processing, environmental technologies, and the circular economy. By educating engineers capable of designing sustainable industrial processes, resource recovery systems, and implementing bioeconomy principles, the program actively contributes to building a competitive, low-emission, and innovation-driven regional economy. Furthermore, through its internationalization model (English-taught curriculum and mobility) and strong collaboration with industry, the program fulfills strategic goals related to human capital development and strengthening the links between academia and

business.

The adopted educational model, which integrates the foundations of the exact sciences and engineering with modern biological technologies and elements of management, ensures a high academic standard and enhances the attractiveness of graduates on the global labor market. The availability of elective courses during the final (diploma) semester enables students to individualize their educational pathways in accordance with their interests and the dynamically evolving needs of the socio-economic environment. Consequently, the Industrial Biotechnology program represents a strategic investment by the University in the development of human capital for an innovation-driven economy, strengthening its position as a leading center for educating engineers of the future.

Educational objectives and employment and continuing education opportunities

A graduate of the first-cycle (Bachelor's) program in Industrial Biotechnology possesses an interdisciplinary education combining biological, chemical, and engineering knowledge, along with practical competencies enabling employment in sectors utilizing biotechnological processes. They are prepared to design, conduct, and optimize biotechnological processes at laboratory and pilot scales. The graduate demonstrates competencies in process monitoring, automation, and control, including the use of Process Analytical Technology (PAT), online sensors, and data management systems. They possess practical laboratory skills, including working with microorganisms and eukaryotic cells, conducting fermentation processes, and applying analytical techniques, as well as maintaining documentation in accordance with GMP and GLP standards. The graduate is capable of analyzing biological and process data using programming tools, fundamentals of bioinformatics, and interpreting omics data in the context of the development, scaling, and optimization of bioproducts. They have application-oriented knowledge of biotechnology in the food, environmental, and medical sectors, taking into account regulatory aspects and life cycle assessment (LCA). The graduate also develops soft skills, including teamwork, technical communication, project management, and proficiency in English. They are aware of contemporary challenges in biotechnology, including biosafety, risks associated with genetic engineering, and ethical responsibility. The program also prepares them for further education and research activities through training in laboratory techniques and computational methods.

Graduates are qualified to work as junior process engineers, fermentation technicians, QC/QA specialists, analytical technicians, or junior R&D scientists, and are well prepared to pursue second-cycle (Master's) studies and to operate in both national and international professional environments.

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

The proposed new study program in Industrial Biotechnology was subject to consultations with representatives of the socio-economic environment. As part of this process, a survey was conducted to assess the alignment of the proposed learning outcomes with current labor market needs and employer expectations. The new program places strong emphasis on educating graduates who integrate biological knowledge with engineering competencies, thereby addressing labor market demands through the enhancement of practical skills and digital competencies.

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

In accordance with the recruitment resolution for a given academic year.

The unit organizing education

Faculty of Biotechnology and Food Sciences

Education program

Semester 1

Course	Number of hours	ECTS points	Form of verification	Obligatory
Mathematics I	Tutorials: 75 Lecture: 15	7	Exam	Obligatory
Physics	Tutorials: 15 Lecture: 30	3	Graded assignment	Obligatory
Introduction to Industrial Biotechnology	Project work: 20 Lecture: 15	3	Graded assignment	Obligatory
General and Inorganic Chemistry	Tutorials: 40 Laboratory classes: 30 Lecture: 30	8	Exam	Obligatory
Information Technology	Laboratory classes: 45	3	Graded assignment	Obligatory
Engineering Drawing	Tutorials: 20 Lecture: 10	2	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
Study Skills for University	Tutorials: 30	1	Graded assignment	Obligatory
Sum	435	30		

Semester 2

Course	Number of hours	ECTS points	Form of verification	Obligatory
Mathematics II	Tutorials: 45 Laboratory classes: 15 Lecture: 30	7	Exam	Obligatory
Modern Physics	Laboratory classes: 20 Lecture: 20	3	Graded assignment	Obligatory
Organic Chemistry for Bioprocesses	Tutorials: 45 Laboratory classes: 30	6	Exam	Obligatory
Cell Biology and Microbiology	Laboratory classes: 55 Lecture: 40	6	Exam	Obligatory
Principles of Sustainable Engineering	Tutorials: 15 Lecture: 15	2	Graded assignment	Obligatory
Computer Aided Design	Laboratory classes: 45	3	Graded assignment	Obligatory
Business Communication for Engineers 2		2	Graded assignment	Obligatory group
The student chooses one module from the group.				
C1 Business Communication for Engineers 2	Tutorials: 30	2	Graded assignment	Optional
C2 Business Communication for Engineers 2	Tutorials: 30	2	Graded assignment	Optional
Physical Education 1	Tutorials: 30	0	Pass	Obligatory
Civic Knowledge and Engagement I	Seminar: 3 Lecture: 3	1	Graded assignment	Obligatory subjects to choose from
Sum	441	30		

Semester 3

Course	Number of hours	ECTS points	Form of verification	Obligatory
Industrial Microbiology	Laboratory classes: 30 Lecture: 15	3	Exam	Obligatory

Course	Number of hours	ECTS points	Form of verification	Obligatory
Biophysics with Elements of Physical Chemistry	Tutorials: 10 Laboratory classes: 15 Lecture: 15	3	Graded assignment	Obligatory
Bioprocess Engineering Fundamentals and Equipment	Tutorials: 15 Laboratory classes: 20 Lecture: 30	4	Graded assignment	Obligatory
Biochemistry and Enzymology	Laboratory classes: 60 Project work: 15 Lecture: 45	8	Exam	Obligatory
Statistics and Data Visualisation	Laboratory classes: 45	3	Graded assignment	Obligatory
Foreign Language Block 1		3	Graded assignment	Obligatory group
The student chooses one module from the group.				
German A1 block I	Tutorials: 60	3	Graded assignment	Optional
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 A1 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 A1 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

Course	Number of hours	ECTS points	Form of verification	Obligatory
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
Interdisciplinary Problem-Based Learning Project	Project work: 30	5	Graded assignment	Obligatory
Civic Knowledge and Engagement II	Seminar: 3 Lecture: 3	1	Graded assignment	Obligatory subjects to choose from
Sum	441	30		

Semester 4

Course	Number of hours	ECTS points	Form of verification	Obligatory
Fermented Food and Beverages	Laboratory classes: 45 Lecture: 20	4	Graded assignment	Obligatory
Genetics and Molecular Biology	Project work: 20 Lecture: 40	4	Exam	Obligatory
Cell Culture Technologies and Immunotechniques	Laboratory classes: 30 Lecture: 20	3	Graded assignment	Obligatory
Environmental Biotechnology	Laboratory classes: 45 Project work: 15 Lecture: 20	5	Exam	Obligatory
Downstream Processing and Product Development	Laboratory classes: 45 Lecture: 10	4	Graded assignment	Obligatory
Physical Education 3	Tutorials: 30	0	Pass	Obligatory
Civic Knowledge and Engagement III	Seminar: 3 Lecture: 3	1	Graded assignment	Obligatory subjects to choose from
Foreign Language Block 2		3	Graded assignment	Obligatory group

Course	Number of hours	ECTS points	Form of verification	Obligatory
The student chooses one module from the group.				
German A1 block II	Tutorials: 60	3	Graded assignment	Optional
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 A1 block II	Tutorials: 60	3	Graded assignment	Optional
Spanish A2 block II	Tutorials: 60	3	Graded assignment	Optional
Spanish B1 block II	Tutorials: 60	3	Graded assignment	Optional
Spanish B2 block II	Tutorials: 60	3	Graded assignment	Optional
French A1 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
Team Project	Project work: 40	6	Graded assignment	Obligatory
Sum	446	30		

Semester 5

Course	Number of hours	ECTS points	Form of verification	Obligatory
Bioreactor Engineering and Scale-up	Laboratory classes: 30 Project work: 10 Lecture: 10	3	Exam	Obligatory
Bioinformatics and Machine Learning Tools in Biotechnology	Laboratory classes: 30 Lecture: 15	3	Graded assignment	Obligatory
Genetic Engineering	Laboratory classes: 45 Lecture: 30	4	Exam	Obligatory
Metabolic Engineering for Precision Fermentation	Laboratory classes: 15 Project work: 20 Lecture: 20	3	Graded assignment	Obligatory
Next-Generation Food Biotechnology	Seminar: 10 Laboratory classes: 20 Lecture: 20	3	Graded assignment	Obligatory
Quality, Regulatory and Process Validation	Seminar: 15 Laboratory classes: 30 Lecture: 15	4	Graded assignment	Obligatory
Capstone Module: Entrepreneurship & Innovation in Biotechnology	Project work: 90	10	Graded assignment	Obligatory
Sum	425	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
Diploma Seminar	Seminar: 30	3	Graded assignment + exam	Obligatory
Diploma Thesis	Diploma Thesis: 0	15	Pass	Obligatory
Biopolymers	Laboratory classes: 15 Project work: 10 Lecture: 10	2	Graded assignment	Obligatory
Internship	Internship: 0	6	Pass	Obligatory
Elective Project	Project work: 30	2	Pass	Obligatory
Elective Courses		2	Graded assignment	Obligatory group
The student chooses 1 subject				
Design of Molecules in Red Biotechnology	Project work: 15 Lecture: 15	2	Graded assignment	Optional
Industry 4.0 in Biotechnology	Project work: 15 Lecture: 15	2	Graded assignment	Optional
Omics in Biotechnology	Project work: 15 Lecture: 15	2	Graded assignment	Optional
Sum	125	30		