Lodz University of Technology

Study programme

Faculty:	Faculty of Chemistry
Major:	Chemical Technology
Level of study:	second-cycle programme (magister)
Form of study:	full-time studies
Academic year:	2026/27

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Basic information

Name of the field of study:	Chemical Technology
Level of study:	second-cycle programme (magister)
Study profile:	general academic
Form of studies:	full-time studies
Duration of studies (number of semesters):	3
The number of ECTS points required to complete studies:	90
Total number of hours of classes:	1145
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:	46
Professional title awarded to graduates:	magister
ISCED code:	0531
Language of study:	polish

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	**2TCH1**	Knows and understands in-depth complex issues in the field of chemistry and chemical technology, enabling the understanding of the mechanisms of processes and unit operations and the development of technological concepts that make up modern chemical technologies.	P7U_W	P7S_WG
2	**2TCH2**	Knows and analyzes in depth the issues of thermodynamic and kinetic analysis of the reaction system, enabling the development of a chemical concept of the process.	P7U_W	P7S_WG
3	**2TCH3**	Knows and understands methods used in the modelling and simulation of technological processes.	P7U_W	P7S_WG
4	**2TCH4**	Knows and understands social, economic, legal, and other non-technical determinants of professional activity in the field of chemical technology.	P7U_W	P7S_WK
5	**2TCH5**	Is able to acquire information from various sources and critically assess its application potential.	P7U_U	P7S_UW
6	**2TCH6**	Is able to work effectively individually and in a team, prepares presentations and technical documentation, in Polish and a foreign language, in line with the B2+ level of the Common European Framework of Reference for Languages, including using language competences in the field of chemical technology.	P7U_U	P7S_UK, P7S_UO, P7S_UU
7	**2TCH7**	Is able to independently develop chemical and technological concepts of processes using appropriate methods as well as available techniques and tools, and is able to design complex systems of equipment necessary for the implementation of a new industrial process, applies occupational health and safety principles.	P7U_U	P7S_UW
8	**2TCH8**	Is able to formulate and carry out research tasks, including those related to scale-up.	P7U_U	P7S_UW
9	**2TCH9**	Is able to propose alternative technological and technical solutions applied in industrial process installations.	P7U_U	P7S_UW
10	**2TCH10**	Practices critical self-assessment of knowledge and information sources; seeks expert input when needed. Initiates and organizes activities for the community and the public interest, acts entrepreneurially, and performs professional roles responsibly, upholding professional ethos and ethics.	P7U_K	P7S_KK, P7S_KO, P7S_KR

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

No.	Course name	Program content	2TCH1	2TCH2	2TCH3	2TCH4	2TCH5	2TCH6	2TCH7	2TCH8	2TCH9	2TCH10
1	Information Systems in Chemical Technology	IT systems for production planning, monitoring, and optimization of technological processes. Platforms supporting the flow of information in industry, exemplified by LIMS software.	x				x					
2	Chemical Databases and Logistics	The course covers the transportation and storage of chemicals and hazardous substances, safety requirements, packaging and labeling, and waste logistics. It also covers IT systems for managing chemical substances (REACH, CLP, GHS), databases (ECHA, PubChem, SDS), and chemical hazard knowledge bases (Chempył).	x			x						
3	Industrial Technology Safety	The curriculum covers the identification and analysis of hazards arising from chemical reactions in industrial installations and the selection of appropriate technical and organizational measures. Students learn methods for assessing process risk in chemical reactions, principles of designing safe reaction systems, and legal and regulatory requirements for chemical process safety. Case studies of chemical reaction-related accidents and the development of preventive measures and emergency procedures are also important elements.	x		x							
4	Integrated Reactor Design and Control	Kinetics and equilibrium of reactions, the influence of process parameters on reaction rates, and reactor balances and selection. Process control systems, control algorithms (including PID), and process parameter measurements. Computer-aided engineering tools and automatic control of catalytic processes.			x				x	x		
5	Water Management and Environmental Protection	Understanding the requirements that users and consumers place on water, the neutralization of water pollutants under natural conditions, the effects of aquatic environmental pollution and the prevention of such pollution, as well as learning methods of water treatment and wastewater purification.										
6	Practical Problems of Patenting and Obtaining Research Funding	Preparation and discussion of a patent application for a selected invention, along with the development of a project seeking EU funding.				x						x
7	Surface Phenomena and Industrial Catalytic Processes	Thermodynamic and molecular characteristics of surfaces, surface tension and energy, work of adhesion and cohesion, contact angle, and methods for measuring surface tension. Industrial applications of surface chemistry (wetting, flotation, detergency, adhesion, emulsions, foams), adsorption, chemisorption, heterogeneous and industrial catalysis in petrochemical, nitrogen, environmental protection, and sulfur production processes.										
8	Technical Biotechnology	Fundamentals of industrial biotechnology, unit processes, selection and improvement of microorganisms, cultivation techniques, bioreactors, aseptics. Methods for isolating and purifying bioproducts, obtaining bioproducts using microorganisms.	x						x		x	
9	Modern Chemical Technologies	Self-composites, polymers from renewable raw materials, their aging, and modern chemical and biotechnological technologies, including insulin preparations and advanced therapeutic conjugates. Modern refining and petrochemical technologies, biorefineries, and industrial catalysis in environmental protection.										

No.	Course name	Program content	2TCH1	2TCH2	2TCH3	2TCH4	2TCH5	2TCH6	2TCH7	2TCH8	2TCH9	2TCH10
10	Technology Project (PBL)	Technological principles, material and energy balances, chemical plant design, economic and engineering analysis, models and algorithms, computer programs (ChemCad), environmental impact, BAT techniques.										
11	Geographic Information Systems in Industry	Databases and data structure. Relationships between objects in topological models. Numerical terrain models.	x					x				
12	Global Legal Regulations and Environmental Management Systems	International, EU, and national environmental regulations, including REACH, CLP, IED, the Seveso III Directive, the EU ETS, and the Basel, Stockholm, and Rotterdam Conventions, with particular emphasis on the chemical industry. Legal systems for chemicals, emissions, and waste management, as well as environmental impact assessment procedures (EIA, SEA), and corporate liability for environmental damage. Fundamentals of corporate environmental management systems (ISO 14001, EMAS) and practical use of digital databases on environmental and chemical law (including EUR-Lex, ECHA databases, ECOLEX, InforMEA).	x								x	
13	Green Chemical Technology	Principles of designing chemical products and processes that minimize or eliminate the use and generation of substances hazardous to health and the environment, pursuing sustainable development through waste reduction, energy efficiency, the use of renewable raw materials and safer synthesis methods.										
14	Accident Simulations and Crisis Scenarios	The course curriculum covers safety fundamentals, including the Seveso III Directive and accident classifications such as ATE (toxic release), BLEVE (boiling liquid explosion), and runaway reactions (runaway exothermic reactions), with a discussion of typical hazard scenarios. Students will learn risk analysis methods, including HAZOP, What-if (what-if scenarios), FMEA, and event trees (FTA/ETA). Students will create and analyze specific accident scenarios. Failure simulations using software such as Aspen Plus/CHEMCAD or FlexSim will be discussed, allowing them to assess the impact of failures on process continuity and the effectiveness of safety measures.	x		x				x			
15	Diploma Project Laboratory	Diploma seminar and experimental or computational research project.						x	x	x		
16	Final Project	Implementing appropriate research methodology: reviewing the literature and formulating hypotheses or specific work objectives, identifying specific tasks. Selecting methods and tools appropriate to solve the problem – conducting experiments. Analyzing and describing the obtained results.	x				x	x	x		x	
17	Foreign Language for Specialist Purposes	Grammar and linguistics appropriate to the needs of writing scientific texts in a given field. Preparing and delivering presentations, case studies, and review articles.						x				
18	Nanotechnology for Medicine	Medical nanomaterials: types, synthesis, properties, applications in therapy and diagnostics, drug carriers, controlled and selective systems, gene therapy, tissue engineering, molecular imprinting, nanodevices, and nanorobots. Research on nanomaterials and their toxicity, molecular and laser spectroscopy (NMR, EPR, IR, UV, Raman), radiation synthesis of metallic nanoparticles, drug-protein interactions (HDS), photochemistry, and analysis of changes in DNA properties.										
19	Organic Processes on Industrial Scale	Basic products of industrial synthesis, raw materials and energy sources, hydrogenation and oxidation reactions, syntheses using carbon monoxide, aromatic compounds – synthesis and transformations, catalytic processes. Industrial methods leading to biologically active compounds, process scaling up, challenges and solutions.						x			x	

No.	Course name	Program content	2TCH1	2TCH2	2TCH3	2TCH4	2TCH5	2TCH6	2TCH7	2TCH8	2TCH9	2TCH10
20	Modern Polymer Technologies and Processing	Characterization of functional elastomers and specialty thermoplastics, modern processing technologies (mixing, injection molding, extrusion, 3D printing, calendering, pressing, vulcanization). Polymer composite manufacturing technologies, innovative auxiliaries, and applications of polymers in industry, medicine, and modern technologies.						x			x	
21	Modern Chemical Technology	Modern chemical technology and green chemistry, waste reduction, nuclear economy, examples of innovative catalysts and chemical reactors. Obtaining energy and fuels from fossil and renewable sources, hydrogen, biomass, fuel cells, and modern solutions in petrochemistry.						x			x	
22	Ethics of New Technologies	Ethical values and the challenges of posthumanism, technological development, bioethics, and the information revolution. The impact of new technologies on human life, innovation planning, and shaping ethical attitudes in the modern economy.				x						x
23	Social and Civilizational Challenges of Modern Chemical Technology	The role of ethical values, bioethics, and social responsibility in the context of modern chemical technologies and their impact on human life and the environment. Analysis of civilizational threats and challenges related to innovations in chemistry, including ethical aspects of designing, implementing, and using new chemical processes and products.				x						x
24	Communication Techniques	Developing interpersonal and teamwork skills, including strategies for collaboration, negotiation, and effective conflict resolution in the engineering environment. Improving specialized communication through the creation of technical reports, presenting research results, and using communication tools to support project management in chemical technology.				x						x
25	Ethical Aspects of Drug and Vaccine Production	Ethical principles in the design and production of pharmaceutical substances. Legal regulations, quality standards, and the responsibility of drug and vaccine manufacturers. Ethical aspects of drug testing.				x						x
26	Spectroscopic Methods	Fundamentals of EPR spectroscopy: magnetic properties of electrons and protons, the Zeeman effect, resonance conditions, spin Hamiltonian, isotropic and powder spectra, hyperfine interactions, spin samples, applications to the study of microheterogeneous systems. 1D and 2D NMR spectroscopy, vibrational spectroscopy (IR, Raman), normal vibrations, special Raman techniques, applications of group theory.	x					x				
27	Radiation and Isotopes in Medicine	Sources of ionizing radiation in the environment, the laws of radioactive decay, nuclear models, the interaction of radiation with matter, radiation detection, and the applications of isotopes in science, technology, and medicine.										
28	Structure and Biological Activity	Structure-activity relationship studies, molecular optimization strategies, examples of small-molecule drugs and peptide therapeutics, molecular tools, and the impact of structural changes on ADMET and pharmacokinetics.	x					x				
29	Sonochemistry and Microwaves	Basics of ultrasound and microwaves, interaction with matter, sonochemistry, sonochemical reactors, primary and secondary effects, process parameters, applications in organic synthesis, polymer synthesis, and environmental protection. Medical diagnostics, initiating reactions with microwaves, occupational safety.										

No.	Course name	Program content	2TCH1	2TCH2	2TCH3	2TCH4	2TCH5	2TCH6	2TCH7	2TCH8	2TCH9	2TCH10
30	Macromolecule in Solution	Structure and properties of macromolecules: conformation, configuration, tacticity, cis-trans isomerism, molecular weights, intermolecular interactions, polymer solutions, viscosity, diffusion, light scattering, polyelectrolytes, and colloids. Measurement of physicochemical properties of polymers, determination of molecular weights and Mark-Houwink parameters, light scattering, gel permeation chromatography, analysis of the effect of polymers on the optical properties of solutions.	x					x			x	
31	Computer Techniques in Medicine	Computers in medicine, biomedical signal and image processing in Origin Pro 2020, data analysis, and computer presentations.						x				
32	Biomaterials and Medical Polymers	History and properties of medical polymers, controlled synthesis, biodegradable polymers, polyurethanes, polysiloxanes, polyacrylates, polymer prodrugs, protein and nucleic acid modifications. Synthesis of medical polymers, production of biomaterials and model medical devices, property analysis.	x					x			x	
33	Polymer Synthesis Technology	Polymerization methods, synthesis of addition and condensation polymers, polymer modification, ion exchange resins, excipients, recycling, environmental protection, occupational safety, industrial process stages and control, polymerization reactors, and monomer synthesis.		x				x				
34	Polymer Physics and Rheology	Polymer morphology: amorphous, crystalline, and viscoelastic states, glass transition temperature, plasticization, crystallization, melting, morphological structures, physical properties, and methods for their study. Elastic state and viscosity of polymers, dynamic properties, stress relaxation, creep, time-temperature superposition, miscibility, criterion numbers, processing, extrudability, moldability, injection molding.		x				x				
35	Polymer Materials Engineering	Basic polymer groups: thermoplastics, elastomers, resins, selected engineering polymers and specialty polymers – properties and applications. Polymer mixtures, composites, surface modification methods (plasma, laser, ion bombardment), surface phenomena, operational aspects, material design.		x				x			x	
36	Technology of Polymer Processing	Polymer blend components, manufacturing and processing operations (mixing, extrusion, calendering, molding, vulcanization, 3D printing), polymer devices, thermoplastic composites, latex, rubber, and adhesive technology, recycling. Preparation of elastomeric mixtures, vulcanization, assessment of mechanical properties and resistance, polymer aging, determination of crosslinking density, polymer-glass laminates, modification of epoxy coatings, dyeing, 3D printing, extrusion.	x					x				
37	Properties of Polymer Materials	Grain size analysis of fillers and nanofillers, chemical resistance of elastomers, intelligent repair materials, UV-VIS absorbance measurement, crosslinking kinetics and dynamic properties, conductive and barrier properties, polymer creep, rheology of biodegradable materials, viscosity and viscoelasticity, thermal resistance, mechanical characterization under dynamic conditions. Design of polymeric materials with specific properties.						x			x	
38	Polymer Nanocomposites	Macromolecular engineering, radical and reversible deactivation polymerization, control of macromolecular architecture, topology, copolymers, functionalization, hybrid polymers, nanocomposites.	x					x			x	

No.	Course name	Program content	2TCH1	2TCH2	2TCH3	2TCH4	2TCH5	2TCH6	2TCH7	2TCH8	2TCH9	2TCH10
39	Polymer Material Modification Technologies	Polymer Modification Methods: Physical, chemical, and surface techniques for modifying the properties of polymer and composite materials. Analysis of the impact of modification on the mechanical, thermal, rheological, and functional properties of polymers, and industrial applications.	x					x			x	
40	Modern Dyes for Special Purposes	Use of diazonium salts as a source of radicals in modern organic syntheses. Dyes derived from coumarins and benzocoumarins. Diketopyrrolo-pyrrole dyes. Benzophenoxazine dyes. BODIPY dyes and their AZABODiPY analogues.	x					x				
41	Aromatic Compound Synthesis Technology	Methods for the synthesis of aromatic and heterocyclic compounds, diazonium compounds, nitrosation reactions, interfacial catalysts, synthesis of pyrazolones, pyridones, and phthalocyanines, oxidation, aromatic carboxylic acids, aldehydes, ketones, and quinones, and reductive alkylation.	x				x	x				
42	Use of Dyes and Auxiliaries in Industry	Dyeing natural, synthetic, and artificial fibers with various dyes in the presence of a wide range of auxiliaries and household chemicals. Transfer and direct printing on polyester fiber products. Testing and evaluating color fastness. Dyeing plastics. Dyeing leather and paper. Preparation of protective paints based on various polymeric substances.						x				
43	Auxiliares and Household Chemistry	Composition and functions of household chemical product components, characteristics and effects of surfactants, modern impregnating agents and film-forming substances, biologically active ingredients, and selected cosmetic formulations. Synthesis and analysis of surfactants, formulation of cleaning, laundry, and bleaching agents, production of fragrances and intermediates for film-forming preparations.	x					x				
44	Color Cosmetics	The history and development of color cosmetics, the health aspects of using natural and synthetic dyes, and legal regulations. Color cosmetic formulation technologies: lip products, nail polishes and removers, eye shadows, blushes, powders, foundations, hair dyes, and skin lightening and bronzing products.						x			x	
45	Environment Protection in Technology of Dyes	Dye toxicity: acute, allergenic, mutagenic, and carcinogenic, in vivo and in vitro assessment methods, analytical and computer-based. Carcinogenic amines, metabolic transformations, wastewater treatment, development of dye and pigment technologies, regulatory frameworks; analysis of azo dye degradation under the influence of oxidants and UV.	x					x			x	
46	Laboratory and Technological Project	Research methodology, literature review, workshop organization. Synthesis of intermediates, analysis, parameter selection, and preparation of materials for subsequent stages of the thesis.						x	x		x	
47	Structure, Activity and Synthesis of Bioactive Compounds in Medicine and Agriculture	Structure-activity relationship studies, molecular optimization strategies, examples of small-molecule drugs, peptide therapeutics, molecular tools, the impact of structural changes on ADMET and pharmacokinetics. Project preparation and presentation, practical consultations, selection of professional literature, discussion of problem-solving issues, and participation in final exams.	x					x				
48	Organic Catalysis in Technological Processes	Organocatalysis and main catalysts (proline, cinchona alkaloids, TADDOL, binaphthol derivatives), example reactions: aldol condensation, Mannich reaction, asymmetric Robinson annulation, Diels-Alder, Morita-Baylis-Hillman, Friedel-Crafts, reactions with ylides and proton transfer.		x				x				

No.	Course name	Program content	2TCH1	2TCH2	2TCH3	2TCH4	2TCH5	2TCH6	2TCH7	2TCH8	2TCH9	2TCH10
49	Organic Technological Processes and Separation Techniques	Separation of compound mixtures using the following chromatographic methods: chiral phase gas chromatography, high-performance liquid chromatography (HPLC), ion exchange chromatography, preparative ion exchange chromatography.	x					x				
50	Modern Spectroscopic Methods	Fundamentals of mass spectrometry, ionization and separation methods, fragmentation, IR spectroscopy, one- and two-dimensional NMR techniques, spectral analysis of various sample types, and spectral parameters for structure determination and studying system dynamics. Seminars and laboratories include analysis of MS, IR, and NMR spectra, interpretation of multidimensional spectra, and structure determination of organic compounds.	x					x				
51	Methods of Investigation of Active Substances	Classical and instrumental methods for identifying and assessing the purity of active substances, including spectroscopic techniques (NMR, EPR, AAS, AES, MS), optical, electroanalytical, chromatographic, and electrophoretic methods, as well as method selection and validation criteria. Active substance selection (toxicity, activity, specificity, HTS, NMR testing), analytical issues in the pharmaceutical industry (QbD, GMP).						x				
52	Chemistry and Technology of Therapeutic Agents	Classification and mechanisms of drug action, prodrugs, biotransformations, the impact of isomerism, the synthesis of selected groups of therapeutic agents, antimicrobial drugs, CNS drugs, cardiovascular drugs, anticancer drugs, immunotropic drugs, and hormones. Design and synthesis of selected active substances, product identification, documentation preparation, substantive consultations, and examination participation.	x					x			x	
53	Drug and Agrochemical Formulations	The structure and physicochemical properties of drugs, pharmacokinetics, routes of administration, excipients, unit processes and production equipment, classic and modern drug formulations. Characteristics of fertilizers and plant protection products, their formulations, application techniques, and trends in technological development. Seminar presentations on drug and agrochemical formulations.	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	Information Systems in Chemical Technology	6		6	6	
2	Chemical Databases and Logistics	4		4	4	
3	Industrial Technology Safety	5		5	5	
4	Integrated Reactor Design and Control	5			5	
5	Water Management and Environmental Protection	2			2	
6	Practical Problems of Patenting and Obtaining Research Funding	3	3			
7	Surface Phenomena and Industrial Catalytic Processes	5			5	
8	Technical Biotechnology	4			4	
9	Modern Chemical Technologies	5			5	
10	Technology Project (PBL)	6			6	
11	Geographic Information Systems in Industry	4		4	4	
12	Global Legal Regulations and Environmental Management Systems	4		4	4	
13	Green Chemical Technology	4		4	4	
14	Accident Simulations and Crisis Scenarios	3		3	3	
15	Diploma Project Laboratory	4			4	
16	Final Project	20		20	20	
17	Foreign Language for Specialist Purposes	2				
18	Nanotechnology for Medicine	2		2	2	2
19	Organic Processes on Industrial Scale	2		2	2	2
20	Modern Polymer Technologies and Processing	2		2	2	2

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
21	Modern Chemical Technology	2		2	2	2
22	Ethics of New Technologies	2	2	2		
23	Social and Civilizational Challenges of Modern Chemical Technology	2	2	2		
24	Communication Techniques	2	2	2		
25	Ethical Aspects of Drug and Vaccine Production	2	2	2		
26	Spectroscopic Methods	4		4	4	
27	Radiation and Isotopes in Medicine	9		9	9	
28	Structure and Biological Activity	2		2	2	
29	Sonochemistry and Microwaves	3		3	3	
30	Macromolecule in Solution	2		2	2	
31	Computer Techniques in Medicine	1		1	1	
32	Biomaterials and Medical Polymers	9		9	9	
33	Polymer Synthesis Technology	3		3	3	
34	Polymer Physics and Rheology	7		7	7	
35	Polymer Materials Engineering	5		5	5	
36	Technology of Polymer Processing	6		6	6	
37	Properties of Polymer Materials	5		5	5	
38	Polymer Nanocomposites	2		2	2	
39	Polymer Material Modification Technologies	2		2	2	
40	Modern Dyes for Special Purposes	6		6	6	
41	Aromatic Compound Synthesis Technology	8		8	8	

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
42	Use of Dyes and Auxiliaries in Industry	1		1	1	
43	Auxiliares and Household Chemistry	6		6	6	
44	Color Cosmetics	2		2	2	
45	Environment Protection in Technology of Dyes	2		2	2	
46	Laboratory and Technological Project	5		5	5	
47	Structure, Activity and Synthesis of Bioactive Compounds in Medicine and Agriculture	7		7	7	
48	Organic Catalysis in Technological Processes	3		3	3	
49	Organic Technological Processes and Separation Techniques	5		5	5	
50	Modern Spectroscopic Methods	5		5	5	
51	Methods of Investigation of Active Substances	1		1	1	
52	Chemistry and Technology of Therapeutic Agents	7		7	7	
53	Drug and Agrochemical Formulations	2		2	2	

ECTS indicators

Name	Specialty: Technological Security	Specialty: Biomedical and Radiation Engineering	Specialty: Polymer Technology	Specialty: Technology of Dyes, Auxiliaries and Household Chemicals	Specialty: Technology of Drugs and Plant Protection Products
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)	54/90 (60%)	54/90 (60%)	54/90 (60%)	54/90 (60%)	54/90 (60%)
The total number of ECTS credits to be earned by a student through courses in the fields of humanities or social sciences	5	5	5	5	5
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	83/90 (92.22%)	83/90 (92.22%)	83/90 (92.22%)	83/90 (92.22%)	83/90 (92.22%)

Methods of verifying and assessing learning outcomes

Verification of learning outcomes is carried out systematically, using a variety of methods adapted to the nature of the courses and the intended learning outcomes. The following are used, among others:

1) written and oral examinations – verifying theoretical knowledge, the ability to analyse and synthesize information, and problem-solving skills;

2) quizzes and partial tests – enabling ongoing monitoring of learning progress;

3) assessment of projects and laboratory work – verification of practical skills, application of research methods, interpretation of results and teamwork;

4) presentations and seminars – verifying communication competences, the ability to argue and present research results;

5) reports and written assignments – assessment of the ability to document and analyse data;

6) a competence examination, diploma thesis and its defence – comprehensive verification of learning outcomes covering knowledge, skills and social competences;

7) activity in discussions and participation in research projects – assessment of engagement, independence and ability to work in groups.

Methods of verification for individual courses are described in detail in course descriptions.

Professional internships

not applicable

Specializations/degree paths offered within the study program

Specialty: Technological Security

Specialty: Biomedical and Radiation Engineering

Specialty: Polymer Technology

Specialty: Technology of Dyes, Auxiliaries and Household Chemicals

Specialty: Technology of Drugs and Plant Protection Products

Characteristics of the course

Graduate profile

Graduates are prepared for rapidly changing conditions on the labour market through their ability to use in-depth general knowledge in the field of contemporary chemistry and chemical technology, encompassing the entire spectrum of processes related to the production, processing and analysis of chemical compounds and materials. They are able to carry out design tasks and conduct technological research within a selected specialization. They can perform a comprehensive analysis of chemical and technological processes and their implementation in practice in cooperation with specialists from other fields. They are able to solve technological problems using modern data analysis methods and to use modern chemical equipment. Their specialist knowledge is accompanied by a good command of chemistry, chemical technology, as well as English chemical and technological terminology. Graduates know the methods of obtaining and safely using chemical products, as well as handling used goods and waste. They can actively participate in teamwork, manage teams of people, and use specialist literature and legal regulations related to business activity. They are able to design, implement and supervise technological processes, and they also have the ability to interpret and quantitatively describe basic chemical and physicochemical phenomena, conduct laboratory work, and organize workplaces for such work so that they operate safely and effectively. Graduates are prepared to work in industry, research laboratories, administration, and other institutions where there is a demand for specialists in chemistry or chemical technology. They possess knowledge in environmental protection and sustainable development, and they are familiar with the legal, ethical and economic principles that guide the development of technological processes; therefore, they are employable also in positions other than chemical technologist. They take up employment both in industry and research institutes, as well as in various sectors of administration and management. A distinctive feature of their qualifications is interdisciplinarity, combining skills in chemical technology, chemistry and environmental protection.

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

The Chemical Technology degree programme is aligned with the Lodz University of Technology Strategy for 2025-2030 (https://p.lodz.pl/uczelnia/strategia-uczelni), an important objective of which is to develop an education model that prepares graduates for the dynamically changing needs of the socio-economic environment.

The Chemical Technology curriculum fits perfectly into both the mission and the vision of the university and constitutes an important element in achieving its strategic goals. The programme was created in response to labour market demand for specialists in the design and implementation of modern technologies. In addition to lectures, the CHEMICAL TECHNOLOGY programme includes numerous laboratory classes, seminars and projects that help develop in students such qualities as independence, creativity, analytical thinking and problem-solving skills, responsibility for their own work as well as teamwork, and systematic work habits. The CHEMICAL TECHNOLOGY programme enables students to become familiar with both experimental work and work involving the use of specialist

software. It also makes it possible to fully utilise the potential of the Faculty of Chemistry through its specialist scientific and teaching laboratories.

The Chemical Technology degree programme implements the following objectives of the LUT Strategy:

● Strengthening the INNOVATION area (Innovation and technology transfer) in the field of technology transfer: supporting scientific research that solves problems of the socio-economic environment. Students of Chemical Technology are involved in research projects linked to the industrial sector. This is made possible by the close and well-established cooperation of LUT units implementing the study programme with the economic environment. Students solve real technological problems of a given plant by developing proposals for specific solutions dedicated to a specific technological line. Developing such a solution has a strong chance of turning into long-term cooperation between the university and the entrepreneur, leading to a joint project, the development of a new material or technology, and perhaps even its implementation. Thanks to this, LUT can develop new technologies that may later be commercialised, which is consistent with the idea of “technology transfer” from the university to industry.

● Developing the mobility offer for LUT employees, doctoral candidates and students. Students of the Chemical Technology programme and the staff of the LUT Faculty of Chemistry regularly take advantage of opportunities for international mobility.

● Development of internationalization in the area of education. The Faculty of Chemistry offers students of the Chemical Technology programme courses and seminars in English.

● Strengthening the SCIENCE area in the field of scientific research: conducting useful, socially and environmentally responsible research that supports a knowledge-based economy, and supporting interdisciplinary research through the development of cooperation between disciplines and fields of science. Students have the opportunity to carry out research linked to industry, responding to social

and environmental needs and supporting a knowledge-based economy. The curriculum of the Chemical Technology programme is consulted with the Business Council at the Faculty of Chemistry, which guarantees its compliance with labour market requirements. The Chemical Technology degree programme offers a broad range of interdisciplinary courses related to issues in chemical technology, chemistry and materials science. The programme fosters interdisciplinary scientific research, which is one of the objectives of the LUT Strategy for 2025-2030. The university declares support for researchers, doctoral candidates and students in building scientific recognition and carrying out research of social and economic value. The Chemical Technology programme is an important component of this strategy because it was created in response to the growing needs of various sectors of industry for socially and environmentally sustainable modern technologies.

● Modernisation of research infrastructure and development of a system for its rational use. Students of the LUT Faculty of Chemistry are provided with access to specialist equipment and modern laboratories in the chemistry building Alchemium – The Magic of Chemistry of

Tomorrow. In other buildings of the Faculty of Chemistry, students of the Chemical Technology programme also have at their disposal unique technological halls with an area of over 700 m², within which there are many highly specialised laboratories focused on polymer technology.

● Implementation of clear and fair rules for the employment, remuneration and promotion of staff, with due regard for tolerance and equality policy. The recruitment process for employees of the LUT Faculty of Chemistry is based on the OTM-R policy – “Open, Transparent and Merit-based Recruitment Process”.

● Continuous improvement of academic teachers’ competences in modern teaching methods, current state of knowledge, technological development and trends in science. Academic teachers involved in teaching classes in the Chemical Technology programme actively participate in numerous training courses, improving their qualifications, among others, in the field of modern teaching methods.

● Supporting the EDUCATION area in the field of modern education adapted to labour market needs: development of a model for educating students and doctoral candidates that prepares graduates for the dynamically changing needs of the socio-economic environment; continuous improvement of academic teachers’ competences in modern teaching methods, current state of knowledge, technological development and trends in science; improvement of the educational offer, including supplementary forms of education, in response to the challenges of the socio-economic environment; support for the scientific development of students and doctoral candidates with regard to interdisciplinarity and internationalization; increasing student participation in research carried out at the university and intensifying the acquisition of practical experience by students outside the university.

The Business Council at the Faculty of Chemistry has a real impact on the shape of the Chemical Technology curriculum, which responds to socio-economic challenges. Most subjects in the programme are directly related to the leading areas of scientific research conducted by the LUT faculties co-creating the programme and representing various scientific disciplines, which creates opportunities for the scientific development of students with regard to interdisciplinarity. Course coordinators and teachers are actively publishing researchers with recognised achievements nationally and internationally, who constantly improve their scientific competences (cooperation with foreign research centres), technological competences (cooperation with industry), and academic competences in modern teaching methods based on creative learning and independent knowledge acquisition, e.g. design thinking (DT), problem-based learning (PBL), research-based learning (RBL), case teaching (CT), or flipped education (FE). These methods, especially PBL, RBL and CT, are widely used in the delivery of classes in this programme. Thanks to education using active methods and based on real technological problems originating from industrial plants, i.e. from the socio-economic environment, graduates may be prepared for real challenges in their later professional practice, which corresponds to the university’s mission of educating “for the needs of the economy and the world”.

● Attracting TALENTS – both students and young researchers: Lodz University of Technology as a university attracting the best study candidates, stimulating research passions and supporting the scientific development of students, doctoral candidates and young employees; supporting the scientific development of students and doctoral candidates with regard to interdisciplinarity and internationalization; increasing student participation in research carried out at the university and intensifying the acquisition of practical experience by students outside the university; conducting an active promotional and recruitment policy aimed at attracting the most talented candidates for study; attracting doctoral candidates with the highest scientific potential and creating conditions for their further development; strengthening talent management through individualized educational paths for students and doctoral candidates.

The LUT Strategy assumes an active recruitment policy, support for students and doctoral candidates in research, and the creation of conditions for the development of young researchers. Talented students may pursue studies within IPS and IOZ and participate in LUT mentoring programmes, such as E²TOP. Offering the Chemical Technology programme in LUT’s educational portfolio may attract people interested in modern technologies of the contemporary chemical industry, processing technologies, advanced methods of materials modification, nanotechnology and industrial applications – that is, talents that LUT seeks to attract. The programme is intended to

encourage graduates to continue an academic and research pathway in doctoral studies. It also provides an opportunity to develop an interdisciplinary staff combining chemical technology, chemistry, technology, and materials manufacturing technology. Students may participate in interdisciplinary research projects, for example combining issues from chemical technology, biology, medicine, materials science and computer science. They may also take part in international mobility and exchange programmes such as Erasmus+, and in internships in foreign laboratories. Students are also co-authors of scientific publications with international reach.

In summary, by implementing the above initiatives, the Chemical Technology programme is aligned with the strategy of Lodz University of Technology, offering students the highest standard of education and preparation for labour market requirements.

Confirmation of the high quality of education in the second-cycle Chemical Technology programme is also the very high evaluation in the PKA accreditation process (10-11 January 2023) – fulfilment of all 10 assessment criteria. By Resolution No. 124/2024 of 22 February 2024, the Presidium of the Polish Accreditation Committee awarded the Certificate of Excellence in Education in the category “Excellent Programme – excellence in programme education” to the Chemical Technology programme at Lodz University of Technology – first- and second-cycle studies with a general academic profile. Moreover, the second-cycle Chemical Technology programme holds international accreditation from ECTN – European Chemistry Thematic Network.

Educational objectives and employment and continuing education opportunities

The objective of education is to equip graduates with the ability to use in-depth knowledge covering the entire range of processes of production, processing and analysis of chemical

compounds and materials. Their specialist knowledge is accompanied by a good command of chemistry, chemical technology, as well as English chemical and technological terminology. Graduates are prepared to work in industry, research laboratories, administration, and other institutions where there is a demand for specialists in chemistry or chemical technology. Graduates know how chemical products are obtained and used safely, can handle used goods and waste, promote sustainable development, actively participate in teamwork, manage teams of people, and use specialist literature and legal regulations related to business activity. The graduate is familiar with basic technological processes (in particular environmentally friendly processes), and also has the ability to interpret and quantitatively describe basic chemical and physicochemical phenomena, conduct laboratory work, and organize workplaces for such work so that they operate safely and effectively. The graduate may continue education in third-cycle studies and postgraduate studies.

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

In response to the needs of the economy and industry, all processes related to the development, quality assessment of education, and supervision of the implementation of the Chemical Technology program are carried out with significant involvement of external stakeholders. The Business Council established at the Faculty of Chemistry of Lodz University of Technology, as a representative of external stakeholders, actively participates in ensuring high-quality education by reviewing educational activities, including work on program modifications.

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

An engineering diploma after completing first-cycle studies, or a Master of Science in Engineering diploma after completing equivalent studies.

The unit organizing education

Faculty of Chemistry

Education program

Semester 1

Course	Number of hours	ECTS points	Form of verification	Obligatory
Integrated Reactor Design and Control	Laboratory classes: 30 Project work: 20 Lecture: 15	5	Graded assignment	Obligatory
Water Management and Environmental Protection	Laboratory classes: 10 Lecture: 20	2	Graded assignment	Obligatory
Practical Problems of Patenting and Obtaining Research Funding	Project work: 30	3	Graded assignment	Obligatory
Surface Phenomena and Industrial Catalytic Processes	Laboratory classes: 15 Project work: 30	5	Exam	Obligatory
Sum	**170**	**15**		

Specialty: Technological Security

Course	Number of hours	ECTS points	Form of verification	Obligatory
Information Systems in Chemical Technology	Laboratory classes: 30 Project work: 15 Lecture: 15	6	Graded assignment	Obligatory specialization courses
Chemical Databases and Logistics	Laboratory classes: 30 Lecture: 30	4	Graded assignment	Obligatory specialization courses
Industrial Technology Safety	Laboratory classes: 30 Lecture: 30	5	Exam	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Technology of Drugs and Plant Protection Products

Course	Number of hours	ECTS points	Form of verification	Obligatory
Structure, Activity and Synthesis of Bioactive Compounds in Medicine and Agriculture	Tutorials: 15 Laboratory classes: 30 Lecture: 45	7	Exam	Obligatory specialization courses
Organic Catalysis in Technological Processes	Laboratory classes: 15 Lecture: 15	3	Graded assignment	Obligatory specialization courses
Organic Technological Processes and Separation Techniques	Laboratory classes: 45 Lecture: 15	5	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Technology of Dyes, Auxiliaries and Household Chemicals

Course	Number of hours	ECTS points	Form of verification	Obligatory
Modern Dyes for Special Purposes	Laboratory classes: 45 Lecture: 30	6	Exam	Obligatory specialization courses
Aromatic Compound Synthesis Technology	Laboratory classes: 45 Project work: 30 Lecture: 15	8	Graded assignment	Obligatory specialization courses
Use of Dyes and Auxiliaries in Industry	Laboratory classes: 15	1	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Polymer Technology

Course	Number of hours	ECTS points	Form of verification	Obligatory
Polymer Synthesis Technology	Laboratory classes: 15 Lecture: 30	3	Exam	Obligatory specialization courses
Polymer Physics and Rheology	Laboratory classes: 45 Lecture: 45	7	Graded assignment	Obligatory specialization courses
Polymer Materials Engineering	Seminar: 10 Project work: 20 Lecture: 15	5	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Biomedical and Radiation Engineering

Course	Number of hours	ECTS points	Form of verification	Obligatory
Spectroscopic Methods	Laboratory classes: 25 Lecture: 15	4	Graded assignment	Obligatory specialization courses
Radiation and Isotopes in Medicine	Laboratory classes: 70 Lecture: 45	9	Exam	Obligatory specialization courses
Structure and Biological Activity	Project work: 15 Lecture: 10	2	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Semester 2

Course	Number of hours	ECTS points	Form of verification	Obligatory
Technical Biotechnology	Laboratory classes: 15 Project work: 10 Lecture: 15	4	Graded assignment	Obligatory

Course	Number of hours	ECTS points	Form of verification	Obligatory
Modern Chemical Technologies	Project work: 25 Lecture: 35	5	Exam	Obligatory
Technology Project (PBL)	Project work: 45 Lecture: 15	6	Graded assignment	Obligatory
Sum	**160**	**15**		

Specialty: Technological Security

Course	Number of hours	ECTS points	Form of verification	Obligatory
Geographic Information Systems in Industry	Laboratory classes: 30 Lecture: 15	4	Graded assignment	Obligatory specialization courses
Global Legal Regulations and Environmental Management Systems	Project work: 15 Lecture: 30	4	Exam	Obligatory specialization courses
Green Chemical Technology	Laboratory classes: 30 Lecture: 15	4	Graded assignment	Obligatory specialization courses
Accident Simulations and Crisis Scenarios	Project work: 15 Lecture: 30	3	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Technology of Drugs and Plant Protection Products

Course	Number of hours	ECTS points	Form of verification	Obligatory
Modern Spectroscopic Methods	Laboratory classes: 50 Lecture: 10	5	Graded assignment	Obligatory specialization courses

Course	Number of hours	ECTS points	Form of verification	Obligatory
Methods of Investigation of Active Substances	Seminar: 10	1	Graded assignment	Obligatory specialization courses
Chemistry and Technology of Therapeutic Agents	Laboratory classes: 30 Project work: 10 Lecture: 45	7	Exam	Obligatory specialization courses
Drug and Agrochemical Formulations	Seminar: 10 Lecture: 15	2	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Technology of Dyes, Auxiliaries and Household Chemicals

Course	Number of hours	ECTS points	Form of verification	Obligatory
Auxiliares and Household Chemistry	Laboratory classes: 30 Lecture: 30	6	Exam	Obligatory specialization courses
Color Cosmetics	Seminar: 15 Laboratory classes: 15	2	Graded assignment	Obligatory specialization courses
Environment Protection in Technology of Dyes	Laboratory classes: 15 Lecture: 15	2	Graded assignment	Obligatory specialization courses
Laboratory and Technological Project	Laboratory classes: 30 Project work: 30	5	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Polymer Technology

Course	Number of hours	ECTS points	Form of verification	Obligatory
Technology of Polymer Processing	Laboratory classes: 45 Lecture: 20	6	Exam	Obligatory specialization courses
Properties of Polymer Materials	Laboratory classes: 45 Project work: 15	5	Graded assignment	Obligatory specialization courses
Polymer Nanocomposites	Project work: 15 Lecture: 15	2	Graded assignment	Obligatory specialization courses
Polymer Material Modification Technologies	Seminar: 10 Lecture: 15	2	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Biomedical and Radiation Engineering

Course	Number of hours	ECTS points	Form of verification	Obligatory
Sonochemistry and Microwaves	Laboratory classes: 20 Lecture: 20	3	Exam	Obligatory specialization courses
Macromolecule in Solution	Laboratory classes: 15 Lecture: 20	2	Graded assignment	Obligatory specialization courses
Computer Techniques in Medicine	Tutorials: 15	1	Graded assignment	Obligatory specialization courses
Biomaterials and Medical Polymers	Laboratory classes: 45 Project work: 15 Lecture: 30	9	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Semester 3

Course	Number of hours	ECTS points	Form of verification	Obligatory
Diploma Project Laboratory	Seminar: 5 Project work: 60	4	Exam	Obligatory
Final Project	Diploma Thesis: 0	20	Pass	Obligatory subjects to choose from
Foreign Language for Specialist Purposes	Tutorials: 45	2	Graded assignment	Obligatory
Elective Course 1		2	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Nanotechnology for Medicine	Seminar: 5 Lecture: 10	2	Graded assignment	Optional
Organic Processes on Industrial Scale	Seminar: 5 Lecture: 10	2	Graded assignment	Optional
Modern Polymer Technologies and Processing	Seminar: 5 Lecture: 10	2	Graded assignment	Optional
Modern Chemical Technology	Seminar: 5 Lecture: 10	2	Graded assignment	Optional
Elective Course 2		2	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Ethics of New Technologies	Seminar: 15 Lecture: 15	2	Graded assignment	Optional
Social and Civilizational Challenges of Modern Chemical Technology	Seminar: 15 Lecture: 15	2	Graded assignment	Optional
Communication Techniques	Seminar: 15 Lecture: 15	2	Graded assignment	Optional
Ethical Aspects of Drug and Vaccine Production	Project work: 30	2	Graded assignment	Optional
Sum	**155**	**30**		