Lodz University of Technology

Study programme

Faculty:	Faculty of Chemistry
Major:	Chemistry
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:	Chemistry
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:	1125
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:	45
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	**2CHM1**	Knows and understands complex theoretical issues at an in-depth level based on advanced knowledge of chemistry, also in non-standard situations, taking into account current development trends in the field of chemical sciences.	P7U_W	P7S_WG
2	**2CHM2**	Knows and understands advanced experimental and simulation techniques and methods used in the field of chemistry and discusses their theoretical foundations.	P7U_W	P7S_WG
3	**2CHM3**	Knows and understands the principles of safe work and operation of chemical equipment to a degree that allows independent work at the measurement station.	P7U_W	P7S_WG
4	**2CHM4**	Discusses in depth the mathematical methods and models used to describe chemical and physical phenomena and processes.	P7U_W	P7S_WG
5	**2CHM5**	Knows and understands concepts related to intellectual property protection, copyright, environmental protection and general principles of establishing and operating enterprises.	P7U_W	P7S_WK
6	**2CHM6**	Is able to work in a team, undertake commitments and manage its work; apply a systems approach, taking into account non-technical aspects, including environmental, economic and legal aspects.	P7U_U	P7S_UO
7	**2CHM7**	Is able to formulate and solve complex and unusual problems, analyze, evaluate and interpret experimental results of conducted research and draw conclusions, indicate sources of errors using advanced methods of experimental data analysis and modern digital technologies.	P7U_U	P7S_UW
8	**2CHM8**	Can obtain information from literature, databases and other carefully selected sources, also in a foreign language at B2+ level, understand and use scientific and technical chemical texts to the extent enabling the acquisition of knowledge and professional development.	P7U_U	P7S_UW, P7S_UK, P7S_UU
9	**2CHM9**	Is able to present the results of his/her work both in writing and orally, meeting specific requirements, is able to communicate with others on topics related to chemistry, integrate the obtained information and interpret and critically evaluate it, as well as draw conclusions, formulate and thoroughly justify opinions, and participate in debates.	P7U_U	P7S_UK
10	**2CHM10**	Is ready for continuous learning, critical assessment of his existing knowledge and received information, improving professional and personal skills, developing his professional achievements, and performing professional roles while taking into account the changing social and environmental needs, being aware of adhering to the principles of professional 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	2CHM1	2CHM2	2CHM3	2CHM4	2CHM5	2CHM6	2CHM7	2CHM8	2CHM9	2CHM10
1	Theoretical and Computational Chemistry	Computational methods in theoretical chemistry: ab initio, Hartree-Fock, DFT, semi-empirical techniques. Modeling atomic and molecular interactions, force fields, complex systems. Quantum calculations and structural analysis: geometry optimization, orbital analysis, vibrational spectra; using HyperChem, GaussView, Gaussian.	x	x		x				x		
2	Crystallography	Crystallography and its applications in physics, chemistry, and molecular biology. Crystal symmetry and structure: lattice systems, point and space groups, crystallization methods. X-ray diffraction and crystallographic calculations: Laue conditions, Bragg's law, reciprocal lattice, Ewald construction; software KRYST2, DISCUS, SHELX, databases CSD and PDB.		x	x				x			
3	Organic Syntheses Strategy and Design	Mechanism, strategy, and tactics of synthesis: retrosynthetic analysis, disconnection rules, pathway selection, types of syntheses, protecting groups, atom economy. Reaction selectivity and bond-forming methods: classical and modern C–C and C–heteroatom techniques, palladium-catalyzed reactions.Special synthesis techniques: PTC, green catalysts, microwave and ultrasonic methods, biocatalysis, solid-phase reactions, flow chemistry.	x	x				x				
4	Methods of Obtaining and Application of Specialized and Functional Polymers	Advanced classes of polymer materials – unique properties and functionalities. Design, synthesis, and applications of modern polymers – smart materials, electronics, biomedical engineering. Innovative polymer technologies – functionality and performance.	x	x								
5	Solid State Chemistry and Single Crystal X-Ray Analysis	Electrical and magnetic properties of solids – superconductivity and its implications. Diffraction methods – XRD, electron, and neutron diffraction; X-ray radiation sources. Structure solution and refinement of single crystals – interpretation and validation of results.		x					x			
6	Forensic Chemistry and Instrumental Methods in Trace Analysis	Introduction to forensic techniques and methods – classical, chromatographic, spectroscopic, and optical analyses. Modern trace analysis methods – SEM-EDS, TOF-SIMS, ICP-AES, AAS, ICP-MS, LA-ICP-MS. Application of advanced tools in forensic science – trace identification and interpretation.		x				x	x			
7	Archeometry	Methods for examining historical objects – destructive and non-destructive techniques (GC, MS, LC, FTIR, XRD). Conservation of artworks and cultural heritage – principles and analytical applications. Ceramic analysis using GC-MS and XRD – identification and interpretation of results.		x					x		x	
8	Instrumental Analysis	Fundamentals of modern analytical methods – optical techniques (UV-Vis), atomic spectroscopy (AAS, emission), electroanalytical methods, thermal analysis. Practical determination of elements and organic compounds – UV-Vis spectroscopy, HPLC, MS, thermal techniques. Application of modern chemical analysis methods.		x	x				x			
9	Spectroscopy	Theoretical basis and applications of spectroscopic methods – selection rules and spectrum interpretation. Nuclear Magnetic Resonance (NMR) spectroscopy – one-dimensional and two-dimensional techniques. Vibrational spectroscopy and advanced analysis – resonance Raman spectroscopy, chemometric analysis, non-hierarchical and hierarchical cluster analysis; selected topics in nonlinear optics.	x	x	x				x			

No.	Course name	Program content	2CHM1	2CHM2	2CHM3	2CHM4	2CHM5	2CHM6	2CHM7	2CHM8	2CHM9	2CHM10
10	Elements of Chemometry	Fundamentals of mathematical statistics in chemometrics – correlations, regression (including nonlinear), goodness-of-fit assessment. Multivariate data analysis – PCA, classification, cluster analysis. Practical use of analytical tools – spreadsheets and software such as Excel, Origin, Statistica, Matlab.		x		x						
11	Analytical Procedures	Sampling and quality: representativeness, normalization, laboratory quality systems. Control and procedures: instrument calibration, reference materials, measurement uncertainty, method validation. Sample preparation and analyte enrichment: sampling solids, liquids, gases, pretreatment, extractions (liquid–liquid, liquid–solid, gas–liquid), microextraction, supercritical extraction.		x				x	x		x	
12	Analytics of Environmental Samples	Fundamentals of environmental chemistry – field and laboratory analyses, retrospective and prospective geochemical methods. Data interpretation and sample characterization – analysis of rocks and sediments of various origins, assessment of composition and properties. Soil and groundwater studies – extraction of heavy metals from soil, groundwater composition analysis, classification and quality evaluation.		x				x	x		x	
13	Modern Industrial Analytics	Industrial process and quality control systems – testing raw materials, intermediates, finished products, auxiliary and waste materials. Sampling and sample distribution – product batch, representativeness, basic sample preparation principles. Analytical methods and work organization – techniques used in selected industries, documentation, good laboratory practice, accreditation and certification.		x				x	x		x	
14	Polycrystalline Analytical Methods	Structural databases for polycrystals: 1D, 2D, 3D data, PXRD analysis. Crystallinity characterization: lattice constants, Bravais lattice types, crystallinity/amorphous degree, crystallite size vs. spectroscopic properties. Qualitative and quantitative analysis: multicomponent systems, reference methods, phase analysis with overlapping reflections, texture, orientation, error estimation.		x					x		x	
15	Startup in Practice: Patents, Funding, and Labor Law	Entrepreneurship and business operations – forms, principles, sources of financing, business plan, rights and obligations of entrepreneurs. Fundamentals of labor law – sources, employment contracts, employment relationship, termination, rights and duties of employees and employers, working time, leave, remuneration, dispute resolution, health and safety. Non-standard employment forms and parental rights – regulations and practical aspects.			x		x	x				x
16	Foreign Language for Specialist Purposes	Grammatical and linguistic scope for scientific writing in chemical sciences – structures and conventions appropriate for academic texts. Preparation of presentations. Case study – scientific article – analysis and development.								x		
17	Final Project	Preparation of a master's thesis in accordance with the established requirements. Under the guidance of a supervisor, independently deepening knowledge and skills leading to the preparation by the student of an original and coherent text that meets the formal and substantive requirements set for a thesis carried out at the Lodz University of Technology.							x	x	x	
18	Diploma Project Laboratory	Diploma seminar and experimental or computational research project.							x	x	x	

No.	Course name	Program content	2CHM1	2CHM2	2CHM3	2CHM4	2CHM5	2CHM6	2CHM7	2CHM8	2CHM9	2CHM10
19	Nanochemistry	Nanochemistry: definitions, history, fabrication and classification of nanostructures, characterization. Production methods and properties of inorganic nanomaterials; magnetic materials, self-assembling molecular structures, polymeric nanomaterials. Applications of nanomaterials.	x					x		x		
20	Novel Strategies, Concepts and Technologies in Medicinal Chemistry	Drug Design Methods – established approaches and selected modern strategies, examples of recent therapeutics. Lipinski's Rule – current perspective, limitations, drugs that break the rule. Advanced Therapies and Techniques – immunotherapy, vaccines, PROTAC, personalized treatments, target discovery methods (ABPP, AfBPP, proteomics).	x					x		x		
21	Modern Chemical Technology	Modern chemical technology: green chemistry, atom economy, waste reduction, process-specific catalysts. Energy and fuels: sourcing from fossil and renewable resources, advanced petrochemical solutions, syngas production. Alternative sources and technologies: biomass, hydrogen from biomass, fuel cells, advanced reactors, microreactors.	x					x		x		
22	Self-Assembly Reconfigurable Matter	Self-Assembly and Supramolecular Chemistry – definitions, molecular recognition, complementarity and selectivity. Interactions and Compounds – covalent, ionic, hydrogen bonding; crown ethers, podands, cryptands, calixarenes, cyclodextrins, catenanes, rotaxanes. Structures and Devices – molecular and hierarchical self-assembly, monolayers, liquid crystals (nematic, cholesteric, smectic), molecular machines.	x					x		x		
23	Chemical Modification of Polymericcomposites	Chemical Modification of Composites – altering properties of composite materials using various techniques. Nomenclature – chemical compounds and polymers used for composite modification. Types of Modifications – overview of chemical methods applied to composites.	x					x		x		
24	Fragrance Chemistry in Perfumery - From Molecule to Aroma	Fundamentals of Fragrance Creation – organic chemistry, biochemistry, and the art of perfumery. Structure and Scent Perception – aromatic molecules, perception mechanisms, role of chemical structures in top, heart, and base notes. Ingredients and Processes – natural and synthetic compounds, extraction, synthesis, accord composition, chemistry's impact on perfume longevity.									x	x
25	Chemistry – Engineering of the Future	Recent Advances in Chemistry – molecular machines, designing systems with diverse properties from a single atom type. Hierarchy and Nanomaterials – using hierarchical structures to create particles with defined features, applications of nanomaterials. Modern Challenges in Chemistry – role in sustainable development and Industry 5.0 technologies.									x	x
26	Presentation Techniques	Improving presentation skills: oral talks, posters, written forms (articles, dissertations). Oral presentations: types, goals, main idea, material selection, adapting content to audience, presentation techniques (workshops). Poster presentations: role, content, graphic design, sessions and preparation. Scientific publications: original papers, reviews, short communications, theses; rules, conventions, publishing process, tips and common mistakes.									x	x

No.	Course name	Program content	2CHM1	2CHM2	2CHM3	2CHM4	2CHM5	2CHM6	2CHM7	2CHM8	2CHM9	2CHM10
27	Ethical and Social Aspects of Biologically Active Compounds	Ethical, Legal and Social Issues – research and use of biologically active compounds, scientific responsibility, bioethical principles. Regulations and Risk Assessment – legal frameworks, critical analysis of risks, misuse and inequalities in therapy access. Technological and Environmental Impact – effects of substances on human health and ecosystems.									x	x
28	Special Techniques In Analysis And Modification Of Materials	Advanced methods for material analysis and modification: functional materials, bio- and nanomaterials. Material characterization using spectroscopic, microscopic, chromatographic, scattering, and isotopic techniques. Non-classical modification methods: photochemical, radiation-based, and sonochemical approaches.		x					x			
29	Chemical Models of Biological Systems	Microemulsions and liposomes as biological environment models: water in microheterogeneous systems, biological water, self-organizing systems. Radicals and enzymology: chemical and radiolytic radical formation in vivo, enzyme reaction kinetics, reaction modeling. Biophysical and biochemical techniques: water in confined spaces, antioxidant capacity, enzymatic reaction mechanisms.		x					x			
30	Selected Topics in the Radiation Chemistry and The Chemistry of Radicals	Reactive molecules and radicals: classification, formation, identification, reactivity of radicals and radical ions, study methods. Reactive oxygen and nitrogen species: properties, detection in vitro and in vivo, oxidative stress concept, biological chemistry. Basics of radiation chemistry: radical reactivity analysis, experimental techniques, data interpretation.		x					x			
31	Chemometrics II	Data in physicochemical measurements – kinetic data, spectroscopic spectra, signal acquisition, analog-to-digital conversion, data storage and compression. Data processing and analysis – filtering, smoothing, approximation, differentiation and integration of spectra, theoretical fitting, nonlinear and multivariate regression, global analysis. Advanced methods – Fourier transform (FFT), deconvolution, PCA, PLS, classification, similarity analysis, optimization of measurement processes.		x		x						
32	Modern Methods of Laser Diagnostics	Laser fundamentals – operating principles, construction, optical feedback, main laser types, comparison of continuous and pulsed modes. Medical applications of lasers – tissue interactions: photochemical, thermal, photoablation, plasma-induced ablation.		x					x			
33	Molecular Modeling	Modeling and visualization of chemical systems: 3D rendering, visualization packages, theory levels for properties and reactivity. Molecular simulations: molecular mechanics, force fields, conformational analysis, molecular dynamics, geometry optimization, vibrational analysis. Advanced techniques: solvent models (explicit, continuum), hybrid QM/MM calculations, docking.		x		x		x	x			
34	Computer Simulations in Chemistry	Simulation methods: deterministic, stochastic, random number generation, Monte Carlo, molecular, stochastic, and quantum dynamics. Applications and algorithms: modeling physical and chemical phenomena (Brownian motion, aggregation, chaos, reactions), Metropolis algorithm, periodic boundaries, Ewald summation. Software and labs: HyperChem, MolDy, Gaussian, VMD, gOpenMol; visualization, result analysis, DLA, RLA, BA simulations, fractal structures.		x		x			x			

No.	Course name	Program content	2CHM1	2CHM2	2CHM3	2CHM4	2CHM5	2CHM6	2CHM7	2CHM8	2CHM9	2CHM10
35	Advanced Methods of Polymer Synthesis	Polymer synthesis: reversible-deactivation polymerizations (ATRP, RAFT, NMP), ROMP, ionic and sequential polymerizations. Advanced techniques: polymer self-assembly in solution (PISA), light-initiated polymerizations, polymers with varied topology and functionality. Physicochemical properties of (nano)polymers: structural characterization and analysis.		x				x	x	x		
36	Analysis of Polymer Materials and Nanomaterials	Methods for studying polymer and nanomaterials – analysis of molecular weight, size, thermal and mechanical properties, degree of crystallinity, and electro-optical characteristics. Research projects – polymers and nanomaterials for organic electronics and biomedical applications.		x				x	x	x		
37	Organic Solid State Physics	Fundamentals of solid-state physics – properties and structure of crystalline and amorphous materials, anisotropy, crystal classification. Interactions and structures – interatomic forces, bonding types, crystal and periodic structures, lattice defects, phonons and vibrations. Physical properties and band theory – elasticity, thermal conductivity, Einstein and Debye models, energy bands, semiconductors and conductivity.		x				x	x	x		
38	Nanomaterials and Polymer Nanotechnologies	Nanomaterials and their properties – comparison with micron-sized materials, specific physicochemical features. Methods of nanoparticle and nanocomposite fabrication – synthesis techniques and structural design for targeted properties. Polymer nanocomposites with advanced functionalities – enhanced dielectric permittivity, barrier properties, electrical conductivity, fire resistance, anti-corrosion coatings.		x				x	x	x		
39	Modeling of Complex Molecular Systems	Programming fundamentals – introduction to Python or C++: data input/output, conditional statements, loops, data structures, arrays, functions and libraries. Numerical computations and data handling – pseudorandom number generators, molecular configuration file formats, simulation result visualization. Computational simulation methods – molecular dynamics, Monte Carlo, cellular automata for modeling polymer systems.		x				x	x	x		
40	Functional Materials for Advanced Technologies - PBL	Project-based classes in PBL system – solving research-oriented problems through group and individual work. Project topics – general, aligned with specialization, fostering teamwork and development of individual project tools. Educational goals – deepening knowledge, enhancing interests, and building skills that complement the core curriculum.						x				
41	Modern Methods of Diagnosis and Therapy	Modern diagnostic and therapeutic methods using electromagnetic radiation: laser principles, clinical applications, beam–tissue interactions.Optical techniques: overview of spectroscopic methods in medicine. Immunological diagnostic and therapeutic approaches: antibodies, monoclonal technologies, lymphocyte activation, cytokine roles, cancer immunotherapy.Ionizing radiation and isotopes: basics of decay, radiation–matter interaction, detection and analysis techniques in medicine and health protection.	x					x	x			
42	Biostereochemistry	Structure and stereochemistry of molecules: hybridization, resonance, spatial factors, stereoisomerism, chirality and biological activity. Molecular conformation: impact of steric and stereoelectronic effects (resonance, anomeric) on spatial structure. Conformation of cyclic compounds: mono-, bi-, and polycyclic (sugars, steroids) and its biological relevance.							x			

No.	Course name	Program content	2CHM1	2CHM2	2CHM3	2CHM4	2CHM5	2CHM6	2CHM7	2CHM8	2CHM9	2CHM10
43	Naturally Derived Medicines and Biopharmaceuticals. Pharmacokinetics and Drug Validation	Biopharmaceuticals – characteristics and types – peptides, interferons, hormones, antibodies, vaccines, nucleic acid-based molecules. Production methods and next generations – genetic engineering, gene therapies, RNAi, hybrid proteins.Applications and market – DNA vaccines, immunotherapeutics, global biopharmaceutical market.	x						x		x	
44	Medicinal Chemistry	Fundamentals of pharmacology – cell structure, drug targets (enzymes, nucleic acids, receptors), receptor theory and signal transduction. Pharmacodynamics and drug design – metabolism, lead structure identification, design strategies. Drug classes – antibacterial, cholinergic, anticholinergic, adrenergic, antiadrenergic, narcotic analgesics, antiviral and anticancer drugs.		x					x		x	
45	Biomaterials	Basics of biomaterials: history, scope, examples, biocompatibility, biofunctionality, regulations, market, ethics. Types and properties: metals, ceramics, glasses, synthetic and natural polymers; structure, synthesis, processing, physicochemical and surface properties. Functional biomaterials and applications: biodegradable polymers, tissue engineering, drug delivery systems, protein/tissue interactions, biofilms, sterilization, radiation engineering.	x					x				
46	Computational Methods in Drugs Design	3D Visualization of Chemical Structures – rendering methods, visualization tools, theory levels and applications. Molecular Modeling – molecular mechanics, force fields, conformational analysis, dynamics, geometry optimization. Computational Techniques – solvent models, QM/MM calculations for enzymes, docking.		x		x		x	x			
47	NMR Techniques in Drug Chemistry	NMR Fundamentals – nuclear magnetic resonance phenomenon, chemical shift, coupling constants, relaxation times, Overhauser effect, dynamic NMR. Spectra and Applications – spectra for liquids and solids, ^1H, ^13C, ^19F, ^31P NMR in drug chemistry, metabolite analysis, DOSY technique. Modern Approaches – sensitivity and precision enhancement, advanced NMR methods for drug structure and drug–biomolecule interactions.	x						x			
48	Advanced Organic Chemistry	Linear combination of atomic orbitals theory illustrated by polyene systems and allylic cation, anion, and radical. Pericyclic reactions: electrocyclic, cycloaddition, sigmatropic rearrangements, and ene reactions – focusing on orbital interactions and stereochemical consequences. Rearrangements: Beckmann, Curtius, Hofmann, Wolff, Baeyer–Villiger, pinacol and semipinacol – mechanisms and electronic factors affecting migration rates of molecular fragments.	x						x		x	
49	Stereoselective Organic Synthesis and Catalysis	Principles of stereoselectivity in organic synthesis – classification of reactions, asymmetric induction, catalytic enantioselective reactions. Organocatalysis – advantages, main catalyst groups, mechanisms, examples of reactions (Michael addition, aldol reaction). Biotransformations and enzyme-catalyzed reactions – applications in organic synthesis.	x						x		x	
50	Retrosynthetic Analysis with Elements of Dynamic Stereochemistry	Fundamentals of retrosynthetic analysis and static stereochemistry – principles and applications. Impact of steric and stereoelectronic effects on molecular conformations – relevance in synthetic design. Stereochemical outcomes of reactions – stereoselective and stereospecific reactions.	x					x				

No.	Course name	Program content	2CHM1	2CHM2	2CHM3	2CHM4	2CHM5	2CHM6	2CHM7	2CHM8	2CHM9	2CHM10
51	Analysis of Organic Compounds	Separation and identification techniques – UV, IR, NMR, MS spectroscopy and gas, liquid, ion-exchange, and affinity chromatography. Theoretical foundations and applications – use of these methods for biologically active compounds and pharmaceuticals. Analysis of organic industry products – qualitative and quantitative assessment of organic substances.		x				x	x			
52	Advanced NMR Spectroscopy	Modern NMR techniques – qualitative and quantitative analysis of organic compounds. Dynamics and diffusion studies – using NMR to assess molecular mobility. Intermolecular interactions – investigation of ligand–receptor complexes by NMR.		x					x			
53	Chemistry of Natural Compounds	Natural organic compounds – amino acids, peptides (synthesis), proteins and their classification, carbohydrates, lipids, steroids, terpenoids. Structure and functions of biomolecules – simple and complex proteins, enzymatic proteins, fatty acids, prostaglandins, phospholipids, signaling compounds (pheromones). Biological mimetics – compounds mimicking natural structures with potential biological relevance.		x					x			
54	Chemistry of Organophosphorus Compounds	Organophosphorus compounds – history of phosphorus discovery, classification and nomenclature. Occurrence and synthesis – natural presence of organophosphorus compounds, reactions of tricoordinate and tetracoordinate phosphorus compounds. Phosphorus ylides – synthesis and reactions of compounds with unique properties.	x	x								
55	Advanced Methods of Polymer Synthesis	Polymer synthesis: reversible-deactivation polymerizations (ATRP, RAFT, NMP), ROMP, ionic and sequential polymerizations. Advanced techniques: polymer self-assembly in solution (PISA), light-initiated polymerizations, polymers with varied topology and functionality. Physicochemical properties of (nano)polymers: structural characterization and analysis.		x				x	x	x		
56	Analysis of Polymer Materials and Nanomaterials	Methods for studying polymer and nanomaterials – analysis of molecular weight, size, thermal and mechanical properties, degree of crystallinity, and electro-optical characteristics. Research projects – polymers and nanomaterials for organic electronics and biomedical applications.		x				x	x	x		
57	Organic Solid State Physics	Fundamentals of solid-state physics – properties and structure of crystalline and amorphous materials, anisotropy, crystal classification. Interactions and structures – interatomic forces, bonding types, crystal and periodic structures, lattice defects, phonons and vibrations. Physical properties and band theory – elasticity, thermal conductivity, Einstein and Debye models, energy bands, semiconductors and conductivity.		x				x	x	x		
58	Nanomaterials and Polymer Nanotechnologies	Nanomaterials and their properties – comparison with micron-sized materials, specific physicochemical features. Methods of nanoparticle and nanocomposite fabrication – synthesis techniques and structural design for targeted properties. Polymer nanocomposites with advanced functionalities – enhanced dielectric permittivity, barrier properties, electrical conductivity, fire resistance, anti-corrosion coatings.		x				x	x	x		

No.	Course name	Program content	2CHM1	2CHM2	2CHM3	2CHM4	2CHM5	2CHM6	2CHM7	2CHM8	2CHM9	2CHM10
59	Modeling of Complex Molecular Systems	Programming fundamentals – introduction to Python or C++: data input/output, conditional statements, loops, data structures, arrays, functions and libraries. Numerical computations and data handling – pseudorandom number generators, molecular configuration file formats, simulation result visualization. Computational simulation methods – molecular dynamics, Monte Carlo, cellular automata for modeling polymer systems.		x				x	x	x		
60	Functional Materials for Advanced Technologies - PBL	Project-based classes in PBL system – solving research-oriented problems through group and individual work. Project topics – general, aligned with specialization, fostering teamwork and development of individual project tools. Educational goals – deepening knowledge, enhancing interests, and building skills that complement the core curriculum.						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	Theoretical and Computational Chemistry	5			5	5
2	Crystallography	3			3	
3	Organic Syntheses Strategy and Design	4			4	
4	Methods of Obtaining and Application of Specialized and Functional Polymers	2			2	
5	Solid State Chemistry and Single Crystal X-Ray Analysis	8		8	8	
6	Forensic Chemistry and Instrumental Methods in Trace Analysis	4		4	4	
7	Archeometry	4		4	4	
8	Instrumental Analysis	5			5	
9	Spectroscopy	7			7	
10	Elements of Chemometry	3				
11	Analytical Procedures	6		6	6	
12	Analytics of Environmental Samples	3		3	3	
13	Modern Industrial Analytics	3		3	3	
14	Polycrystalline Analytical Methods	3		3	3	
15	Startup in Practice: Patents, Funding, and Labor Law	3	3			
16	Foreign Language for Specialist Purposes	2				
17	Final Project	20		20	20	
18	Diploma Project Laboratory	2			2	
19	Nanochemistry	1		1	1	1
20	Novel Strategies, Concepts and Technologies in Medicinal Chemistry	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
21	Modern Chemical Technology	1		1	1	1
22	Self-Assembly Reconfigurable Matter	1		1	1	1
23	Chemical Modification of Polymericcomposites	1		1	1	
24	Fragrance Chemistry in Perfumery - From Molecule to Aroma	2	2	2		
25	Chemistry – Engineering of the Future	2	2	2		
26	Presentation Techniques	2	2	2		
27	Ethical and Social Aspects of Biologically Active Compounds	2	2	2		
28	Special Techniques In Analysis And Modification Of Materials	10		10	10	
29	Chemical Models of Biological Systems	3		3	3	
30	Selected Topics in the Radiation Chemistry and The Chemistry of Radicals	3		3	3	
31	Chemometrics II	4		4	4	
32	Modern Methods of Laser Diagnostics	2		2	2	
33	Molecular Modeling	5		5	5	
34	Computer Simulations in Chemistry	4		4	4	
35	Advanced Methods of Polymer Synthesis	7		7	7	
36	Analysis of Polymer Materials and Nanomaterials	4		4	4	
37	Organic Solid State Physics	5		5	5	
38	Nanomaterials and Polymer Nanotechnologies	5		5	5	
39	Modeling of Complex Molecular Systems	5		5	5	
40	Functional Materials for Advanced Technologies - PBL	5		5	5	
41	Modern Methods of Diagnosis and Therapy	7		7	7	

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
42	Biostereochemistry	2		2	2	
43	Naturally Derived Medicines and Biopharmaceuticals. Pharmacokinetics and Drug Validation	7		7	7	
44	Medicinal Chemistry	5		5	5	
45	Biomaterials	3		3	3	
46	Computational Methods in Drugs Design	5		5	5	
47	NMR Techniques in Drug Chemistry	2		2	2	
48	Advanced Organic Chemistry	4		4	4	
49	Stereoselective Organic Synthesis and Catalysis	7		7	7	
50	Retrosynthetic Analysis with Elements of Dynamic Stereochemistry	5		5	5	
51	Analysis of Organic Compounds	4		4	4	
52	Advanced NMR Spectroscopy	3		3	3	
53	Chemistry of Natural Compounds	7		7	7	
54	Chemistry of Organophosphorus Compounds	1		1	1	
55	Advanced Methods of Polymer Synthesis	7		7	7	7
56	Analysis of Polymer Materials and Nanomaterials	4		4	4	4
57	Organic Solid State Physics	5		5	5	5
58	Nanomaterials and Polymer Nanotechnologies	5		5	5	5
59	Modeling of Complex Molecular Systems	5		5	5	5
60	Functional Materials for Advanced Technologies - PBL	5		5	5	5

ECTS indicators

Name	Specialty: Analytical and Structural Chemistry	Specialty: Physicochemical and Computational Techniques in Chemistry, Biology and Medicine	Specialty: Smart Materials	Specialty: Medicinal Chemistry	Specialty: Modern Organic Synthesis and Analysis	Specialty: Smart Materials (in English)
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%)	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	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	80/90 (88.89%)	80/90 (88.89%)	80/90 (88.89%)	80/90 (88.89%)	80/90 (88.89%)	80/90 (88.89%)

Methods of verifying and assessing learning outcomes

Verification of achieved learning outcomes requires the use of diverse forms of student assessment, appropriate to the categories of knowledge, skills, and social competences to which these outcomes relate. The selection of appropriate tools also depends on the specifics of the subject and the form of instruction, and is described each time in the course syllabi. The achievement of required learning outcomes is assessed through: 1. written assignments (exams, tests, reports, essays, projects, posters, diploma theses, etc.); 2. oral statements (oral examinations of knowledge, public speaking such as delivering papers, presentations, etc.); 3. practical and/or project-based tasks (team and individual); 4. observation and evaluation of students' activity during classes; 5. self-assessment and peer assessment (especially in team projects); 6. competency examinations and the diploma examination. Assessment may be formative (partial, conducted multiple times during the course) and/or summative (final grade). The final assessment result is provided according to the currently applicable grading scale. The course coordinator or instructor is required, during the first class, to discuss the course syllabus and to define and formally communicate to students the methods of assessment and the conditions for verifying the achievement of learning outcomes.

Professional internships

not applicable

Specializations/degree paths offered within the study program

Specialty: Analytical and Structural Chemistry

Specialty: Physicochemical and Computational Techniques in Chemistry, Biology and Medicine

Specialty: Smart Materials

Specialty: Medicinal Chemistry

Specialty: Modern Organic Synthesis and Analysis

Specialty: Smart Materials (in English)

Characteristics of the course

Graduate profile

Graduates of the Chemistry program possess in-depth knowledge of the chemical sciences, encompassing chemistry and chemical technology. They understand the mechanisms of chemical processes and can analyze them in both laboratory and industrial contexts. They possess the skills to design and conduct research in selected areas of chemistry, utilizing advanced instrumental analysis methods and interpreting results using statistical and digital tools. They can operate modern chemical and analytical equipment, applying the principles of occupational health and safety and environmental protection. They describe methods for the production and safe use of chemical products, as well as the principles of waste and waste management, promoting the concept of sustainable development. They possess competence in technological risk assessment, product quality control, and the implementation of innovative solutions in the chemical industry. They are able to use professional literature, databases, and legal regulations concerning business activity, environmental protection, and chemical safety. Graduates can work both independently and in interdisciplinary teams, including taking on leadership roles. They communicate effectively with specialists from other fields. They apply ethical, legal, and economic principles in their professional work, enabling responsible decision-making in technological and environmental contexts. They are ready to continuously improve their skills and actively contribute to the community and the development of science. A distinguishing feature of the graduate is the interdisciplinary nature of their competencies, resulting from the combination of knowledge in chemistry, chemical technology, chemical synthesis, and modern chemical analytics. This prepares them to solve complex research problems and implement innovations consistent with the principles of sustainable development.

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

The Chemistry program is aligned with the Lodz University of Technology's strategy for 2025-2030 (https://p.lodz.pl/uczelnia/strategia-uczelni), the primary goal of which is to develop a model of education that prepares graduates for the dynamically changing needs of the socio-economic environment. The Chemistry program pursues the following strategic goals of Lodz University of Technology: ● Supporting research that addresses socio-economic challenges. Chemistry students are engaged in research projects related to the industrial sector. ● Developing mobility opportunities for employees, doctoral candidates, and students of Lodz University of Technology. Chemistry students and faculty of the Faculty of Chemistry at Lodz University of Technology regularly take advantage of opportunities to travel abroad. ● Developing internationalization in education. The Faculty of Chemistry offers Chemistry students courses and seminars in English. ● Conducting useful, socially and environmentally responsible research that supports a knowledge-based economy and fosters interdisciplinary research through the development of collaboration between disciplines and fields of science. Students have the opportunity to conduct industry-related research that addresses social and environmental needs and supports a knowledge-based economy. The Chemistry curriculum is consulted with the Business Council at the Faculty of Chemistry, ensuring its alignment with the requirements of the labor market. Specializations such as Smart Materials and Medicinal Chemistry are interdisciplinary in nature, integrating various fields of science. ● Modernization of research infrastructure and the development of a system for its rational use. Students of the Faculty of Chemistry at Lodz University of Technology have access to specialized equipment and modern laboratories in the chemistry building – Alchemium – The Magic of Tomorrow's Chemistry. ● Implementation of clear and fair principles for hiring, remuneration, and career advancement, while respecting tolerance and equality policies. The recruitment process for the Faculty of Chemistry at Lodz University of Technology is based on the OTM-R policy – "Open, Transparent, Merit-Based Recruitment Process." ● Continuous improvement of academic teachers' competencies in modern teaching methods, the current state of knowledge, technological developments, and scientific trends. Academic teachers involved in teaching in the Chemistry program actively participate in numerous training courses, enhancing their qualifications, including in modern teaching methods. ● Improving the educational offer, including supplementary forms of education, in response to the challenges of the socio-economic environment. The Business Council at the Faculty of Chemistry has a real influence on the shape of the Chemistry program, which responds to socio-economic challenges. ● Strengthening the talent management process by individualizing the education paths of undergraduate and doctoral students. Talented students can pursue studies within the IPS and IOZ programs and participate in TUL's mentoring programs, such as E2TOP. ● Supporting the scientific development of undergraduate and graduate students, with an emphasis on interdisciplinarity and internationalization; and increasing student participation in research conducted at the university and intensifying their practical experience outside the university. Students have the opportunity to participate in interdisciplinary research projects, for example, combining topics in chemistry, biology, medicine, materials science, and computer science. They can also participate in foreign trips and exchange programs, such as Erasmus+, and internships in foreign laboratories. Students are also co-authors of scientific publications with international reach. In summary, thanks to the implementation of these initiatives, the Chemistry program aligns with Lodz University of Technology's strategy, offering students the highest level of education and preparing them for the demands of the job market.

Educational objectives and employment and continuing education opportunities

The Master's degree program in Chemistry aims to deepen students' theoretical and practical knowledge in chemistry, chemical technology, and modern instrumental and computational analysis methods. The program develops skills in designing and conducting complex research, interpreting results using statistical and digital tools, and prepares students to implement innovative solutions consistent with the principles of sustainable development. Emphasis is also placed on developing competencies in technological risk assessment, product quality control, minimizing the impact of processes on the environment, and applying legal regulations and ethical principles in professional activities. A key element of the education is developing the ability to work in interdisciplinary teams, lead and manage projects, and communicate effectively in an international environment. The program also prepares students for self-study and doctoral studies. The Chemistry program prepares students for work in research and development laboratories in the chemical, pharmaceutical, cosmetics, and materials industries, as well as in quality control departments for chemicals and industrial products. Graduates can find employment in analytical, chemical, biochemical, and environmental laboratories, as well as in accredited research institutions. Their competencies also include technical consulting, chemical safety consulting, and quality assurance consulting, as well as implementing environmentally friendly technologies. They are prepared to work in chemical companies implementing innovative solutions, as well as in micro-businesses and startups involved in the production and processing of chemicals. Furthermore, they possess qualifications enabling them to develop a scientific career in research and educational institutions.

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

The concept of education in the second-cycle Chemistry program was created in response to the socio-economic needs of the environment for chemists. The Business Council at the Faculty of Chemistry, Lodz University of Technology actively participated in the process of reviewing the prepared study program. The Business Council includes representatives of the following companies: Atlas sp. z o.o., CDM sp. z o.o., Corning Cable Systems Polska sp. z o.o., Krajowa Grupa Spożywcza S.A., Lubawa S.A., Polfarmex S.A., Adamed Pharma S.A., Delia Cosmetics sp. z o.o., Petecki sp. z o.o., QWERTY sp. z o.o., Hitachi Energy, KIKGEL sp. z o.o., TomTom Polska, CloudFerro S.A., WITKO sp. as well as representatives of the Business Centre Club, the Lodz Regional Development Agency, the Investor Service and International Cooperation Office of the City of Lodz, the Polish Forensic Society, and the Forensic Laboratory of the Provincial Police Headquarters in Lodz. Collaboration with the socio-economic community in the educational process takes place on many levels and includes: conducting classes, supervising students during their internships, acquiring materials for theses, and reviewing the study program, primarily in terms of learning outcomes. The cooperation also aims to improve the program's education; to align the needs and expectations of external entities with student education; to link research with the needs of the external community; and to jointly implement teaching, research, and outreach projects. The study program received positive written opinions from: the Business Council of the Faculty of Chemistry of Lodz University of Technology and ChemiPack sp. z o.o.

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

Engineer's diploma after completing first-cycle studies, Master of Science 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
Theoretical and Computational Chemistry	Laboratory classes: 15 E-learning: 35	5	Exam	Obligatory
Crystallography	Tutorials: 10 Laboratory classes: 10 Lecture: 20	3	Graded assignment	Obligatory
Organic Syntheses Strategy and Design	Project work: 30 Lecture: 15	4	Graded assignment	Obligatory
Methods of Obtaining and Application of Specialized and Functional Polymers	Lecture: 35	2	Graded assignment	Obligatory
Sum	**170**	**14**		

Specialty: Analytical and Structural Chemistry

Course	Number of hours	ECTS points	Form of verification	Obligatory
Solid State Chemistry and Single Crystal X-Ray Analysis	Laboratory classes: 60 Lecture: 30	8	Exam	Obligatory specialization courses
Forensic Chemistry and Instrumental Methods in Trace Analysis	Laboratory classes: 30 Project work: 10 Lecture: 20	4	Graded assignment	Obligatory specialization courses
Archeometry	Seminar: 5 Laboratory classes: 15 Lecture: 10	4	Graded assignment	Obligatory specialization courses
Sum	**180**	**16**		

Specialty: Modern Organic Synthesis and Analysis

Course	Number of hours	ECTS points	Form of verification	Obligatory
Advanced Organic Chemistry	Tutorials: 10 Seminar: 10 Lecture: 25	4	Graded assignment	Obligatory specialization courses
Stereoselective Organic Synthesis and Catalysis	Seminar: 15 Laboratory classes: 30 Lecture: 30	7	Exam	Obligatory specialization courses
Retrosynthetic Analysis with Elements of Dynamic Stereochemistry	Tutorials: 15 Project work: 15 Lecture: 30	5	Graded assignment	Obligatory specialization courses
Sum	**180**	**16**		

Specialty: Physicochemical and Computational Techniques in Chemistry, Biology and Medicine

Course	Number of hours	ECTS points	Form of verification	Obligatory
Special Techniques In Analysis And Modification Of Materials	Laboratory classes: 70 Lecture: 40	10	Exam	Obligatory specialization courses
Chemical Models of Biological Systems	Laboratory classes: 20 Lecture: 15	3	Graded assignment	Obligatory specialization courses
Selected Topics in the Radiation Chemistry and The Chemistry of Radicals	Laboratory classes: 20 Lecture: 15	3	Graded assignment	Obligatory specialization courses
Sum	**180**	**16**		

Specialty: Smart Materials

Course	Number of hours	ECTS points	Form of verification	Obligatory
Advanced Methods of Polymer Synthesis	Seminar: 5 Laboratory classes: 15 Project work: 25 Lecture: 30	7	Exam	Obligatory specialization courses
Analysis of Polymer Materials and Nanomaterials	Seminar: 5 Laboratory classes: 15 Project work: 15 Lecture: 10	4	Graded assignment	Obligatory specialization courses
Organic Solid State Physics	Laboratory classes: 20 Project work: 20 Lecture: 20	5	Graded assignment	Obligatory specialization courses
Sum	**180**	**16**		

Specialty: Smart Materials (in English)

Course	Number of hours	ECTS points	Form of verification	Obligatory
Advanced Methods of Polymer Synthesis	Seminar: 5 Laboratory classes: 15 Project work: 25 Lecture: 30	7	Exam	Obligatory specialization courses
Analysis of Polymer Materials and Nanomaterials	Seminar: 5 Laboratory classes: 15 Project work: 15 Lecture: 10	4	Graded assignment	Obligatory specialization courses
Organic Solid State Physics	Laboratory classes: 20 Project work: 20 Lecture: 20	5	Graded assignment	Obligatory specialization courses
Sum	**180**	**16**		

Specialty: Medicinal Chemistry

Course	Number of hours	ECTS points	Form of verification	Obligatory
Modern Methods of Diagnosis and Therapy	Laboratory classes: 30 Project work: 15 Lecture: 45	7	Graded assignment	Obligatory specialization courses
Biostereochemistry	Tutorials: 15	2	Graded assignment	Obligatory specialization courses
Naturally Derived Medicines and Biopharmaceuticals. Pharmacokinetics and Drug Validation	Laboratory classes: 15 Project work: 24 Lecture: 36	7	Exam	Obligatory specialization courses
Sum	**180**	**16**		

Semester 2

Course	Number of hours	ECTS points	Form of verification	Obligatory
Instrumental Analysis	Laboratory classes: 30 Lecture: 15	5	Graded assignment	Obligatory
Spectroscopy	Laboratory classes: 46 Lecture: 24	7	Exam	Obligatory
Elements of Chemometry	Laboratory classes: 25	3	Graded assignment	Obligatory
Sum	**140**	**15**		

Specialty: Analytical and Structural Chemistry

Course	Number of hours	ECTS points	Form of verification	Obligatory
Analytical Procedures	Laboratory classes: 30 Project work: 15 Lecture: 15	6	Exam	Obligatory specialization courses
Analytics of Environmental Samples	Laboratory classes: 30 Lecture: 15	3	Graded assignment	Obligatory specialization courses

Course	Number of hours	ECTS points	Form of verification	Obligatory
Modern Industrial Analytics	Laboratory classes: 30 Lecture: 15	3	Graded assignment	Obligatory specialization courses
Polycrystalline Analytical Methods	Laboratory classes: 30	3	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Modern Organic Synthesis and Analysis

Course	Number of hours	ECTS points	Form of verification	Obligatory
Analysis of Organic Compounds	Laboratory classes: 15 Project work: 15 Lecture: 15	4	Graded assignment	Obligatory specialization courses
Advanced NMR Spectroscopy	Laboratory classes: 30 Lecture: 15	3	Graded assignment	Obligatory specialization courses
Chemistry of Natural Compounds	Laboratory classes: 60 Lecture: 15	7	Exam	Obligatory specialization courses
Chemistry of Organophosphorus Compounds	Lecture: 15	1	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Physicochemical and Computational Techniques in Chemistry, Biology and Medicine

Course	Number of hours	ECTS points	Form of verification	Obligatory
Chemometrics II	Laboratory classes: 30 Lecture: 15	4	Exam	Obligatory specialization courses

Course	Number of hours	ECTS points	Form of verification	Obligatory
Modern Methods of Laser Diagnostics	Laboratory classes: 15 Lecture: 15	2	Graded assignment	Obligatory specialization courses
Molecular Modeling	Laboratory classes: 30 Project work: 15 Lecture: 15	5	Graded assignment	Obligatory specialization courses
Computer Simulations in Chemistry	Laboratory classes: 30 Lecture: 15	4	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Smart Materials

Course	Number of hours	ECTS points	Form of verification	Obligatory
Nanomaterials and Polymer Nanotechnologies	Seminar: 5 Laboratory classes: 20 Project work: 20 Lecture: 15	5	Exam	Obligatory specialization courses
Modeling of Complex Molecular Systems	Laboratory classes: 30 Project work: 15 Lecture: 15	5	Graded assignment	Obligatory specialization courses
Functional Materials for Advanced Technologies - PBL	Project work: 60	5	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Smart Materials (in English)

Course	Number of hours	ECTS points	Form of verification	Obligatory
Nanomaterials and Polymer Nanotechnologies	Seminar: 5 Laboratory classes: 20 Project work: 20 Lecture: 15	5	Exam	Obligatory specialization courses
Modeling of Complex Molecular Systems	Laboratory classes: 30 Project work: 15 Lecture: 15	5	Graded assignment	Obligatory specialization courses
Functional Materials for Advanced Technologies - PBL	Project work: 60	5	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Specialty: Medicinal Chemistry

Course	Number of hours	ECTS points	Form of verification	Obligatory
Medicinal Chemistry	Seminar: 15 Laboratory classes: 15 Lecture: 30	5	Exam	Obligatory specialization courses
Biomaterials	Project work: 15 Lecture: 15	3	Graded assignment	Obligatory specialization courses
Computational Methods in Drugs Design	Laboratory classes: 30 Project work: 15 Lecture: 15	5	Graded assignment	Obligatory specialization courses
NMR Techniques in Drug Chemistry	Laboratory classes: 15 Lecture: 15	2	Graded assignment	Obligatory specialization courses
Sum	**180**	**15**		

Semester 3

Course	Number of hours	ECTS points	Form of verification	Obligatory
Startup in Practice: Patents, Funding, and Labor Law	Project work: 15 Lecture: 15	3	Graded assignment	Obligatory
Foreign Language for Specialist Purposes	Tutorials: 45	2	Graded assignment	Obligatory
Final Project	Diploma Thesis: 0	20	Pass	Obligatory subjects to choose from
Diploma Project Laboratory	Seminar: 5 Project work: 30	2	Graded assignment + exam	Obligatory
Elective Course 1		1	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Nanochemistry	Project work: 10 Lecture: 5	1	Graded assignment	Optional
Novel Strategies, Concepts and Technologies in Medicinal Chemistry	Project work: 10 Lecture: 5	1	Graded assignment	Optional
Modern Chemical Technology	Project work: 10 Lecture: 5	1	Graded assignment	Optional
Self-Assembly Reconfigurable Matter	Project work: 10 Lecture: 5	1	Graded assignment	Optional
Chemical Modification of Polymericcomposites	Project work: 10 Lecture: 5	1	Graded assignment	Optional
Elective Course 2		2	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Fragrance Chemistry in Perfumery - From Molecule to Aroma	Seminar: 15	2	Graded assignment	Optional
Chemistry – Engineering of the Future	Seminar: 15	2	Graded assignment	Optional
Presentation Techniques	Seminar: 15	2	Graded assignment	Optional
Ethical and Social Aspects of Biologically Active Compounds	Seminar: 15	2	Graded assignment	Optional
Sum	**140**	**30**		