Appendix to Resolution No. 79/2025 of the Senate
of the University of Wroclaw, June 25, 2025

Field of study Chemistry, speciality Advanced Synthesis in Chemistry: study plan, curriculum content, learning outcomes

YEAR OF STUDY: I											
SEMESTER: FIRST											
Name of the subject/course	O/W/OzW	Form of course Number of class hours						Way to verify learning outcomes	ECTS credits	The discipline(s) to which the course relates	Organizational unit conducting the course
		W	S	L	K	Other	Total				
Safety in a chemical laboratory	O	15		15			30	E/Zo	3	chemical sciences	Faculty of Chemistry
Advanced organic chemistry (Block I)	O	90	30	75			195	E/Zo/Zo	17	chemical sciences	Faculty of Chemistry
Health and safety course	O					4	4	Z	0		Department of Occupational Health and Safety and Fire Protection
Elective Courses I *	W						105	Zo	10	chemical sciences	Faculty of Chemistry
Polish for Foreigners**	O					30	30	Zo	0		School of Polish Language and Culture for Foreigners
TOTAL of class hours/ECTS points							**364**	**2E**	**30**		

YEAR OF STUDY: I											
SEMESTER: SECOND											
Name of the subject/course	O/W/OzW	Form of course Number of class hours						Way to verify learning outcomes	ECTS credits	The discipline(s) to which the course relates	Organizational unit conducting the course
		W	S	L	K	Other	Total				
Advanced inorganic chemistry (Block II)	O	60	45	90			195	E/Zo/Zo	17	chemical sciences	Faculty of Chemistry
Molecular modelling	O	20	15	30			65	E/Zo/Zo	7	chemical sciences	Faculty of Chemistry
Polish for Foreigners**	O					30	30	E	5**		School of Polish Language and Culture for Foreigners
Foreign language course***	OzW***					60	60	E	4***		Foreign Languages Centre
TOTAL of class hours/ECTS points							**350**	**4E**	**28/33****		

YEAR OF STUDY: II											
SEMESTER: THIRD											
Name of the subject/course	O/W/OzW	Form of course Number of class hours						Way to verify learning outcomes	ECTS credits	The discipline(s) to which the course relates	Organizational unit conducting the course
		W	S	L	K	Other	Total				
Master's Degree Project****	OzW								16	chemical sciences	Faculty of Chemistry
Elective Courses II*	W						180	Zo	16	chemical sciences	Faculty of Chemistry
TOTAL of class hours/ECTS points							**180**		**32**		

YEAR OF STUDY: II											
SEMESTER: FOURTH											
Name of the subject/course	O/W/OzW	Form of course Number of class hours						Way to verify learning outcomes	ECTS credits	The discipline(s) to which the course relates	Organizational unit conducting the course
		W	S	L	K	Other	Total				
Entrepreneurship and protection of intellectual property	O	15					15	E	2	economics and finance/law	Faculty of Chemistry
Communication, speech freedom and other human rights and freedoms in democratic society	O	30					30	Zo	3	communication and media studies	Faculty of Social Communication and Media
Master's Degree Project and preparation for the master's exam****	OzW							E	21	chemical sciences	Faculty of Chemistry
Master's Seminar	O		30				30	Zo	4	chemical sciences	Faculty of Chemistry
TOTAL of class hours/ECTS points							**75**	**2E**	**30**		

Name of elective courses I and elective courses II*	W	Form of course Number of class hours						Way to verify learning outcomes	ECTS credits	The discipline(s) to which the course relates	Organizational unit conducting the course
		W	S	L	K	Other	Total				
Combinatorial chemistry	W	15		30			45	Zo/Zo	4	chemical sciences	Faculty of Chemistry
Applications of chemical materials	W	30					30	Zo/Zo	3	chemical sciences	Faculty of Chemistry
Computer design and modelling of new materials	W	30		15			45	Zo/Zo	4	chemical sciences	Faculty of Chemistry
Chemistry in action: ideas and applications	W	45					45	Zo/Zo	4	chemical sciences	Faculty of Chemistry
Catalysis and green chemistry	W	15		45			60	Zo/Zo	6	chemical sciences	Faculty of Chemistry
Biological inorganic chemistry	W	30					30	Zo/Zo	3	chemical sciences	Faculty of Chemistry
Bioorganic chemistry	W	15		15			30	Zo/Zo	3	chemical sciences	Faculty of Chemistry
Protein chemistry	W	15		15			30	Zo/Zo	3	chemical sciences	Faculty of Chemistry
Forensic chemistry	W	7	14	24			45	Zo/Zo/Zo	4	chemical sciences	Faculty of Chemistry
Molecular magnetism	W	15		15			30	Zo/Zo	3	chemical sciences	Faculty of Chemistry
Analytical methods in cultural heritage research	W	30		15			45	Zo/Zo	4	chemical sciences	Faculty of Chemistry

* Elective Courses from the Table below with a list of courses. Elective Corses offered in the first semester (I) and third semester (II)
** Polish course is obligatory for foreigners only. Subject to separate University regulations 5 ECTS credits gained for this course do not count for the total of 120 ECTS credits required to complete the curriculum and get the degree.
*** Modern language elective, B2+ level.
**** Upon choosing the topic of Master thesis, the student carries out the Master's Degree Project in one of the research groups at the Faculty. The number of class hours is project-specific, and hence, remains undefined (estimated total student workload is 400 hours per semester)

Total number of hours during studies: 969
Total number of ECTS credits: 120, including 67 ECTS in electives (55,8%)

EXPLANATIONS
Character of the course: O - mandatory , W - elective, OzW - mandatory with choice
Course form: W – lecture, S – seminar, L - laboratory, K – conversion course, Other – online course, lectorate.
Ways of verification of learning outcomes: E - exam, Zo – passing with grade, Z- pass.

Curriculum content

l.p.	Name of the course	Curriculum content	Course-assigned directional learning outcomes
1.	Health and safety course	Basic concepts of occupational health and safety. Harmful or burdensome factors affecting health that may occur during student activities. Content of the Regulation of the Minister of Science and Higher Education of 5 July 2007 on occupational health and safety in higher education institutions. Procedures in the event of an accident. Basic principles of first aid. Occupational health and fire safety hazards present in the place of study. Causes of fire outbreaks and fire spread. Basic duties and responsibilities arising from fire prevention regulations and procedures in case of fire. Principles of use and ability to operate firefighting equipment and device.	K_W07
2.	Safety in a chemical laboratory	Safety culture and ethic. Basic safety rules in chemistry laboratory, experiment planning and organization of work. Preparing for emergency response: chemical spills, fire, first aid in chemistry laboratory. Understanding and communicating laboratory hazards: signs, symbols, and labels. Information resources about laboratory hazards and safety: safety data sheets (SDS/MSDS), GHS. Recognizing laboratory hazards of toxic substances and biological agents. Basic concepts in toxicology: toxicants, toxins and poisons, measuring toxicity, acute and chronic toxicity. Recognizing laboratory physical hazards: flammables, corrosives, incompatible chemicals, reactive chemicals, peroxides, electrical hazard, hazard from low- or high-pressure systems, cryogenic hazard, radiation related hazard. Risk assessment and managing. Personal protective equipment and engineering control. Chemical management: inspections, storage, local transport, wastes, and security.	K_W01, K_W07 K_K01
3.	Advanced organic chemistry (Block I)	Contemporary organic synthesis: Role of organic synthesis in contemporary chemistry and chemical industry. Types of synthetic transformations. Oxidations and reductions in organic chemistry. Reagents and their applications. Methods of carbon-carbon bond formation. Aldol-type condensations, reactions with carbanions, coupling reactions (oxidative, reductive, and catalytic). Synthesis of carbocycles. Synthesis of heterocyclic and macrocyclic systems. Strategy and planning in organic synthesis. Retrosynthetic analysis, synthons, umpolung. Analytical methods in organic synthesis. Publication standards.	K_W01, K_W03, K_W05, K_W07 K_U01, K_U03, K_U07, K_U08 K_K02, K_K03, K_K04

		Practical organic chemistry: Scientific information in the organic chemistry. Safety in the organic chemistry laboratory. How to conduct a lab book and a synthetic documentation? Modern laboratory equipment. Separation and purification of the reaction products. High vacuum techniques – vacuum/inert gas line, Schlenk techniques, vacuum distillation. Work in a controlled atmosphere. Glove-box as a convenient tool for protecting substrates/products from decomposition. Purification of reagents and solvents. Chromatography as a powerful tool for identification and separation of products. Special reaction techniques (photochemical and microwave synthesis, solid phase synthesis). Visualisation of the experimental data. Analytical methods in organic chemistry: NMR spectroscopy. Mass spectrometry. Other analytical methods useful in organic chemistry Laboratory: The laboratory course creates an opportunity to face all steps necessary in organic synthesis. It starts with a purification of reagents and solvents, required for further work, including a distillation in inert atmosphere. All prepared purified chemicals will be used for a microscale synthesis. Some experiments will require the use of moisture and oxygen-sensitive reagents. In this case high vacuum/inert gas Schlenk methodology will be applied. Multistep synthesis will be also conducted. The isolation and purification (crystallization, distillation and chromatography) of the final product will be an important part of the course. Vacuum distillation will be used as a method of removal of highboiling solvents and separation of mixtures (high vac and bulb-to bulb technique). Variety of chromatographic procedures will be also presented.	
4.	Advanced inorganic chemistry (Block II)	Lecture, seminar: Fundamental theories describing metal-carbon bonds. Synthesis, characterization and applications of organometallic compounds. Metal hydride and carbonyl compounds. Elementary steps in catalytic reactions. Mechanisms of catalytic reactions. Structure reactivity relationships. Application of catalytic reactions in industrial processes. Inorganic supramolecular chemistry. The role of coordination bonds in the formation of supramolecular assemblies, macrocyclic complexes, selective binding of cations and anions, self-organization of metal complexes. Supramolecular aspects in bioinorganic chemistry, optical and magnetic materials, molecular electronics, chemical sensors. Inorganic-organic hybrid materials, metal-organic frameworks. The concept of a node and a linker in a coordination polymer. Classification of coordination polymers. Zeolites and their inorganic-organic analogues. Covalent organic frameworks. Isoreticular approach in the design of coordination polymers. Solvothermal synthesis and mechanochemistry. Topology and isomerism in coordination polymer	K_W01, K_W07 K_U01, K_U02, K_U05, K_U08, K_U09 K_K03

		frameworks. Theoretical and experimental description of porosity in solids. Dynamic coordination networks. Sorption and separation of gases and vapors in porous materials. Heat of adsorption. Porous materials in catalysis. Coordination polymers as drug delivery systems. Electroactive materials. Laboratory: Preparation of selected coordination compounds under inert atmosphere with the use of advanced laboratory techniques. Physicochemical characterization of obtained compounds.	
5.	Foreign Language course	Lexical and grammatical resources of the language corresponding to proficiency at level B2+ of the Common European Framework of Reference for Languages.	K_U07
6.	Polish for Foreigners (studies in English)	Vocabulary and grammar rules necessary to achieve fluency at level A1 of the Common European Framework of Reference for Languages. topics necessary in communication.	
7.	Molecular modelling	Classical mechanics methods, force fields. Theoretical basis of quantum chemistry methods: Hartree-Fock method, semi-empirical methods, ab initio SCF methods, basis functions, correlation methods (MPn, CI and CC), density functional methods. Stationary points on the potential energy surface, optimization of the geometrical structure, localization of transition states, modelling of the chemical reaction path. Modelling of the structure and properties of molecular systems in the gas phase and solution (explicit solvation model and polarizable continuum methods). Application of quantum chemistry methods in molecular spectroscopy. Research of molecular systems using Monte Carlo methods. Research on the dynamic properties of molecular systems - methods of molecular dynamics (classical, based on the force fields, and ab initio MD). Experimental chemistry supported by computational methods and AI. Design of chemical compounds and reactions based on computational chemistry methods and AI. Cheminformatics tools and databases - AI in practice.	K_W03, K_W04, K_W06 K_U01, K_U02, K_U05, K_U09 K_K01, K_K02
8.	Master's Degree Project including preparation for the diploma exam	The student completes a master's project, which ends with a master's thesis, choosing a topic proposed and assigned to the research group of the faculty. The project includes a review of the literature on the issues discussed in the master's thesis, synthesis of compounds, the use of physicochemical methods to characterize and explain the properties of the compounds obtained, correlation of the observed properties with current literature data.	K_W01, K_W02, K_W03, K_W04, K_W05, K_W07 K_U01, K_U02, K_U03, K_U04, K_U05, K_U06, K_U09 K_K01, K_K03, K_K04

9.	Entrepreneurship and intellectual property protection	Introduction to a global high technology market. Assessment of individual business skills. Selection of a new business idea from a high technology area. Market evaluation of a new idea/technology. Study of market competitiveness. Possible methods of IP assessment and protection. Raising capital for innovative activity/business. Successive stages of the introduction of a technology to the market. Registration and introduction of a new entity into the market.	K_W08, K_W09, K_W10, K_W11, K_K03, K_K04
10.	Communication, speech freedom and other human rights and freedoms in democratic society	Meaning and nature of law and democracy. Sources of law in the Constitution of RP. Legal system. Media in international regulations. Specific responsibilities of media. Advertising Law. The issue and limits of freedom of expression. Rights and obligations of journalists. Law on Competition in activity of media. The issue and protection of copyright and related rights. Digital media law. Right for privacy.	K_W12
11.	Master's Seminar	Issues in chemistry in the field of approved thesis topics. The subject matter is related to the profile of the Research Team. Students present presentations-projects from the literature review, the results of their research work and present their master's thesis	K_W01, K_W06, K_U02, K_U04, K_U03, K_U05, K_U06 K_K01, K_K02, K_K03, K_K04
12.	Combinatorial chemistry	Combinatorial libraries. Natural libraries: immune response, proteins, antibiotics, polyketides, phage systems and viruses. Synthetic and virtual libraries. Combinatorial biosynthesis. General and focused libraries, library design, deconvolution. Chemical diversity, Synthetic and analytical procedures, screening protocols, HTPS. Application of combinatorial libraries in biological and organic chemistry as well as in analytical chemistry and material science. Development of inhibitors and catalysts. Bioinformatics and data mining. Classical organic synthesis, solid phase chemistry and polymer-assisted solution synthesis. Design of a library, synthesis, analysis, prediction of physicochemical and biological properties. Evaluation of synthetic methods. Applications of solid phase synthesis: biopolymers and natural products, combinatorial libraries, analytical applications.	K_W04 K_U04

13.	Applications of chemical materials	Classification of materials due to their physicochemical properties. Fullerene chemistry. New materials: graphene, metamaterials, composites and organic materials in optoelectronics. Discussion of the properties of ferroic materials (mainly ferroelectrics and ferroelastics). Presentation of the main research methods for the characterization of ferroic crystals. Discussion of the properties of nonlinear ferroelectric crystals. Organometallic catalysts in the synthesis of organic materials. Types of catalysts, systems in which they are used, their design and applications of nanomaterials	K_W01, K_W06
14.	Computer design and modeling of new materials	General aspects of molecular modelling. Molecular mechanics (MM) methods – formulations, approximations and application to biological and nano systems. Short description of advanced quantum chemical methods: the Hartree-Fock method, semiempirical methods, ab initio methods, basis sets used in ab initio calculations, post-HF methods like MPn, CI and CC. Methods formulated on base on density functional theory (DFT). Prediction of molecular properties important to design of new materials. The Born-Oppenheimer approximation and potential energy surface (PES). Energy minimization and related methods for exploring the PES – determination stable structures, transition state structures and reaction pathways. Genetic algorithms. Quantum chemical topology methods for analysis of the chemical bond nature: Atoms in Molecules (AIM) and Electron Localization Function (ELF). Calculations of excited states – CI and DTDFT methods (structure and properties). Theory of intermolecular interactions – energy decomposition analysis. Modelling of new materials on base of fullerenes and graphene. Design of new medical drugs – QSAR approach.	K_W04 K_U03, K_U04 K_K04
15.	Chemistry in action: ideas and applications	The lecture encompasses selected examples related to many areas of chemistry: Smart contrast agents for medical imaging, molecular machines, sensors, molecular switches, nanotechnology and molecular computers, NO and Viagra story, enantioselective catalysts in pharmaceutical industry, artificial nucleases and antisense technology, optical, conducting and magnetic materials	K_W01, K_W06

16.	Catalysis and green chemistry	Phenomenon of catalysis, elementary steps of catalytic reactions. Mechanism of catalytic reaction and methods used in mechanistic studies. Evaluation of catalytic activity and reaction selectivity. Characterization of homogenous and heterogeneous catalytic systems. Immobilised catalysts and nanoparticles in catalysis. Application of catalytic reactions in organic synthesis and industry – oxidation, hydrogenation, hydroformylation, carbonylation, metathesis, C-C coupling. Methods used for recovery of catalyst from reaction mixture (biphasic systems, ionic liquids, supercritical fluids). Application of alternative energy sources in catalytic reactions.	K_W01, K_W03, K_W06 K_U01, K_U02, K_U03 K_K02
17.	Biological inorganic chemistry	Metals in biological processes. Essential and toxic metal ions. Relations between chemical properties of metal ions, structure of their complexes and their biological functions. Metalloproteins. Metalloenzymes. Metals in biology of nucleic acids. Transport, storage and homeostasis of metal ions. Sodium and potassium—channels and pumps. Magnesium and calcium in biological systems. Zinc: Lewis acid and gene regulator. Iron: essential for almost all life. Copper: coping with dioxygen. Nickel and cobalt: evolutionary relics. Manganese: water splitting, oxygen atom donor. Molybdenum, tungsten, vanadium and chromium – chemistry and biochemistry. Selected methods of analysis of metal ions complexes with bio-ligands. Metals in medicine, introduction to chemistry of inorganic drugs.	K_W01, K_W06
18.	Bioorganic chemistry	Molecules of Life: Chemical bonds and shape of organic molecules, Nucleotides and nucleic acids, amino acids, peptides and proteins, carbohydrates and lipids, „Natural Products” – secondary metabolites. Biological Activity: quantitative aspects of biological activity, examples of molecular targets: receptors, ion channels and their ligands, molecules interacting with nucleic acids, enzyme inhibitors and molecules interacting with proteins involved in cellular adhesion, designing of biologically active compounds. Isolation of natural products from biological sources. Chemical and spectroscopic characterization of organic compounds. Chromatographic methods: TLC, gel filtration, HPLC. Peptide chemistry: synthesis and sequence analysis.	K_W01, K_W05, K_W06 K_U01, K_U04 K_K01, K_K03
19.	Protein chemistry	Chemical properties of amino acids. Protein structures. Synthesis of peptides and peptidomimetics. Protein purification and characterization. Chemical and enzymatic modifications of proteins. Implementation of methods presented in the lecture. For protein isolation and analysis.	K_W01, K_W05, K_W06 K_U01, K_U04 K_K01, K_K03

20.	Forensic chemistry	Forensic chemistry: history and methods. Analytical methods in forensic chemistry. Material evidence and biological traces. Toxic substances and their metabolism. Detection and identification of psychoactive substances. Fingerprints, blood traces, analysis of hair and fibres. GSR and arson analysis. Methods of examining traces and remains after the use of firearms and explosives, the problem of terrorism. Technical examination of documents of so-called "white collar" crimes. Problems of determining the age of coatings on documents. Methods of examining arson and the effects of fires. Reporting the results of forensic analyses. Practical application of chemical methods in the analysis of evidence. Assessment of the credibility of the obtained results.	K_W01, K_W03, K_W07, K_W08 K_U01, K_U02, K_U03, K_U05 K_K01, K_K02, K_K05
21.	Molecular magnetism	Selected issues from the theory of "solid phase" magnetism and molecular systems. Basic units and parameters describing the magnetic properties of compounds. Types of orders in a magnetic field and their characteristics; paramagnetism, antiferromagnetism, ferromagnetism, ferrimagnetism, metamagnetism. The theory of Langevin, Neel. Long range order. Magnetic superexchange in coordination compounds. Parameters defining and determining the magnitude of magnetic interactions. New molecular magnetic materials: molecular magnets, molecular nanowires, spin glasses, superparamagnets, compounds showing the spin-crossover phenomenon. Factors determining SMM behaviour: magnetic anisotropy, high spin, relaxation phenomenon, quantum tunnelling effect. Selected measurement techniques. Technological applications of molecular magnetics: nanomaterials, microprocessors, computer memory, medical diagnostics. Research on natural and synthetic biosystems. Occurrence and role of magnets in organisms.	K_W01, K_W05, K_W06 K_U01, K_U04 K_K01, K_K03
22.	Analytical methods in cultural heritage research	Research methodology of archaeological objects and works of art used in conservation chemistry. Physical and chemical methods and techniques (infrared spectroscopy, Raman, ATR, XRD, XRF, SEM-EDX, UV-VIS, digital radiography and others) used in the study of historic objects: painting materials such as pigments, dyes and binders; ceramics and historical building materials; writing materials and paper; metals and alloys; natural resins; wood; minerals; maintenance materials. Degradation processes of historic materials. Issues related to the examination of the authenticity of historic objects. Methods of dating historic objects (e.g. dendrochronology, isotopic methods, thermoluminescence, C14 dating). Identification of the origin of archaeological objects using physicochemical tests. Research on the origin of minerals and precious stones. Synthesis of historical pigments	K_W01, K_W05, K_W06 K_U01, K_U04 K_K01, K_K03

		and paints. Development of identification tests for the obtained paints and binders based on qualitative analysis methods. Identification of unknown pigments and binders based on the methods of qualitative analysis and Raman spectrometry. Identification of historic materials using spectroscopic techniques - infrared spectroscopy, ATR, Raman spectroscopy, SEM-EDS. Familiarization with legal and ethical issues related to research in the field of conservation chemistry. Improving the skills of writing reports and processing data obtained from conducted research and searching for scientific information.	

FIELD OF STUDY: Chemistry		
SCIENTIFIC DISCIPLINES: Chemical sciences (100%)		
LEVEL OF EDUCATION: 7 PRK		
PROFILE OF EDUCATION: Academic profile		
LEARNING OUTCOMES FOR THE FIELD OF STUDY		
Symbol of the learning outcomes for the study programme	Upon completion of the second-cycle studies at the field of study **Chemistry** the graduate will obtain learning outcomes in the following areas:	Reference to the second-cycle PRK characteristics
WIEDZA/ KNOWLEDGE		
K_W01	possesses in-depth knowledge of chemistry, knows chemical concepts and theories, and their importance in the development of science	P7S_WG
K_W02	demonstrates higher mathematical knowledge allowing to describe and analyze physical phenomena and chemical processes of high complexity	P7S_WG
K_W03	demonstrates in-depth knowledge of experimental methods that enable solving chemical problems	P7S_WG
K_W04	demonstrates in-depth knowledge of IT and computational methods used to analyze problems in the field of chemistry	P7S_WG
K_W05	demonstrates in-depth knowledge of the construction, operation and application of selected control and measurement equipment	P7S_WG
K_W06	is familiar with the latest discoveries and current development trends in the field of chemical sciences	P7S_WG
K_W07	demonstrates up-to-date knowledge of the principles of health and safety regulations to a degree that enables responsible use of acquired knowledge in research and professional practice	P7S_WK

K_W08	is familiar with the current legal and ethical aspects related to professional, scientific and educational activities	P7S_WK
K_W09	understands the principles and legal aspects related to the protection of industrial property and is familiar with the patent information system	P7S_WK
K_W10	is familiar with the basic principles of creating and developing forms of individual entrepreneurship, taking into account the area of modern technologies	P7S_WK
K_W11	is familiar with the principles of creating forms of individual professional development in the chemical industry	P7S_WK
K_W12	demonstrates extended knowledge of men as a creators of culture, deepened in relation to selected areas of human activity, knows the fundamental dilemmas of modern civilization	P7S_WK
UMIEJĘTNOŚCI/ SKILLS		
K_U01	is able to plan and carry out experimental research to analyse and solve complex chemical problems	P7S_UW
K_U02	is able to use acquired knowledge to describe and evaluate the results of research and chemical processes	P7S_UW
K_U03	is able to use appropriate databases and specialist literature to search for and verify scientific information in the field of chemistry	P7S_UW
K_U04	is able to apply knowledge from the field of chemistry to solve interdisciplinary problems using experimental and computational methods	P7S_UW
K_U05	presents, in advanced manner, results and analysis of research, leads the debate and discusses current issues in the field of chemistry forms in Polish and English	P7S_UK
K_U06	has the ability to develop and present current issues in the field of chemistry, communicates with various audiences	P7S_UK
K_U07	Presents language skills described by B2+ specifications of Common European Framework of Reference (CEFR)	P7S_UK
K_U08	is able to improve professional competences and organize the learning process	P7S_UU

K_U09	has the ability to manage team work and carry out assigned individual and group tasks	P7S_UO
KOMPETENCJE SPOŁECZNE/ SOCIAL SKILLS		
K_K01	is ready to solve problems related to the professional work of a chemist, initiate activities for the public interest related to chemical safety and environmental protection	P7S_KO
K_K02	is critical of the acquired knowledge, understands its importance in solving problems and in complicated situations seeks the opinion of experts in the field of chemistry, promotes a scientific attitude, distinguishes scientific theories from pseudoscientific views	P7S_KK
K_K03	is ready to perform professional roles, responsibility and the rules of professional ethics and developing the achievements of the profession related to the field of chemistry	P7S_KR
K_K04	is ready to raise funds for investment activities in the field of chemistry, thinks and acts in an entrepreneurial manner	P7S_KO

Explanation of symbols
PRK – Polish Qualifications Framework
P6S_WG/P7S _WG – code of qualification description component for level 6 and 7 in the second-cycle characteristics of Polish Qualifications Framework
K_W - directional learning outcomes in terms of knowledge
K_U - directional learning outcomes in terms of skills
K_K - directional learning outcomes in terms of social skills
01, 02, 03 and following - the number of the specific learning outcome