Course learning outcomes and learning content

Chemistry

Course name: **Theoretical chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. understands and explains the postulates of quantum mechanics.
2. knows and understands how to solve exactly the basic models of quantum mechanics, how to characterize the solutions, indicates the applications of models.
3. knows how to extract, modify and present the results of quantum mechanical calculations.
4. understands how to present in graphical form the results of ab initio calculations, also those referring to the reaction path.
5. knows how to use the bibliographic sources.

in terms of skills:
1. is able to explain the postulates of quantum mechanics.
2. is able to explain how to solve exactly the basic models of quantum mechanics, how to characterize the solutions, indicates the applications of models.
3. is able to explain the interactions on atomic and molecular level and describes the resulting chemical properties.
4. is able to apply the basic approximate quantum calculations to complex atomic and molecular systems.
5. is able to extract, modify and present the results of quantum mechanical calculations.
6. is able to present in graphical form the results of ab initio calculations, also those referring to the reaction path.
7. is able to use the bibliographic sources.
8. is able to apply the safety and ergonomics rules in the computer laboratory.

in terms of social competences:
1. is ready to critical presentation in graphical form the results of ab initio calculations, also those referring to the reaction path.

Course learning content:
Industrial safety In the computer laboratory.
Introduction to quantum mechanics (black body radiation, photoelectric effect, wave-particle duality). Postulates of the quantum mechanics.
Exact solution of the Schrödinger equation: tunnelling effect, particle in a box. Analysis and visualization of the solutions for a hydrogen atom.
Approximate variational method of solving the Schrödinger equation. One-electron approximation. Hartree-Fock method. Electron correlation. Molecular orbitals, functional basis.
The Gaussian package: possible applications, graphical interface GaussView. Practical quantum mechanical calculations using the Gaussian package. Multielectron atom, Mendeleev periodic table.
Separation of electrons and nuclei in molecules. Chemical Bond. Potential energy surface. Force constants. Force field. Energy levels in molecules. Molecular geometry optimization. Excited states, the CI method.
Graphical presentation of the ab initio calculation.
Calculation of the two-dimensional potential function for a molecule.
Modelling the reaction energy path, activation energy for a complex molecular system.

Course name: **Master seminar - didactic laboratory of inorganic chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the research methods and apparatus used in the experiments for the master's thesis carried out in the inorganic chemistry laboratory.
2. knows and understands the latest scientific developments relating to the research topic within his/her Master's thesis in inorganic chemistry.
3. knows and understands methods of data analysis appropriate to the problem being solved in inorganic chemistry.

in terms of skills:
1. is able to read with comprehension a scientific text, also in English, related to the subject of the master's thesis in inorganic chemistry.

2. is able to use literature sources, databases and patents and read with comprehension a scientific text related to the topic of the master's thesis on inorganic chemistry.
3. is able to prepare and deliver a paper directly related to his/her studies and to speak in a scientific discussion.
4. is able to prepare a scientific presentation on the theory and design of the research, the current state of knowledge, the research thesis, the apparatus used and the interpretation and discussion of the results obtained.

in terms of social competences:

1. is willing/ready to discuss the professional ethics of a chemist and to lead a discussion on ongoing research.

Course learning content:

Familiarisation with working on specialised databases.
Finding solutions to scientific problems using specialised databases and an Internet search engine.
Issues of ethics and plagiarism in research and academic studies, e.g. in master's theses, scientific articles.
Methodology for planning scientific experiments and critically interpreting their results.
Methodology for the preparation of scientific studies, including the master's thesis.
Ways of presenting direct results (preparing and delivering presentations) and leading scientific discussions.

Course name: **Master seminar - didactic laboratory of organic chemistry and biochemistry**

On successful completion of this course, a student

in terms of knowledge:

1. knows and understands the research methods and apparatus used in the experiments for the master's thesis carried out in the organic chemistry and biochemistry laboratory.
2. knows and understands the latest scientific developments relating to the research topic within his/her Master's thesis in organic chemistry and biochemistry.
3. knows and understands methods of data analysis appropriate to the problem being solved in organic chemistry and biochemistry.

in terms of skills:

1. is able to read with comprehension a scientific text, also in English, related to the subject of the master's thesis in organic chemistry and biochemistry.
2. is able to use literature sources, databases and patents and read with comprehension a scientific text related to the topic of the master's thesis on organic chemistry and biochemistry.
3. is able to prepare and deliver a paper directly related to his/her studies and to speak in a scientific discussion.
4. is able to prepare a scientific presentation on the theory and design of the research, the current state of knowledge, the research thesis, the apparatus used and the interpretation and discussion of the results obtained.

in terms of social competences:

1. is willing/ready to discuss the professional ethics of a chemist and to lead a discussion on ongoing research.

Course learning content:

Familiarisation with working on specialised databases.
Finding solutions to scientific problems using specialised databases and an Internet search engine.
Issues of ethics and plagiarism in research and academic studies, e.g. in master's theses, scientific articles.
Methodology for planning scientific experiments and critically interpreting their results.
Methodology for the preparation of scientific studies, including the master's thesis.
Ways of presenting direct results (preparing and delivering presentations) and leading scientific discussions.

Course name: **Master seminar - didactic laboratory of physical and theoretical chemistry**

On successful completion of this course, a student

in terms of knowledge:

1. knows and understands the research methods and apparatus used in the experiments for the master's thesis carried out in the physical and theoretical chemistry laboratory.
2. knows and understands the latest scientific developments relating to the research topic within his/her Master's thesis in physical and theoretical chemistry.

3. knows and understands methods of data analysis appropriate to the problem being solved in physical and theoretical chemistry.

in terms of skills:

1. is able to read with comprehension a scientific text, also in English, related to the subject of the master's thesis in physical and theoretical chemistry.
2. is able to use literature sources, databases and patents and read with comprehension a scientific text related to the topic of the master's thesis on physical and theoretical chemistry.
3. is able to prepare and deliver a paper directly related to his/her studies and to speak in a scientific discussion.
4. is able to prepare a scientific presentation on the theory and design of the research, the current state of knowledge, the research thesis, the apparatus used and the interpretation and discussion of the results obtained.

in terms of social competences:

1. is willing/ready to discuss the professional ethics of a chemist and to lead a discussion on ongoing research.

Course learning content:

Familiarisation with working on specialised databases.
Finding solutions to scientific problems using specialised databases and an Internet search engine.
Issues of ethics and plagiarism in research and academic studies, e.g. in master's theses, scientific articles.
Methodology for planning scientific experiments and critically interpreting their results.
Methodology for the preparation of scientific studies, including the master's thesis.
Ways of presenting direct results (preparing and delivering presentations) and leading scientific discussions.

Course name: **Master seminar - didactic laboratory of general and analytical chemistry**

On successful completion of this course, a student

in terms of knowledge:

1. knows and understands the research methods and apparatus used in the experiments for the master's thesis carried out in the general and analytical chemistry laboratory.
2. knows and understands the latest scientific developments relating to the research topic within his/her Master's thesis in general and analytical chemistry.
3. knows and understands methods of data analysis appropriate to the problem being solved in general and analytical chemistry.

in terms of skills:

1. is able to read with comprehension a scientific text, also in English, related to the subject of the master's thesis in general and analytical chemistry.
2. is able to use literature sources, databases and patents and read with comprehension a scientific text related to the topic of the master's thesis on general and analytical chemistry.
3. is able to prepare and deliver a paper directly related to his/her studies and to speak in a scientific discussion.
4. is able to prepare a scientific presentation on the theory and design of the research, the current state of knowledge, the research thesis, the apparatus used and the interpretation and discussion of the results obtained.

in terms of social competences:

1. is willing/ready to discuss the professional ethics of a chemist and to lead a discussion on ongoing research.

Course learning content:

Familiarisation with working on specialised databases.
Finding solutions to scientific problems using specialised databases and an Internet search engine.
Issues of ethics and plagiarism in research and academic studies, e.g. in master's theses, scientific articles.
Methodology for planning scientific experiments and critically interpreting their results.
Methodology for the preparation of scientific studies, including the master's thesis.
Ways of presenting direct results (preparing and delivering presentations) and leading scientific discussions.

Course name: **Research laboratory - didactic laboratory of organic chemistry and biochemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands test methods used in organic chemistry and biochemistry.
2. knows and understands the chemical properties of the materials tested.
in terms of skills:
1. can select appropriate methods leading to the solution of a research problem in organic chemistry and biochemistry.
2. is able to conduct scientific research on issues relating to organic chemistry and biochemistry.
3. is able to analyse the data obtained, prepare reports and present the results of his/her research.
Course learning content:
Design of research experiments.
Analysis of experimental and statistical data.
Sample preparation and application of different measurement techniques.
Data analysis and preparation of the scientific report.

Course name: **Research laboratory - didactic laboratory of inorganic chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands test methods used in inorganic chemistry.
2. knows and understands the chemical properties of the materials tested.
in terms of skills:
1. can select appropriate methods leading to the solution of a research problem in inorganic chemistry.
2. is able to conduct scientific research on issues relating to inorganic chemistry.
3. is able to analyse the data obtained, prepare reports and present the results of his/her research.
Course learning content:
Design of research experiments.
Analysis of experimental and statistical data.
Sample preparation and application of different measurement techniques.
Data analysis and preparation of the scientific report.

Course name: **Research laboratory - didactic laboratory of general and analytical chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands test methods used in general and analytical chemistry.
2. knows and understands the chemical properties of the materials tested.
in terms of skills:
1. can select appropriate methods leading to the solution of a research problem in general and analytical chemistry.
2. is able to conduct scientific research on issues relating to general and analytical chemistry
3. is able to analyse the data obtained, prepare reports and present the results of his/her research.
Course learning content:
Design of research experiments.
Analysis of experimental and statistical data.
Sample preparation and application of different measurement techniques.
Data analysis and preparation of the scientific report.

Course name: **Research laboratory - didactic laboratory of chemical technology and study of materials**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands test methods used in materials chemistry and chemical technology.
2. knows and understands the chemical properties of the materials tested.
in terms of skills:
1. can select appropriate methods leading to the solution of a research problem in materials chemistry, catalysis and chemical technology.
2. is able to conduct scientific research on issues relating to materials chemistry, catalysis and chemical technology.
3. is able to analyse the data obtained, prepare reports and present the results of his/her research.
Course learning content:

Design of research experiments.
Analysis of experimental and statistical data.
Sample preparation and application of different measurement techniques.
Data analysis and preparation of the scientific report.

Course name: **Master laboratory - didactic laboratory of physical and theoretical chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands definitions and concepts in physical and theoretical chemistry.
2. knows and understands the chemical properties of the compounds studied.
in terms of skills:
1. can apply basic laboratory techniques.
2. is able to analyse research results and formulate conclusions based on them.
3. is able to work in a chemical laboratory, taking into account the hazards of the chemistry profession and applying the principles of occupational health and safety.
4. is able to use databases, including English-language databases.
5. is able to write a scientific paper based on experiments conducted and available literature sources on physical and theoretical chemistry.
in terms of social competences:
1. is ready to present his/her acquired knowledge and to lead discussions in physical and theoretical chemistry.
2. is willing/ready to apply alternative solutions in laboratory work with a view to protecting the environment and promoting professional ethics.
Course learning content:
Self-organisation of laboratory studies.
Selection and application of laboratory methods used in the graduate physical and theoretical chemistry laboratory.
Planning and execution of tests, respecting health and safety rules in accordance with the specifics of the physical and theoretical chemistry laboratory.
Preparation of an oral or poster presentation outlining the results of the research obtained.
Methods and form of writing a final paper in the form of a master's thesis using the conducted experiments and literature data.

Course name: **Master laboratory - didactic laboratory of general and analytical chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands definitions and concepts in general and analytical chemistry.
2. knows and understands the chemical properties of the compounds studied.
in terms of skills:
1. can apply basic laboratory techniques.
2. is able to analyse research results and formulate conclusions based on them.
3. is able to work in a chemical laboratory, taking into account the hazards of the chemistry profession and applying the principles of occupational health and safety.
4. is able to use databases, including English-language databases.
5. is able to write a scientific paper based on experiments conducted and available literature sources on general and analytical chemistry.
in terms of social competences:
1. is ready to present his/her acquired knowledge and to lead discussions in general and analytical chemistry.
2. is willing/ready to apply alternative solutions in laboratory work with a view to protecting the environment and promoting professional ethics.
Course learning content:
Self-organisation of laboratory studies.
Selection and application of laboratory methods used in the graduate general and analytical laboratory.
Planning and execution of tests, respecting health and safety rules in accordance with the specifics of the physical and theoretical chemistry laboratory.
Preparation of an oral or poster presentation outlining the results of the research obtained.
Methods and form of writing a final paper in the form of a master's thesis using the conducted experiments and literature data.

Course name: **Analytical chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the construction of analytical instrumentation and indicates the possibility of its application.
2. knows and understands the principles of analytical instrumentation.
3. knows and understands the following analytical techniques: UV-Vis, AAS, potentiometry, conductometry, ICP-MS, ICP-OES, HPLC.
4. knows and understands appropriate analytical techniques depending on the sample type and matrix.
5. knows and understands how to correctly interpret the results of analytical determinations.
6. knows and understands how to prepare a report on the analytical determination.
in terms of skills:
1. is able to obtain information from the literature, allowing for planning and carrying out the determination of the selected ingredient(s) in a food sample.
2. is able to perform basic chemical calculations for comparative methods, including the ability to prepare appropriate concentrations of solutions.
3. is able to discuss and proposes appropriate analytical tools in order to perform reliable measurements.
4. is able to prepare the apparatus for the determination, including the appropriate solutions, while observing the rules of safe work in the laboratory.
5. is able to interpret the results of the analyzes and prepares the appropriate research report.
6. is able to work both individually and in a team during laboratory work.
in terms of social competences:
1. understands the need for self-education and improving their professional competences.
2. is aware of the principles of ethics and work in the analytical laboratory.
3. is aware of the responsibility for the performed determinations and has the appropriate knowledge of the acceptable content of selected analytes in food samples.
Course learning content:
Occupational health and safety in the laboratory and basic analytical chemistry.
UV-Vis spectrometry.
Atomic absorption spectrometry.
Potentiometry, conductometry, woltamperometry.
Inductively Coupled Plasma MS.
Inductively Coupled Plasma OES.
Gas chromatography.
Liquid chromatography.
Ion Chromatography.
Standards, Reference Materials and correct interpretation and verification of the measurements results on the basis of relevant statistical calculations.

Course name: **Master seminar - didactic laboratory of chemical technology and study of materials**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the research methods and apparatus used in the experiments for the master's thesis carried out in the chemical technology and study of materials laboratory.
2. knows and understands the latest scientific developments relating to the research topic within his/her Master's thesis in materials chemistry and chemical technology.
3. knows and understands methods of data analysis appropriate to the problem being solved in materials chemistry and chemical technology.
in terms of skills:
1. is able to read with comprehension a scientific text, also in English, related to the subject of the master's thesis in materials chemistry and chemical technology.
2. is able to use literature sources, databases and patents and read with comprehension a scientific text related to the topic of the master's thesis on materials chemistry and chemical technology.
3. is able to prepare and deliver a paper directly related to his/her studies and to speak in a scientific discussion.
4. is able to prepare a scientific presentation on the theory and design of the research, the current state of knowledge, the research thesis, the apparatus used and the interpretation and discussion of the results obtained.

in terms of social competences:
1. is willing/ready to discuss the professional ethics of a chemist and to lead a discussion on ongoing research.
Course learning content:
Familiarisation with working on specialised databases.
Finding solutions to scientific problems using specialised databases and an Internet search engine.
Issues of ethics and plagiarism in research and academic studies, e.g. in master's theses, scientific articles.
Methodology for planning scientific experiments and critically interpreting their results.
Methodology for the preparation of scientific studies, including the master's thesis.
Ways of presenting direct results (preparing and delivering presentations) and leading scientific discussions.

Course name: **Research laboratory - didactic laboratory of physical and theoretical chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands test methods used in physical and theoretical chemistry.
2. knows and understands the chemical properties of the materials tested.
in terms of skills:
1. can select appropriate methods leading to the solution of a research problem in physical and theoretical chemistry.
2. is able to conduct scientific research on issues relating to physical and theoretical chemistry.
3. is able to analyse the data obtained, prepare reports and present the results of his/her research.
Course learning content:
Design of research experiments.
Analysis of experimental and statistical data.
Sample preparation and application of different measurement techniques.
Data analysis and preparation of the scientific report.

Course name: **Master laboratory - didactic laboratory of chemical technology and study of materials**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands definitions and concepts in material chemistry and chemical technology.
2. knows and understands the chemical properties of the compounds studied.
in terms of skills:
1. can apply basic laboratory techniques.
2. is able to analyse research results and formulate conclusions based on them.
3. is able to work in a chemical laboratory, taking into account the hazards of the chemistry profession and applying the principles of occupational health and safety.
4. is able to use databases, including English-language databases.
5. is able to write a scientific paper based on experiments conducted and available literature sources on material chemistry and chemical technology.
6. is able to carry out the physicochemical characterization of the investigated materials.
in terms of social competences:
1. is ready to present his/her acquired knowledge and to lead discussions in material chemistry and chemical technology.
2. is willing/ready to apply alternative solutions in laboratory work with a view to protecting the environment and promoting professional ethics.
Course learning content:
Self-organisation of laboratory studies.
Selection and application of laboratory methods used in the graduate laboratory of chemical technology and study of materials.
Planning and execution of tests, respecting health and safety rules in accordance with the specifics of the laboratory of chemical technology and study of materials.
Preparation of an oral or poster presentation outlining the results of the research obtained.
Methods and form of writing a final paper in the form of a master's thesis using the conducted experiments and literature data.

Course name: **Physical chemistry**

On successful completion of this course, a student
in terms of knowledge:
1. knows and understand selected topics in advanced physical chemistry.
in terms of skills:
1. is able to analyse the results of laboratory experiments and prepare reports.
2. is able to carry out physicochemical calculations and interpret their results.
3. is able to use the measuring equipment to run physicochemical experiments.
4. is able to present selected topics of advanced physical chemistry.
in terms of social competences:
1. is ready for group work and for promoting and observing professional ethics in their own and others' activities.
2. is ready to participate in group discussions and shows respect for other participants views.
3. is ready to recognize and bring out physicochemical aspects in natural sciences.
Course learning content:
Kinetics of physicochemical processes.
Equilibria of physicochemical processes.
Modelling and visualization of physicochemical processes.
Analysis of physicochemical data.

Course name: **Chemical technology**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the main processes used in chemical technology.
2. knows and understands the analytical techniques used in chemical technology to resolve research problem.
3. knows and understands terminology and nomenclature typical for chemical technology.
4. knows and understands traditional and novel processes used in chemical technology.
in terms of skills:
1. is able to enumerates and describes the main processes used in chemical technology.
2. is able to selects and applies the analytical techniques used in chemical technology to resolve research problem.
3. is able to uses terminology and nomenclature typical for chemical technology.
4. is able to describes and explains traditional and novel processes used in chemical technology.
5. is able to selects the proper reagents for technological processes in order to obtain a target product.
6. is able to uses a different literature data to enlarge his/her knowledge concerning chemical technology and well as to resolve research problems.
7. is able to performs a critical evaluation of research results, draws the conclusions and prepares the research report.
8. is able to applies the principle of occupational health and safety in the laboratory.
in terms of social competences:
1. is ready to apply critical evaluation of research results.
Course learning content:
Occupational health and safety in the laboratory.
Processes of inorganic technology (production of sulphur, nitrogen and phosphorus compounds).
Processing of fossil fuels.
Processes of organic chemistry (production of methanol, aldehydes, epoxides).
Processes based on renewable sources (biofuels, biofuel' additives, valuable chemicals).
Ecological aspects of chemical technology.
Analytical techniques used to design and control technological processes (chemical, spectral and chromatographic).
Conducting of technological processes in laboratory scale.

Course name: **English in chemistry**
On successful completion of this course, a student
in terms of skills:
1. knows and understands grammatical structures, as well as commonly used vocabulary on B2+ level connected with his/her specializaltion.
2. can discuss selected general, academic and professional topics, express and justify his/her opinions.

3. can understand academic texts, as well as texts related to his/her professional activity and field of study, analyze their content and choose relevant information.
4. can understand audio and video materials related to academic subjects, his/her professional activity and field of study.
5. can prepare and give a presentation related to his/her professional activity and field of study.
6. can write formal texts related to academic subjects, his/her professional activity and field of study.

Course learning content:

Effective use of tenses for academic and professional content.
Effective use of other grammatical structures necessary to express variety of content and opinion: passive voice, reported speech, clauses of purpose, comparison of adverbs and adjectives, countable and uncountable nouns, irregular plural forms of nouns, articles.
Academic and specialized vocabulary related to student's professional activity and field of study.
Reading strategies aiming at understanding the general meaning, guessing the meaning of unknown words from context (concerning the subjects mentioned in point 3).
Listening strategies aiming at understanding the general meaning, guessing the meaning of unknown words from context (concerning the subjects mentioned in point 3).
Expressing a variety of communication functions, participating in conversation and discussing various topics (concerning the subjects mentioned in point 3).

Course name: **X-Ray structure analysis**

On successful completion of this course, a student
in terms of knowledge:

1. knows how to describe the crystal lattice, including Miller indices, and how to draw and read the symmetry elements of the space group.
2. knows the basics of diffraction of X-rays including Laue's and Bragg's equations.
3. knows how to calculate the structure factor and how to predict the systematical extinctions for given space group.
4. has the basic knowledge of the techniques of X-ray generation, the properties of X-rays and the safety regulations.
5. understands the phase problem and knows the methods of solving it.

in terms of skills:

1. is able to characterize the crystalline state, to show and describe the symmetry of the external shape of the crystal.
2. is able to plan the diffraction experiment, to choose the appropriate crystal.
3. has the skills allowing to interpret the results of X-ray structure determination.
4. is able to critically analyze the published results of the structural X-ray analysis and to retrieve such data from the databases.
5. is able to apply safety rules in laboratory work.

Course learning content:

Crystalline state, symmetry, point groups. History of crystallography.
Crystal lattice, Miller indices, Bravais lattice, translational elements of symmetry, space groups.
Diffraction, interference, Laue theory, Braggs theory.
Atomic scattering factor, structure factor, Friedel's law, Laue classes, systematic absences.
X-rays generation, tubes, synchrotron, properties of X-rays, monochromatization, absorption.
Policrystalline methods, identification of phases.
Phase problem, Patterson method, direct methods. Fourier maps.
X-ray structure determination in practice: from crystal selection to structure refinement.
Analysis of the results: coordinates, geometry, interactions. Graphical presentation.
Structural databases: CCDC, PDN etc.

Course name: **Organic chemistry**

On successful completion of this course, a student
in terms of knowledge:

1. knows selected notions from advanced organic chemistry.
2. knows the synthetic principles of chosen name reactions and is able to critically analyse reaction mechanisms.

3. knows the rules of spectroscopic analysis and interpret the results of spectral analyses of organic compounds, proposes an appropriate method to study various aspects of the compound structures.
in terms of skills:
1. plans to synthesize the organic compounds, also in several stages, uses of the specific compounds and reagents in asymmetric and selective organic synthesis.
2. interprets the results of spectral analyses of organic compounds, applies the appropriate spectroscopic techniques (IR, UV-Vis, EI-MS and NMR) for the identification and characterization of organic compounds, proposes an appropriate method to study various aspects of the compound structures.
3. is able to plan rationally syntheses of complex compounds and to discuss selected topics in organic chemistry, plans and conduct the experimental work according to given procedure, timeframe and look after tidiness and safety of working area and evaluates the work contribution of themselves and other group members.
4. writes reports on the conducted experiment, describes the properties and performs spectroscopic analyzes of the obtained compound.
in terms of social competences:
1. is ready to identify and evaluate cognitive and practical problems in the field of chemical research.
2. is ready to work in a group by applying safety rules and promote and observe professional ethics in their own and others' activities.
Course learning content:
Introduction to the modern organic synthesis with strategies for analyzing organic reactions and electron pushing mechanisms.
Chemistry of Carbonyl Compounds - formation and reactions of enols and enolates.
Retrosynthetic analysis.
Review of spectroscopic methods and interpretation and analysis of organic compounds using UV-Vis, FTIR, MS and NMR methods.
Stereochemistry and conformational analysis. Asymmetric synthesis.
Selective reduction and oxidation reactions.
Applications of phosphorus, sulphur and silicon chemistry: stereo- and regioselective synthesis of alkenes.
Pericyclic reactions: cycloadditions and rearrangements.
Organometallic reagents in controlling reactivity, regioselectivity and stereoselectivity.
Design of the synthesis of compounds, experimental synthesis of the planned products, interpretation of spectroscopic data and correct analysis with verification of the obtained compounds
safety rules of work in the laboratory of organic chemistry.

Course name: **Inorganic chemistry**
On successful completion of this course, a student
in terms of knowledge:
1. knows and understands the synthetic principles of generating elements, coordination compounds and complex inorganic architectures.
2. knows and understands the properties and applications of inorganic elements and their compounds.
3. knows the factors affecting the stability of coordination compounds.
4. knows the applications of inorganic compounds, complexes of transition metal ions and metalloorganic compounds.
5. knows the basic aspects of metallo-supramolecular chemistry.
in terms of skills:
1. is able to apply the appropriate analytical techniques for the identification and characterization of inorganic compounds.
2. is able to use literature sources.
3. is able to conduct and control the experimental work according to the given procedure.
4. is able to plan experimental work according to timeframe given and look after tidiness and safety of working area.
5. is able to prepare a written report concerning the conduced experiment, properties and activity of metal complexes.
6. is able to evaluate the work contribution of themselves and other group members.
in terms of social competences:
1. is ready to apply the rules of occupational health and safety in the laboratory of inorganic chemistry.
2. is ready to evaluate the correctness of the experiment and the results obtained.

3. is ready to evaluate the actual contribution of his own work and that of other team members in carrying out the research and preparing the report.

Course learning content:

Introduction to inorganic chemistry.
Chemistry of transition metals and their complexes.
Coordination and metallo-supramolecular chemistry.
Importance of inorganic chemistry in biological systems.
Inorganic catalysis and its applications.
Application of inorganic compounds and materials in electronics.
Data analysis of the obtained products.
Safety rules of work in laboratory of inorganic chemistry.
Working techniques in the laboratory of inorganic chemistry.
Interpretation of research results, methods of writing reports based on performed experiments.

Course name: **Master laboratory - didactic laboratory of organic chemistry and biochemistry**

On successful completion of this course, a student

in terms of knowledge:

1. knows and understands definitions and concepts in organic and bio-organic chemistry.
2. knows and understands the chemical properties of the compounds studied.

in terms of skills:

1. can apply basic laboratory techniques.
2. is able to analyse research results and formulate conclusions based on them.
3. is able to work in a chemical laboratory, taking into account the hazards of the chemistry profession and applying the principles of occupational health and safety.
4. is able to use databases, including English-language databases.
5. is able to write a scientific paper based on experiments conducted and available literature sources on organic and bio-organic chemistry.
6. is able to propose methods analytically and interpret spectroscopic results correctly.

in terms of social competences:

1. is ready to present his/her acquired knowledge and to lead discussions in organic and bio-organic chemistry.
2. is willing/ready to apply alternative solutions in laboratory work with a view to protecting the environment and promoting professional ethics.

Course learning content:

Self-organisation of laboratory studies.
Selection and application of laboratory methods used in the graduate organic and bioorganic laboratory.
Planning and execution of tests, respecting health and safety rules in accordance with the specifics of the organic and bioorganic chemistry laboratory.
Preparation of an oral or poster presentation outlining the results of the research obtained.
Methods and form of writing a final paper in the form of a master's thesis using the conducted experiments and literature data.

Course name: **Master laboratory - didactic laboratory of inorganic chemistry**

On successful completion of this course, a student

in terms of knowledge:

1. knows and understands definitions and concepts in inorganic chemistry.
2. knows and understands the chemical properties of the compounds studied.

in terms of skills:

1. can apply basic laboratory techniques.
2. is able to analyse research results and formulate conclusions based on them.
3. is able to work in a chemical laboratory, taking into account the hazards of the chemistry profession and applying the principles of occupational health and safety.
4. is able to use databases, including English-language databases.
5. is able to write a scientific paper based on experiments conducted and available literature sources on inorganic chemistry.

in terms of social competences:

1. is ready to present his/her acquired knowledge and to lead discussions in inorganic chemistry.
2. is willing/ready to apply alternative solutions in laboratory work with a view to protecting the environment and promoting professional ethics.

Course learning content:

Self-organisation of laboratory studies.
Selection and application of laboratory methods used in the graduate inorganic chemistry.
Planning and execution of tests, respecting health and safety rules in accordance with the specifics of the inorganic chemistry laboratory.
Preparation of an oral or poster presentation outlining the results of the research obtained.
Methods and form of writing a final paper in the form of a master's thesis using the conducted experiments and literature data.