

**MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL PEDAGOGICAL UNIVERSITY NAMED AFTER ABAI**



We train teachers who are able to anticipate the needs of modern education, based on advanced methods, national heritage and global approaches. We are increasing the prestige of the teaching profession and becoming a driver of human capital development.

EDUCATIONAL PROGRAM

6B05301-Chemistry

Department of Chemistry

Data on disciplines

№	Name of discipline	Short description of discipline	Cycle	Component	Credits
1	Fundamentals of ecology and sustainable development	Formation in students of basic knowledge and skills necessary for conducting scientific research in the field of ecology and ensuring safe human life. Contents: basic patterns about the concepts, strategies and practical tasks of sustainable development in various countries and the Republic of Kazakhstan; problems of ecology, environmental protection, sustainable development. Life safety, its main provisions. Dangers, emergencies. Human security systems. Social dangers, protection from them: dangers in the spiritual sphere, politics, protection from them: dangers in the economic sphere, dangers in everyday life, everyday life.	GED	EC	5
2	Methods of economics and entrepreneurship research	Purpose: To help students acquire the knowledge and skills necessary to conduct research in the field of economics and entrepreneurship. Content: Research methods, such as statistical analysis, economic modeling, questionnaires, interviews, etc.; General principles, techniques and methods of data collection, processing of data analysis, study of regularities and trends in the development of mass economic phenomena and processes; Essence, forms, structure of capital; Production; costs of production. Income of production in a market economy; The concept of business. Types of entrepreneurial activity. Theory of property, social forms of economic management. Commodity, money. Social economic system. Emergence of the market. Financial system. The role of the state in the development of business. Macroeconomics. Resource saving. Cyclicity of economic development. Inflation and unemployment. Kazakhstan in the system of world economic relations. Also within the framework of the course students learn methods of data collection and analysis, formulation of hypotheses and conclusions, as well as design and presentation of research results. Competencies: the ability to conduct qualitative research using various methods and techniques, analyze and interpret the data obtained, formulate conclusions and recommendations based on the results of the study, as well as design and present the results of the study in written and oral form	GED	EC	5
3	Research in the field of law and anti-corruption culture	Development of research skills among students in the field of law, as well as the formation of an anti-corruption culture. Contents: Basic provisions of the Constitution, current legislation of the Republic of Kazakhstan; system of government bodies, terms of reference, goals, methods of government regulation of the economy, the role of the public sector in the economy; financial law and finance; the essence of corruption, the reasons for its origin; current anti-corruption legislation	GED	EC	5
4	Abaytanu	The aim: to educate students in the taste for the literary heritage of Abai, the expansion of the spiritual world. Contents: Life of Abai Kunanbayev. Philosopher, poet, public educator, public figure, founder of Kazakh written literature and its first classic, cultural reformer in the spirit of rapprochement with European culture based on the culture of enlightened Islam. Poems, sayings by Abai. The role of Abay Kunanbayev in the formation and development of the Kazakh people, the political and cultural development of Kazakhstan. M. Auezov is a great writer, popularizer of Abai. Ideas of Abai's works. Principles and cultures of academic integrity. Competencies: improve the creative thinking of students, develop cognitive abilities, instill independent thinking skills, and the ability to express thoughts in literary language.	BD	UC	3
5	Fundamentals of academic writing	Purpose: to familiarize with main features of scientific style of speech, with most common genres of oral and written academic discourse, mastering the basic principles of communication in academic environment Content: Requirements for structure of text and its design. The use of a scientific style of presentation; ability to argue and paraphrase.	BD	UC	5
6	Advanced foreign language	Comprehensive presentations on various themes. News and reports. Articles and posts on contemporary issues, modern literary prose. Active participation in discussions on a familiar problem, explaining and defending one's opinion. Presenting all arguments for and against a current issue. Writing essays, reports, letters, highlighting particularly important events and impressions.	BD	EC	5

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7	Chemistry of elements of the periodic table	Purpose: To form skills and abilities to draw conclusions about periodic changes in the chemical properties of elements, the properties of their compounds, apply the knowledge and ideas about chemical elements when performing various calculations for chemical, environmental and chemical-technological purposes, etc. Content: hydrogen, production, properties, practical application. General characteristics of s-elements, p-elements, d-elements, obtaining, properties, important compounds, application. General characteristics of f-elements, radioactivity, industrial use in science and technology. Production of metals and their alloys in Kazakhstan. Competence: sets goals and formulates tasks related to the implementation of their activities in general and applied aspects of chemistry, applies theoretical and experimental knowledge of chemistry.	BD	EC	5
8	Chemistry tasks of increased complexity	Purpose: formation of students' competencies in the field of solving problems of increased complexity and non-standard combined tasks. Contents: basic algorithms for solving typical problems, principles and approaches to solving non-standard, combined computational problems Competence: applies the most important physical and chemical laws in solving problems, as well as knowledge of natural science laws and methods in his professional activity; use reference literature on chemistry for the selection of quantitative quantities necessary for solving problems.	BD	EC	5
9	Environmental chemistry	Purpose: study of the processes of migration and transformation of chemical compounds of natural and anthropogenic origin. Content: problems of environmental chemistry are considered against the background of the description of natural geochemical and biogeochemical processes. Modern views on the origin of chemical elements, the emergence of the Earth and its biosphere. The main pollutants, ways of their entry into the environment and behavior in it. Radiation pollution, and the consequences of atmospheric pollution: acid rain, ozone depletion and the greenhouse effect. Physical and chemical conditions for finding chemical elements in the environment. Form and intensity of migration of chemical elements in the environment. Competence: Knows the basics of nature management, sustainable development, assessment of the impact of chemical pollution on the environment.	BD	EC	4
10	General chemical technology	Consideration of specific technologies for the production of some of the most important chemical products (sulfuric, nitric and phosphoric acids, ammonia, urea, ethylene, polymeric materials, etc.). Industrial processing of inorganic substances. Raw materials, energy, water. Problems of nature protection. Sulfuric acid production. Synthesis of ammonia. Production of nitric acid. Electrochemical and electrothermal productions. Manufacture of iron and steel. Fuel handling. Basic organic synthesis. Oil refining. Chemical fibers. Polymer production. Possession of the basic chemical, physical and technical aspects of chemical industrial production, taking into account raw materials and energy costs.	BD	EC	5
11	Organic chemistry of cyclic compounds	Acquaintance with the main provisions and modern achievements in the theory of organic chemistry and industrial organic synthesis, as well as training in modern methods for analyzing the structure, properties and methods for obtaining organic cyclic compounds. Carbohydrates. Monosaccharides. Oligosaccharides, polysaccharides. Alicyclic series of hydrocarbons. aromatic aldehydes and ketones. aromatic acids. aromatic amines. Aromatic diazo and azo compounds. Benzene rings are non-condensed polynuclear aromatic carbohydrates. Polynuclear aromatic hydrocarbons condensed with benzene rings. heterocyclic compounds. Six-membered and five-membered heterocycles. Able to carry out experiments and formalize the results of research and development in the field of organic chemistry.	BD	EC	5
12	Physical chemistry	The purpose of studying the discipline is to study chemical systems and the fundamental laws of chemistry from the standpoint of modern science, develop students' chemical worldview and acquire modern ideas about the physical and chemical process based on thermodynamics and kinetics; mastering the theoretical foundations of classical and statistical thermodynamics and methods of applying thermodynamic methods to solve chemical problems, as well as developing	BD	EC	5

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		students' knowledge and skills that allow modeling and performing numerical calculations when describing various types of chemical and phase equilibria and the properties of substances in solutions.			
13	Physical methods of chemical research	This course forms an understanding of the importance of physical research methods for solving modern scientific and applied problems, to show trends in the development of methods; give an idea of the instrumental base of physical research methods; on the example of classical physical methods, introduce the most general rules for conducting research, interpreting and describing the results. Able to analyze and interpret the results of chemical experiments, observations and measurements, as well as apply theoretical and calculation methods to study the properties of substances and the depth of chemical processes.	BD	EC	5
14	Quantitative chemical analysis	Formation among students of general ideas about the variety of methods of quantitative chemical analysis used to study the chemical composition of substances, as well as the activities of laboratories accredited in the field of quantitative chemical analysis. Principles of quantitative analysis. Classification of methods of quantitative analysis. The essence of gravimetric, titrimetric analysis and scope. Methods of acid-base, redox, complexometric titration. precipitation method. Able to analyze and apply knowledge and skills in the performance of specific professional tasks.	BD	EC	5
15	Theoretical bases of Inorganic Chemistry	The course forms students' knowledge of the basic concepts and laws of chemistry, the basics of atomic and molecular theory, the structure of matter, the Periodic Law, chemical bonding, the laws of the chemical process, the doctrine of solutions, metabolic reactions in electrolyte solutions, redox reactions. Future teachers study the basics of chemical thermodynamics, the kinetic foundations of the description of chemical reactions, methods and mechanisms of their acceleration, the doctrine of chemical equilibrium and methods of its displacement, the basics of the theory of solutions, elements of electrochemistry. The proposed course is practice-oriented both in theory and in fact: all concepts, laws and theories, as well as the most important processes, substances and materials are given in terms of their practical significance, the use of substances in everyday life and their role in living and inanimate nature. Future teachers demonstrating competence can: · predict the possibilities of chemical processes and factors affecting the equilibrium of chemical reactions, determine the direction of the process in these conditions; · classify reactions occurring in aqueous solutions and propose optimal conditions for conducting reversible reactions; · compare the thermodynamic and redox activity of substances; · apply the academic language of chemical concepts and terms; · formulate the basic laws of chemistry using reasoned judgments; · understand the properties of substances and the mechanism of chemical processes, discuss chemical phenomena with thermal effects occurring in nature, in a living organism; · apply the acquired theoretical knowledge and skills with general scientific and special disciplines in their teaching activities; · teach experiments using elementary methods of chemical research of substances and compounds to form research skills; · collect, process and interpret research data.	BD	EC	5
16	Theoretical foundations of analytical chemistry	Theoretical foundations of analytical chemistry; classification, types of analyzes. Qualitative analysis methods. The law of the masses. Basic concepts of the theory of electrolytic dissociation. Theory of strong electrolytes. Activity coefficient. Protolytic theory of acids and bases, calculation of pH of solutions. Hydrolysis and amphoteric processes. Equilibrium in heterogeneous systems. Redox processes. Complex compounds.	BD	EC	5
17	Theoretical foundations of organic chemistry	Purpose: to provide knowledge of the basic theoretical provisions of organic chemistry (on the structure and reactivity of the most important classes of organic compounds). Theory of the structure of A.M. Butlerov. The electronic structure of the carbon atom and chemical bonds. Mutual influence of atoms in molecules of organic compounds. Stereochemistry of organic compounds. The relationship of electronic and spatial structure. Mechanisms of nucleophilic substitution reactions. Mechanisms of nucleophilic cleavage reactions. Reactions of carbonyl compounds. Electrophilic addition reactions.	BD	EC	5

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18	Bioorganic chemistry	The course examines the issues and problems of bioorganic chemistry, develops skills for obtaining and identifying organic substances in a living organism. During lectures and laboratory classes, future teachers analyze the relationship between the structure of organic substances and their biological functions, conduct laboratory studies of the structure, properties and functions of biologically important natural (biopolymers, vitamins, hormones, biologically active substances, antibiotics) and synthetic compounds (medicines, pesticides, etc.). Future teachers practice practical skills of working with devices, materials, choose ways and methods of conducting individual and group research, solve creative tasks and offer new non-standard solutions to problems, demonstrate the practical application of the results of a biological experiment for professional development, evaluate experimental and calculated data, prepare research reports and take an exam. Future teachers demonstrating competence can: • classify organic compounds by nomenclature when composing names and writing formulas of biologically active substances; • conduct experiments to study the chemical structure and properties of biologically important substances; • demonstrate the skills of conducting a biological experiment using chemical, physical, physico-chemical, mathematical and biological methods; • evaluate the importance of biopolymers, enzymes, hormones, vitamins, signaling substances, antibiotics, BAS and others in the vital activity of living organisms; • carry out small projects: formulation of hypotheses and conclusions, planning, assessment of strengths and weaknesses, preparation of a report; • collect, process and interpret research data on design and laboratory work; • it is appropriate and correct to use scientific language, subject terminology and symbols; • to offer creative non-standard solutions to problems in the field of bioorganic chemistry; • apply the results of biological research for professional development; • organize project activities of schoolchildren, demonstrate skills in the formation and development of interdisciplinary and research competencies of students	PD	EC	5
19	Chemical ecology	Purpose: mastering knowledge, laws and theories for the development of modern technologies and their implementation in production, taking into account environmental problems. Contents: fundamentals of chemical ecology and environmental problems. Chemical basis of the transformation of pollutants in natural environments. Ecology of organic compounds. Nuclear pollution. Chemical ecology of the atmosphere, hydrosphere, lithosphere. Heavy metals. Industrial wastewater treatment technology. Ecology and energy. Environmental monitoring. Competence: independently assess the anthropogenic pollution of the planet in the context of the global environmental crisis and solves the problems of protecting the environment from chemical pollution, has the skills to plan research to reduce the environmental risk of chemical production.	PD	EC	5
20	Chemical experiment	This discipline allows you to teach students to theoretically and experimentally explore materials of various origins based on special methods of working methods used in general chemistry, to instill skills in performing basic operations when conducting a chemical experiment, contributing to the development of primary professional skills.	PD	EC	5
21	Chemical kinetics and electrochemistry	Forming an understanding of the basic laws of electrochemistry and the kinetics of chemical reactions, the ability to describe transfer phenomena using the apparatus of chemical thermodynamics, mastered in the first part of the module, as well as mastering modern experimental research methods. The subject and tasks of chemical kinetics and electrochemistry, the main stages of their development. Formal kinetics. Theory of chemical kinetics. Catalysis. electrolyte solutions. Electrochemical thermodynamics and kinetics. Competently apply theoretical laws to the solution of various applied problems, conduct physical and chemical experiments, ways of mathematical processing of the results of work and their generalization.	PD	EC	4
22	Chemistry of biologically active substances	Purpose: Obtaining theoretical foundations, basic skills and practical skills in the field of chemistry of biologically active substances (BAS). formation of students' professional skills in the field of isolation and analysis of biologically active	PD	EC	4

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		substances. Identification and research of biologically active substances; determine the main physicochemical and biochemical characteristics of biologically active substances; analyze the relationship between the composition, structure, spatial organization and properties of the main classes of biologically active substances; work with scientific and technical information; use domestic and foreign experience in the field of chemistry of biologically active substances; Competence: developing skills in studying the physical and chemical properties of biologically active substances, analyzing the relationship between the composition, structure and properties of biologically active substances, as well as the relationship with ecology and other branches of science.			
23	Chemistry of metals	Preparation for research and teaching activities related to solving the problems facing modern civilization when conducting research in various fields of chemistry. To form ideas about metals as chemical elements and metals as simple substances. To acquaint students with the structure and general properties of metals. To give concepts about the metal bond and the metal crystal lattice, some methods of obtaining metals. To summarize students' knowledge about the physical and chemical properties of metals. To consider the division of metals into groups, to study the features of the properties of the elements of the first three main ones. The ability to fluently master the sections of metal chemistry and use the knowledge of the theoretical foundations of the fundamental sections of chemistry in professional activities.	PD	EC	6
24	Chemistry of non-metals	Formation of the foundations of theoretical and applied knowledge in the field of metals and their compounds. General characteristics of non-metals. Nonmetals as macro and microelements. Group VIA non-metals. Non-metals of the VA group. Group IV non-metals. The ability to be fluent in sections of the chemistry of non-metals and to use the knowledge of the theoretical foundations of the fundamental sections of chemistry in professional activities.	PD	EC	3
25	Colloid chemistry	This course covers the most important advances and ideas in modern colloidal chemistry. Formation of basic knowledge about the theory and practice of surface phenomena and dispersed systems, laws and patterns in this area of chemistry and learn to use them rationally in practice and in solving environmental problems. Main stages in the development of colloidal chemistry. Classification and nature of disperse systems. Molecular-kinetic and rheological properties of colloidal systems. Optical properties of colloidal systems. Surface phenomena. Methods for obtaining and purifying colloidal solution. Stability and coagulation of colloidal systems. Coagulation. Aerosols. Powders. Semicolloids. Soap. Suspension. Emulsion. Foam. Use of colloidal properties of systems in solving environmental problems. Competence: develops modern ideas about the achievements of colloidal chemistry, methods of their application to solve theoretical, practical and environmental problems in professional activities.	PD	EC	4
26	Computer chemistry	Purpose: increasing professional competence using ICT in the educational process in chemistry. Content: teaching students the use of digital technology in chemistry. Software. Formation of skills in using digital technologies, programs and practical use. Database. Search, storage and protection of data. Graphic data. Competence: developing competence in computer modeling and application of chemical scientific research using chemistry programs, know the techniques of academic writing.	PD	EC	4
27	Fundamentals of crystal chemistry	Formation of knowledge in the field of modern crystal chemistry, including basic laws, concepts and patterns that reflect the internal structure and properties of crystal structures and their connection with the chemical nature of the substance. Historical background and introduction to crystal chemistry. Basic macro properties of crystals. Types of spatial lattices. Elements of symmetry of crystal structures. Symmetry groups. Methods for studying the internal structure of crystals Possesses the skills to analyze crystal structures of various inorganic and organic substances and their physical properties.	PD	EC	4
28	Fundamentals of nanochemistry	Fundamentals of Nanochemistry is a branch of chemistry that studies the properties, structure and features of chemical	PD	EC	4

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		transformations of nanoparticles. A distinctive feature of nanochemistry is the presence of a dimensional effect — a qualitative change in physicochemical properties and reactivity when the number of atoms or molecules in a particle changes, methods for obtaining and studying nanostructures: scanning tunneling microscopy and spectroscopy. Modern scientific methods of nanostructured materials research.			
29	Fundamentals of research in chemistry	Methods of scientific research. Choosing the research direction. Choosing the direction of research and stages of research work. Methodological foundations of scientific knowledge and creativity. General scheme of scientific research. Search, collection and processing of scientific data. Experimental study. Processing of experimental research results.	PD	EC	4
30	Geochemistry	Purpose: formation of ideas about the chemical composition of the Earth's crust, hydrosphere, atmosphere and living matter, chemical elements of the environment, including man-made ones; development of natural-scientific worldview and thinking. Content: geochemical science. The purpose and objectives of geochemistry. Modern model of the Earth. Geochemical barriers and their impact on the formation of deposits. Geochemical classification of elements. Hydrosphere geochemistry, chemical composition of sea waters. Distribution of minerals in the Earth's crust. Biological absorption of chemical elements. The influence of organisms on the accumulation of chemical elements. Geochemical circulation of the main gases of the Earth's atmosphere. Environmental problems of Kazakhstan. Competence: ready to apply in practice basic general professional knowledge about the theory and methods of geochemical research in solving scientific and production tasks and environmental problems.	PD	EC	3
31	Group of biogenic elements	Formation of general professional competence through mastering the theoretical foundations of the chemistry of biogenic elements, studying the role of chemical elements in the construction and functioning of living systems. The prevalence of chemical elements in nature and the concept of the biosphere. Biogenic classification of chemical elements. macro-, micro-, ultramicroelements; vital and impurity elements; s-elements, p-elements, d-elements and f-elements. Applies basic biological methods of analysis for the development, research and examination of biogenic elements.	PD	EC	3
32	History of chemistry	Purpose: to acquaint with the main stages of the development of chemistry from ancient times to the modern period, to show that the history of chemistry is part of chemistry and the history of culture, to reveal the role of the historical approach in establishing the relationship between natural science and humanities subjects on the example of chemical research. Stages of development of chemical science. The period before alchemy. The period of alchemy. Iatrochemistry and technical chemistry. Stages of structural chemistry. Physical chemistry. Chemistry of the twentieth century. Atomic model. Modern chemistry. Nanotechnology.	PD	EC	3
33	Inorganic synthesis	Purpose: mastering the basic principles of synthesis of inorganic compounds of different classes and in acquiring practical skills of obtaining chemical compounds and materials based on them with specified properties. Content: synthesis of inorganic and coordination substances. Basic methods of purification, concentration and separation of inorganic substances. Reactions in the gas phase. Synthesis of anhydrous inorganic compounds. Preparation of simple substances, oxides, halogens, hydrides, hydroxides, acids and salts. Physicochemical methods of purification of synthesised substances. Modern methods of synthesis of inorganic substances and materials. Competence: predicts the possibility, direction and depth of the synthesis of chemicals, and is also ready to solve environmental and economic issues of the synthesis of inorganic compounds.	PD	EC	5
34	Macromolecular chemistry	This discipline introduces students to the basics of polymer science and its most important applications, which are necessary for every chemist, regardless of his narrow subsequent specialization, which involves working both in research institutions and in teaching. Formation of an approach to the study of the properties of macromolecular compounds based on electronic	PD	EC	5

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		and stereochemical concepts using established reaction mechanisms and physicochemical research methods, obtaining knowledge about various macromolecular compounds that are currently widely used in everyday life, technology, and medicine. Competence: possession of the skills of a chemical experiment, basic synthetic and analytical methods for obtaining and studying macromolecular compounds.			
35	Methods of teaching chemistry	Purpose: formation of basic ideas about the achievements of Russian pedagogy, didactics in teaching chemistry to create conditions for understanding future professional activities related to the use of knowledge about chemical processes and phenomena. Theoretical and methodological foundations of methodological science and initial methodological skills that ensure the performance of various functions of a chemistry teacher. Subject and problems of ChTM. The structure and content of chemistry in school. Classification of ChTM.	PD	EC	5
36	Organic synthesis	Formation of students' knowledge system of the main methods of synthesis in organic chemistry. Reactions of nucleophilic substitution of the aliphatic series. Nucleophilic substitution in alkyl halides. Nucleophilic substitution of the hydroxyl subgroup in alcohols: reactions of carboxylic acid with nucleophilic reagents and its derivatives (anhydrides, halogen anhydrides). esterification reactions. Owns the basics of chemistry of biological systems, the skills of synthesis, identification of organic compounds, work with chemical laboratory equipment.	PD	EC	6
37	Petrochemistry	Purpose: formation of the development and deepening of students' knowledge in that part of organic chemistry that studies minerals, namely oil and gas. Contents: petroleum products and their application. Composition and properties of oil and natural gases. Origin of oil and natural gases. Primary processing of associated gases. Purification of oil from water and solid impurities. Oil cracking. Physical and chemical bases of thermal cracking. Optimal state of thermal cracking. Physical and chemical bases of catalytic cracking. Optimal state of hydrocracking. Hydrolytic purification of petroleum products. The main processes of processing products from oil and natural gas. Competence: able to analyze new scientific issues, apply methods and tools for planning, organizing and conducting scientific research in the chosen field of chemistry, owns the skills of planning research to reduce the environmental risk of chemical production.	PD	EC	6
38	Physical chemistry of polymers	Students gain solid theoretical knowledge and practical skills in the field of synthesis and research of polymer properties, allowing not only to accurately reproduce known techniques, but also to obtain, analyze and investigate compounds with predetermined properties. Classification, nomenclature. Features of the polymer state of the substance. Isomerism of the macromolecule. The nature of polymer solutions. Properties of ionizing macromolecules (polyelectrolytes). Methods of polymer synthesis. Polymerization, copolymerization. Methods of polycondensation. Reactions of chemical transformation of polymers. The ability to acquire new knowledge using modern scientific methods and possess them at the level necessary to solve problems.	PD	EC	5
39	Physical Chemistry of Surfactants	Purpose: formation of the ability to possess practical skills in determining the properties of surfactants and their application for various processes, consideration of modern trends in the production and consumption of surfactants, the principles of classification and basic properties of surfactants, the mechanism of their action and behavior at various phase boundaries, the theory of micellization, solubilization, analysis methods surfactant. Contents: regularities and mechanisms of surface phenomena involving a variety of physicochemical and specific colloidal experimental methods; correct application of theoretical laws of chemistry to the solution of various colloid-disperse problems; molecular-kinetic, optical, electrical, structural-mechanical properties of dispersed systems and the theory of stability of colloidal systems; practical skills in obtaining and purifying sols; determination of particle dispersion, production and destruction of foams, aerosols and emulsions, regulation of electrical properties and stability of disperse systems. Competence: owns methods for obtaining	PD	EC	4

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		surfactants, analyzing and predicting the properties of surfactant-based mixtures for further use in production processes, determines the relationship with other branches of science.			
40	Processing of chemical industrial waste	Purpose: special training of students in the field of modern practical knowledge about environmentally friendly methods for the elimination of industrial, agricultural and domestic waste, processing technologies, as well as their reuse in the national economy. Contents: chemical industry, environmental safety. Classification of chemical industry waste. Sources of chemical waste: pharmaceuticals, cosmetics, petrochemical industries, metallurgical, electrochemical plants, rubber and elastomer production sites, household chemicals and fertilizer production, medical institutions, scientific laboratories, etc. Features of processing products of the chemical industry, types: neutralization, oxidation, chlorination, thermal method, distillation method, biological method. Recycling of expired chemicals. Processing of polymers. Responsibility for improper handling of chemical waste. Competence: Able to predict the possibility, direction and depth of a chemical process, knows the theoretical and experimental foundations for solving modern environmental problems.	PD	EC	4
41	Quantum chemistry	Mastering the skills of applying quantum chemistry methods for interpretation and prediction of experimental data by students. Obtaining theoretical knowledge about modern concepts of quantum chemistry, methods for calculating the spatial and electronic structure of molecules, as well as acquiring skills and abilities to work with complexes of quantum chemical programs to solve problems facing theoretical and experimental chemical science. Capable of being fluent in sections of quantum chemistry and applying the results of scientific research in innovative activities.	PD	EC	5
42	Selected chapters of thermodynamics	The study of the laws of thermodynamics, as applied to systems for the transfer and transformation of heat; thermal and caloric properties of substances, the study of methods for evaluating the effectiveness of the considered thermodynamic systems. First law of thermodynamics. Postulates of thermodynamics. Derivation of basic thermodynamic equations. Thermochemistry. Hess' law. The second law of thermodynamics. Entropy, thermodynamic potentials. Phase transitions. Van der Waals gas. Thermodynamics of surface tension. The ability to use the acquired knowledge of the theoretical foundations of the fundamental sections of chemistry in solving professional problems.	PD	EC	5
43	Solving Olympiad problems in chemistry	Purpose: Acquisition by students of knowledge, skills and abilities necessary to master various methods of solving computational problems provided for by the improved school chemistry curriculum. The main goals and objectives of the Olympiad movement in the context of modern education in the Republic of Kazakhstan. The role of chemical Olympiads in education and science. Methods of preparation and holding of Olympiads of various levels. Organization of chemical Olympiads: from simple to complex. The conceptual basis of the content of Olympiad tasks. Classification of Olympiad tasks. An approximate program of the content of various stages of chemical Olympiads. Mastery of the skills of thought experiment in solving computational and experimental problems.	PD	EC	3
44	Solving problems in inorganic chemistry	Purpose: Development and deepening of knowledge of basic chemical laws and theories, general patterns of chemical processes and changes in the properties of simple substances and their compounds as an integral part of students' chemical knowledge necessary in the process of mastering the profession. Contents: Guidelines for the correct use of names, signs and definitions of physical quantities and their units in chemistry. The simplest formula calculations. Determination of the mass of soluble and dissolved substances. Calculations for determining the concentration of solutions. Qualitative and quantitative tasks for chemical transformations involving mixtures of inorganic substances. Competence: Able to use knowledge of the theoretical foundations of inorganic chemistry in professional activities.	PD	EC	5
45	Structure of the substance	The study of the basic provisions of quantum chemistry, obtaining ideas about modern methods of quantum chemistry, allowing you to calculate the structure and properties of molecules and interpret the results of chemical experiments.	PD	EC	3

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		Chemical bond. Geometry of molecules. Symmetry of molecules. Electrical properties of molecules. The magnetic field of molecules. Average energy properties of molecules. The state of electronic vibrations of a molecule. Variable state. Vibrations and electronic spectra of the molecule. Intermolecular interaction. Spatial structure of the molecule. Method of molecular orbitals. Sequence and energy of connections. Electronic configuration of molecules. He has experience in working with equipment used in analytical and physico-chemical studies.			
46	Water and food analysis	Purpose: mastering the basic and specific methods used in the study of water analysis and food products, the study of methods for monitoring and assessing the quality of raw materials and food products. Obtaining knowledge in the field of the composition of food objects, their properties, methods of analysis of macro- and micronutrients, the formation of students' knowledge and skills in the field of modern methods of integrated quality assessment, nutritional value and products to obtain biologically complete, safe products with a wide range of consumer properties. They should be able to select the appropriate quality research method for a particular type of food raw material, product, taking into account their properties and the required level of accuracy and speed of determining the indicator, acquire practical skills in using methods for testing the quality of raw materials and food products in laboratory and production practice. Competence: forms practical, experimental and research skills.	PD	EC	5