



**This educational program «8D05301-Chemistry» was developed on the basis of:**

- The Law of the Republic of Kazakhstan dated 27 July, 2007 No. 319-III «On Education»;
- The Law of the Republic of Kazakhstan dated 11 July, 1997 No. 151-I. «On languages in the Republic of Kazakhstan»;
- State compulsory standard of postgraduate education from 22 July, 2022 No. 2;
- The National Qualifications Framework, approved by the Republican Tripartite Commission on Social Partnership and the Regulation of Social and Labor Relations on 16 March, 2016;
  - The Order of the Ministry of Education and Science of the Republic of Kazakhstan «On approval of the Rules for the organization of the educational process on credit technology» dated 2 October, 2018 No. 152;
  - Classifier of training with higher and postgraduate education of 13 October, 2018 No. 569;
  - Professional standard «Science (scientific, scientific and technical activity)», «Higher and postgraduate education (pedagogical and methodological activity)» (Approved by the Ministry of Health on the 10 July, 2015. No. 10-3-16 / 14215);
  - Sectoral Qualifications Framework «Chemical Production» (Approved by Protocol No. 1 of the meetings of sectoral commissions on social partnership and the regulation of social and labor relations for the mining and metallurgical, chemical, construction industries and woodworking, light industry and mechanical engineering.

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## Passport of the educational program

1. Code and name of the educational program - 8D05301-Chemistry
2. Code and classification of the field of education, direction of training- 8D05-Science, Mathematics and Statistics, 8D053-Physical and Chemical Sciences
3. Group of educational programs - Chemistry
4. Volume of credits - 180
5. Form of education - full-time
6. Language of instruction - Russian, Kazakh, English
7. Degree awarded - Doctor of Philosophy (PhD) on the 8D05301-Chemistry educational program
8. Type of educational program - current
9. Level according to the International Standard Classification of Education - 8
10. Level according to the National Qualifications Framework - 8
11. Level according to the Industry Qualification Framework - 8
12. Distinctive features of the Educational program- no
13. The number of the appendix to the license for the direction of training - KZ83LAA00018495 from July 28, 2020
14. The name of the accreditation body and the validity period of the accreditation of the educational program–IQAA, certified SA-A No. 0174 / 6 dated 23 December, 2019, valid until 20 December, 2024
15. The purpose of the Educational program - The purpose of the 8D05301-Chemistry educational program is to prepare competitive highly qualified scientific and pedagogical personnel with high spiritual and moral qualities, who are able think independently and ensure the progressive scientific, technical, socio-economic and cultural development of society, have a fundamental knowledge, innovative approaches, research skills for scientific, educational, vocational and practical activities in the field of chemistry and related scientific fields.
16. Qualification characteristics of the graduate
  - a) List of graduate positions -University professor, Engineer, Head of Laboratory, Production Manager, Principal Researcher; Leading Researcher; Senior Researcher: Researcher; laboratory assistant; engineer; methodologist of the structural unit.
  - b) Scope and objects of professional activity of the graduate - The sphere of professional activity of «8D05301-Chemistry» educational program graduates are the branches of chemical, metallurgical, petrochemical and pharmaceutical industries; education, science and ecology. The objects of «8D05301-Chemistry» educational program doctors professional activity are: institutions of higher education; research institutes, governments in the field of education, the chemical industry; the establishment of control and analytical services, standardization and certification centers; natural resource agencies and environmental protection.
  - c) Types of professional activity of the graduate - educational and pedagogical: work as teachers of chemistry at the universities public and private sector;- organizational and management: working as heads of departments and services in different scientific organizations, research institutes, as well as various departments and departments of chemical, pharmaceutical, metallurgical industries, and environmental services;- produc-

tion and technology: work in institutions of chemical, environmental, metallurgical, pharmaceutical, petrochemical, gas and coal Profile ;- Research and experimental research: work as professionals and researchers in the laboratory of chemical, environmental, metallurgical, pharmaceutical, petrochemical, gas and coal profile.

d) Functions of the graduate's professional activity - implementation of the organization of production and technological processes in the chemical industries, and industry; implementation of development methodologies, organizing and conducting a variety of chemical analyzes, research chemicals and the characteristics of their composition; planning and organization of research programs; Manual industrial, scientific and teaching staff, laboratory; implementation of educational and pedagogical activities; planning and organization of educational work in the field of education.

## Formulation of learning outcomes based on competencies

Type of competencies	Learningresultcode	Learning result (according to Bloom's taxonomy)
1. Behavioral skills and personal qualities: (Softskills)	LO 2	Demonstrate the ability to teach chemistry and other related sciences in university educational programs
	LO 5	Demonstrate the ability to organize the work of a research team in the field of chemistry and related sciences
	LO 6	He demonstrates the ability to develop their point of view in professional matters and to defend it during a discussion with specialists and non-specialists; abstracted the scientific literature, including foreign languages, subject to scientific ethics and copyright
	LO 8	Able to formulate goals for personal and professional development and conditions for their achievement, based on the trends of development of the field of professional activities, career stages, individually-personal features; to exercise personal choice in a variety of professional and moral-value situations, assess the consequences of the decision and bear the responsibility for it ourselves and society.
	LO 12	Demonstrate the ability to analyze and evaluate modern scientific achievements, generate new ideas in solving research and practical problems, including in interdisciplinary fields
2. Digitalcompetencies: (Digitalskills):	LO 9	Demonstrate the ability to carry out scientific research independently in the relevant professional field using modern research methods, information and communication technologies
3. Professional competencies: (Hardskills)	LO 1	Demonstrate proficiency in educational information selection methods, in teaching and education process management at universities.
	LO 3	He owns the experimental and theoretical methods analytical determination chemicals instrumental framing method and conditions of the experiment; It is aware of the sensitivity and resolution of the method, the method of the characteristic time
	LO 4	Demonstrate the ability to use modern methods and technologies of scientific and pedagogical communication in native and foreign languages in the field of professional activity at a level that allows research and teaching special disciplines in universities
	LO 7	Demonstrates knowledge of laws and regulations on metrology, standardization and certification, safety regulations, industrial hygiene, fire safety, and labor standards; standards for control and uniformity of measurements; theory of reproduction of units of physical quantities and the transfer of their size; processing the measurement results of measurement methods and means of their metrological characteristics; the rules for testing and product acceptance
	LO 10	Demonstrate the ability to design and implement integrated, interdisciplinary research, based on a holistic system of scientific outlook
	LO 11	Demonstrate the ability to participate in the work of national and international research teams to solve scientific and scientific-educational problems

### Determination of modules of disciplines in accordance with the results of training

Learningresultcode	Name of the module	Name of disciplines	Volume (ECTS)
LO 1, LO 2, LO 3, LO 4, LO 5, LO 6, LO 7, LO 8, LO 9, LO 10, LO 11, LO 12	Methodological basics of research	Academic Writing	5
		Methods of scientific research	5
LO 1, LO 2, LO 3, LO 4, LO 5, LO 6, LO 7, LO 8, LO 9, LO 10, LO 11, LO 12	Modern Problems of Chemistry	Modern Problems of Physical Chemistry	5
		Teaching practice	10
		Research practice	10
LO 3, LO 4, LO 5, LO 7, LO 8, LO 9, LO 10, LO 12	Nanochemistry	Computer Nanochemistry (in English)	5
		Physical chemistry of nanomaterials (in English)	
		Magnetic Resonance Spectroscopy (in English)	5
LO 3, LO 4, LO 5, LO 6, LO 7, LO 8, LO 9, LO 10, LO 11, LO 12	Research work by a doctoral candidate	Research work of doctoral candidate, including internships and doctoral thesis	123
		Final assessment	Writing and defending doctoral thesis

### Matrix of achievability of learning outcomes

NN	Name of disciplines	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)											
				LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10	LO 11	LO 12
Cycle of basic disciplines University component															
D1	Academic Writing	The discipline is studied in order to form competencies related to analytical research and textual activities; skills of analytical-synthetic, critical and pragmatic thinking. In the process of studying the discipline, the types, methods and ethical principles of writing scientific texts, the principles of constructing a scientific text and preparing it for publication, the design of a bibliographic list, the basic rules for quoting scientific literature, the types of annotations and the features of their compilation, reviewing a scientific text are considered.	5				+	+	+			+		+	
D2	Methods of scientific research	The discipline is studied in order to form the skills of doctoral students to carry out independent research activities; the use of scientific research methods to achieve the objectives set in the dissertation research; the use of methods of processing empirical data on the topic of their dissertation research.	5					+			+	+	+	+	
D3	Teaching practice	The purpose of pedagogical practice is the formation of doctoral students professional competencies that ensure readiness for pedagogical activity in universities, designing the educational process in accordance with the profile of training and conducting certain types of training sessions using innovative educational technologies.	10	+	+		+	+	+	+			+		
Cycle of basic disciplines Elective component															
D4	Computer Nanochemistry (in English)	It is studied in order to form knowledge and skills of using computational nanotechnology,	5		+							+	+	+	



		computational algorithms, basic concepts and mathematical apparatus of quantum mechanics, modern methods of modeling quantum systems, including hybrid methods. Skills are acquired to model molecular nanosystems, to determine the structure and mechanisms of formation of nanomaterials.													
	Physical chemistry of nanomaterials (in English)	The purpose of studying this discipline is to form a system of knowledge for students about the physicochemical properties of nanomaterials, methods for determining the thermodynamic and kinetic characteristics of systems, the ability to determine the enthalpies and entropies of the reactions of formation of nanostructures, assess their stability, as well as the development of methods for calculating the kinetic parameters of reactions with their participation.		+	+					+	+	+			+
Cycle of profile disciplines University component															
D5	Modern Problems of Physical Chemistry (in English)	It is studied in order to form knowledge about modern problems of chemical equilibrium and nonequilibrium thermodynamics, kinetics of enzymatic and heterogeneous reactions, thermodynamics and kinetics of electrode processes. Skills are acquired to use approximate methods for calculating the kinetic characteristics of complex reactions, skills in solving theoretical and applied problems of statistical thermodynamics.	5	+	+	+				+	+				+
D6	Research practice	The purpose of the research practice is the study by doctoral students of the latest theoretical, methodological and technological achievements of national and international science, as well as the consolidation of practical skills in applying modern methods of scientific research, processing and interpretation of experimental data in a dissertation research.	10			+	+	+		+	+	+	+		+
Cycle of profile disciplines Elective component															
D6	Magnetic Resonance Spectroscopy (in English)	It is studied in order to form knowledge of the theoretical foundations of NMR and EPR spectroscopy methods, methods for interpreting the spectra of organic and inorganic com-	5			+	+		+	+	+				+

		pounds, devices and circuits of modern devices in the field of magnetic resonance spectroscopy. The skills of deciphering the molecular structure of unknown compounds based on a set of spectroscopic data are acquired.													
	Molecular spectroscopy of nanoparticles (in English)	The purpose of studying this discipline is to master the classical and latest methods of molecular spectroscopy used to study nanoparticles, to establish their advantages and disadvantages, to master the methods of preparing samples for analysis, conducting analysis, obtaining spectra, the ability to process spectral data and interpret them, as well as determine the possibilities of preventing typical experimental errors.			+	+		+	+	+					+
Research work															
D8	Research work of doctoral candidate, including internships and doctoral thesis	The purpose of the research work of a doctoral student is the formation of the level of knowledge necessary for the implementation of professional activity, the abilities and skills of scientific research activity and the preparation for defense of a doctoral dissertation. It includes conducting independent scientific research, a foreign scientific internship, preparing scientific publications and completing a doctoral dissertation.	123			+	+	+	+	+	+	+	+	+	+

## Coordination of the planned learning outcomes with the methods of teaching and evaluation within the module

Learning outcomes	Planned learning outcomes for the module	Teaching methods	Assessment methods
LO 1	Demonstrate proficiency in educational information selection methods, in teaching and education process management at universities.	interactive lecture, discussion	colloquium, test
LO 2	Demonstrate the ability to teach chemistry and other related sciences in university educational programs	interactive lecture, discussion	presentation, test
LO 3	He owns the experimental and theoretical methods analytical determination chemicals instrumental framing method and conditions of the experiment; It is aware of the sensitivity and resolution of the method, the method of the characteristic time	interactive lecture, project preparation	project, test
LO 4	Demonstrate the ability to use modern methods and technologies of scientific and pedagogical communication in native and foreign languages in the field of professional activity at a level that allows research and teaching special disciplines in universities	interactive lecture, presentation	presentation, test
LO 5	Demonstrate the ability to organize the work of a research team in the field of chemistry and related sciences	interactive lecture, presentation	presentation, test
LO 6	He demonstrates the ability to develop their point of view in professional matters and to defend it during a discussion with specialists and non-specialists; abstracted the scientific literature, including foreign languages, subject to scientific ethics and copyright	interactive lecture, round table	colloquium, test
LO 7	Demonstrates knowledge of laws and regulations on metrology, standardization and certification, safety regulations, industrial hygiene, fire safety, and labor standards; standards for control and uniformity of measurements; theory of reproduction of units of physical quantities and the transfer of their size; processing the measurement results of measurement methods and means of their metrological characteristics; the rules for testing and product acceptance	interactive lecture, presentation	colloquium, test
LO 8	Able to formulate goals for personal and professional development and conditions for their achievement, based on the trends of development of the field of professional activities, career stages, individually-personal features; to exercise personal choice in a variety of professional and moral-value situations, assess the consequences of the decision and bear the responsibility for it ourselves and society.	interactive lecture, discussion	colloquium, test
LO 9	Demonstrate the ability to carry out scientific research independently in the relevant professional field using modern research methods, information and communication technologies	interactive lecture, discussion	colloquium, test
LO 10	Demonstrate the ability to design and implement integrated, interdisciplinary research, based on a holistic system of scientific outlook	interactive lecture, presentation	presentation, test
LO 11	Demonstrate the ability to participate in the work of national and international research teams to solve scientific and scientific-educational problems	interactive lecture, project preparation	project, test
LO 12	Demonstrate the ability to analyze and evaluate modern scientific achievements, generate new ideas in solving research and practical problems, including in interdisciplinary fields	interactive lecture, discussion	colloquium, test

## Criteria for assessing the achievability of learning outcomes

Codes of LO	Criteria
LO 1	<b>Knows:</b> the basic concepts of mathematical, natural sciences and technical disciplines that contribute to the formation of a highly educated personality with a broad outlook and culture of thinking, a modern strategy for the development of higher education in Kazakhstan, the basics of managing the educational process.
	<b>Can:</b> design the educational process in higher education in accordance with the profile of training, carry out teaching activities in the main educational programs of higher education in the field of chemistry and chemical technology.
	<b>Owens:</b> the skills of managing the learning process, teaching in educational institutions of higher education, developing training courses, applying innovative methods in the learning process.
LO 2	<b>Knows:</b> in-depth chemistry, chemical technology and related sciences, classical and innovative teaching methods, the specifics of the teaching process at the university, the features of designing educational programs for higher educational institutions
	<b>Can:</b> select educational material in accordance with the educational programs of higher education in the field of chemistry and related fields, apply innovative and classical methods in the learning process
	<b>Owens:</b> teaching skills in the main educational programs of higher education in the field of chemistry and related fields in both native and foreign languages.
LO 3	<b>Knows:</b> instrumentation of chemical analysis methods, experimental conditions, sensitivity and resolution of the method, characteristic time of the method.
	<b>Can:</b> select a methodology for conducting an experiment in accordance with the tasks of a dissertation research, directly conduct an experiment, taking into account the conditions for conducting, the sensitivity and resolution of the method.
	<b>Owens:</b> experimental and theoretical methods for the analytical determination of chemicals, skills in working with modern scientific equipment in conducting scientific research.
LO 4	<b>Knows:</b> modern methods and technologies of scientific and pedagogical communication in native and foreign languages, methods of writing scientific texts in a foreign language, principles of constructing a scientific text.
	<b>Can:</b> use modern methods and technologies of scientific and pedagogical communication in native and foreign languages in the field of professional activity at a level that allows conducting scientific research and teaching special disciplines at the university.
	<b>Owens:</b> communication skills in native and foreign languages in the professional pedagogical and scientific field, teaching special disciplines at the university.
LO 5	<b>Knows:</b> stages of research activities, design features of scientific research
	<b>Can:</b> organize the work of a research team in the field of chemistry and related sciences.
	<b>Owens:</b> the skills of independent organization and implementation of research activities in the relevant professional field using modern research methods.
LO 6	<b>Knows:</b> features of reviewing a scientific text, ethical principles and norms of the scientific publication process.
	<b>Can:</b> develop their own point of view in professional matters and defend it during discussions with specialists and non-specialists; abstract scientific literature, including in foreign languages, subject to scientific ethics and copyrights.
	<b>Owens:</b> summarizing scientific literature, defending one's point of view during the discussion.
LO 7	<b>Knows:</b> legislative and regulatory legal acts on metrology, standardization and certification, safety regulations, industrial sanitation, fire safety and labor protection standards; theory of reproduction of units of physical quantities and transfer of their sizes.
	<b>Can:</b> conduct product quality tests in accordance with regulatory documentation, process measurement results, calculate metrological characteristics.
	<b>Owens:</b> control system for standards and uniformity of measurements; methods of processing measurement results and measuring instruments, their metrological characteristics.
LO 8	<b>Knows:</b> the possibilities of personal and professional development and the conditions for their achievement, based on the trends in the development of the field of professional activity.
	<b>Can:</b> formulate the goals of personal and professional development and the conditions for their achievement, based on the trends in the development of the field of professional activity, stages of professional growth, individual and personal characteristics.
	<b>Owens:</b> the skills of planning and solving problems of their own professional and personal development, making personal choices in various professional and moral-value situations, evaluating the consequences of a decision.

LO 9	<b>Knows:</b> modern research methods, information and communication technologies, world innovative developments in chemistry and related fields.
	<b>Can:</b> independently carry out research activities in the relevant professional field using modern research methods and information and communication technologies.
	<b>Owens:</b> the skills of using computer software packages for solving computational problems, processing the results of scientific research and storing information.
LO 10	<b>Knows:</b> the process and stages of designing complex studies, methods for choosing technologies for research work, predicting research results.
	<b>Can:</b> design and implement comprehensive research, including interdisciplinary, based on a holistic systemic scientific outlook.
	<b>Owens:</b> the skills of designing and implementing integrated research, choosing a technology for conducting scientific research, estimating costs.
LO 11	<b>Knows:</b> the latest trends in the development of science and education in Kazakhstan and in the world community as a whole.
	<b>Can:</b> solve scientific and scientific-educational tasks at the world level, critically analyze modern problems of innovation in the field of chemistry, set tasks and develop new research programs.
	<b>Owens:</b> the skills of working in domestic and international research teams to solve scientific and scientific-educational problems.
LO 12	<b>Knows:</b> modern scientific achievements and their practical application in the field of chemistry, chemical technology and interdisciplinary fields.
	<b>Can:</b> analyze and evaluate modern scientific achievements, generate new ideas in solving research and practical problems, including in interdisciplinary areas.
	<b>Owens:</b> the skills of introducing modern developments into the process of implementing research projects.

## The graduate model of the educational program

### Graduate Attributes:

- Deep professional knowledge in their field of study.
- Interest in mastering trends in education and science.
- Ability to collaborate in the professional community.
- Independence in the search for opportunities for professional and personal growth.
- Sociability.
- Tolerance and good manners.
- Academic integrity.
- Willingness to participate in solving state tasks and strategies of Kazakhstan.

Type of competencies	Description of competencies
1. Behavioral skills and personal qualities: (Softskills)	Willingness to organize and conduct teaching activities in the main educational programs of higher education in the field of chemistry and chemical technology Ability to independently organize and carry out research activities in the relevant professional field using modern research methods. Ability to develop their own point of view in professional matters and defend it. Ability to plan and solve the problems of one's own professional and personal development, to make a conscious personal choice in various professional and moral situations. Ability to critically analyze and evaluate modern scientific achievements, generate new ideas in solving research and practical problems, including in interdisciplinary areas.
2. Digital competencies: (Digitalskills):	The ability to independently carry out research activities using modern information and communication technologies and advanced computer developments. Ability to use computer software packages for solving computational problems, processing the results of scientific research and saving information.
3. Professional competencies: (Hardskills)	Knowledge of the basics of managing the learning process, the ability to carry out pedagogical activities. Possession of conceptual knowledge in fundamental mathematical, natural science and technical disciplines, contributing to the formation of a highly educated personality with a broad outlook and a culture of thinking. Willingness to use modern methods and technologies of scientific and pedagogical communication in native and foreign languages in the field of professional activity at a level that allows conducting scientific research and teaching special disciplines in universities. Understanding the principles of work and the ability to work on modern scientific equipment when conducting scientific research. Ability to use normative documents on metrology, quality, standardization in practice; the ability to apply the rules of safety, industrial sanitation, fire safety and labor protection standards. Ability to design and implement complex studies, choose the technology for the implementation of scientific research, estimate costs and organize its implementation. Ability to analyze the results of a scientific experiment using modern methods and processing tools; present the result of the research work in a documented form, drawn up in accordance with the existing requirements, apply the results obtained. Ability to solve scientific and scientific-educational problems at the world level, critically analyze modern problems of innovation in the field of chemistry, set goals and develop new research programs.

**Created by:**

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Engineer of LLP «KhimKo»

The educational program was reviewed by the Faculty Council from 26.04.2013 protocol No. 10

The educational program was reviewed at the meeting of the Academic Council from 28.04.2013 protocol No. 5

The educational program was reviewed and approved at the meeting of the University Board from 30.05.2013 protocol No. 12

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