

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF
KAZAKHSTAN

M.Auezov SOUTH KAZAKHSTAN STATE UNIVERSITY

« APPROVED BY»

Rector _____

d.h.s., academician

Kozhamzharova D.P.

« ___ » _____ 20 ___ y.

EDUCATION PROGRAMME

6B07160 – Chemical technology of inorganic substances

Registration number	
Code and classification of the field of education	6B07-Engineering, processing and construction branches
Code and classification of training areas	6B071- Engineering and engineering business
Group of educational programs	Chemical engineering and processes
Type of EP	Active
ISCE level	6
NQF level	6
SQF of education level	6, Chemical production
Language of learning	Russian
Typical duration of study	4 years
Form of study	Full time, evening, distance learning
The complexity of the EP, not less	244 credits
Distinctive features of EP	Dual training
University Partner (JEP)	
University Partner (TDEP)	
Social Partner (DE)	LLP«Kazphosphat»

Shymkent, 2019

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The EP was considered by Committee on Innovative Learning Technologies and Methodological Support of Higher School "Chemical engineering and biotechnology"

protocol № _____ from _____ 2019.

Chairman of Committee _____ Yesmurzayeva R.M.

The EP was considered and recommended for approval at the meeting of Educational and Methodical Council of M. Auezov SKSU

protocol № ____ from _____.

Approved by the decision of the Academic Council of the University

protocol № _____ from _____ 2019

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Introduction

1. Application area

It is intended for training of bachelors of technics and technology according to educational program 6B07160 – Chemical technology of inorganic substances (hereinafter referred to as EP) of RSE with the right of economic management “M.Auezov South Kazakhstan State University” of MES RK.

1. Regulatory documents

Education Act of the Republic of Kazakhstan (as amended and supplemented on 07/04/2018);

Standard rules for the operation of educational organizations implementing educational programs of higher and (or) postgraduate education, approved by order of the Minister of Education and Science of the Republic of Kazakhstan from October 30, 2018 No. 595 (registered with the Ministry of Justice of the Republic of Kazakhstan on October 31, 2018 No. 17657);

State obligatory standards of higher and postgraduate education, approved by order of the Minister of Education and Science of the Republic of Kazakhstan, October 31, 2018 No. 604;

The rules for the organization of educational process on credit technology education, approved by order of the Minister of Education and Science of the Republic of Kazakhstan on April 20, 2011 No. 152 as amended and supplemented of October 12, 2018 No. 563

Branch framework of qualifications «Chemical production» (it is confirmed by protocol № 1 of August, 16th, 2016 of the meeting of branch commissions on social partnership and regulation of social and labour relations for mining and smelting, chemical, construction, woodworking, light industries and mechanical engineering.

2. Concept of Educational Program

The goal of the educational program is coordinated with the mission of university and is aimed at training the intellectual elite of the country with advanced entrepreneurial skills, fluent in three languages, demonstrating conceptual, analytical and logical thinking skills, creative approach in professional activities, being able to work in national and international teams obtaining the lifelong strategy.

The educational program has been developed according to the Dublin descriptors, harmonized with the 6th level of the National framework of qualifications of RK, the 1st cycle of the Framework for Qualification of the European Higher Education Area and also with the 6th level of the European Qualification Framework for Lifelong Learning.

The educational program is focused on professional and social needs by means of formation of professional competencies connected with necessary kinds of research, practical and business activity taking into account requirements of stakeholders.

Uniqueness of EP 6B07101 - Chemical technology of inorganic substances:

EP 6B07160 – Chemical technology of inorganic substances is accredited by Independent International Agency ASIIN (Germany) in 2008 and re-accredited in 2014 with conferment of label “Chemistry Eurobachelor» that makes possible recognition of a diploma of a bachelor of technics and technology on the international labour market.

EP “Chemical technology of inorganic substances” provides for dual training according to the contract with LP “Kazphosphat”. The department “Chemical technology of inorganic substances” is an operating platform of successful activity of well-known Kazakhstan scientific schools on chemical technology of inorganic substances headed by professors of the department having long-term experience of scientific work.

The educational program is aimed at training of highly qualified competitive specialists for enterprises of the chemical industry through organization of an educational process using principles of the Bologna process, student-centered training, accessibility and inclusiveness.

EP training outcomes are reached by means of the following educational actions:

- class lessons: lectures, seminars, practical and laboratory lessons are realized taking into consideration innovative training technologies, application of advanced achievements of science, technologies and information systems, use of modern equipment and devices in accredited laboratories of the department;

- out-of-class lessons: independent work including the work under the guidance of a teacher, individual consultations;

- carrying out of professional practical trainings, implementation of course and diploma works (projects).

The University takes measures on maintenance of academic honesty and freedom, prevention of any kind of intolerance and discrimination concerning the students.

EP quality is provided with involvement of stakeholders to its development and assessment, regular monitoring and review of its content.

4. Requirements for applicants

The matriculation criteria for applicants were developed according to Standard Rules for admission to training in educational organizations realized educational programs of higher and postgraduate education (order of MES RK №600 of 31.10.2018).

1. EDUCATION PROGRAMME PASSPORT

1.1 The education program goal and objectives

EP goal: Development of competitive bachelors possessing fundamental theoretical and practical knowledge, methods and instruments in the area of chemical engineering.

EP objectives:

- formation of socially-responsible behaviour in the society, understanding of the importance of professional ethical standards and compliance with these norms;

- provision with knowledge and skills during all life that will allow them to adapt successfully for varying conditions of the labour market throughout all their professional career;

- provision with the conditions for acquisition of a high general intellectual level of development, mastering the thinking culture and skills of organisation of inorganic compounds manufacture;

- formation of competitiveness of the graduates in the sphere of chemical engineering for ensuring the possibility of their employment on EP “Chemical technology of inorganic substances» or continuation of training on master degree programs.

1.2 List of qualifications and positions

A graduate of EP 6B07160 – Chemical technology of inorganic substances obtain the degree “Bachelor of technics and technology”.

Bachelors of EP “Chemical technology of inorganic substances” can hold such positions as a chemical engineer, an operator of a remote control panel of a chemical enterprise, a processing engineer on manufacture of chemical production, a machinery operator, a processing engineer of research institutes, design and project departments without presentation of requirements to practical experience according to qualifying requirements “Skilled manual of positions of heads, specialists and other employees” approved by Minister of Labour and Social Protection of the population of the Republic of Kazakhstan (order № 201-ө-ми of May, 21st, 2012) and Attachment 2 to the Branch framework of qualifications “Chemical production” confirmed on August, 16th 2016 (protocol №1).

1.3 Qualification characteristic of EP graduates

1.3.1 Professional area

Industrial enterprises producing inorganic substances, mineral acids, salts and fertilizers; electrochemical and electrothermal manufactures; ore-dressing factories; factory and scientific laboratories; research and design organizations.

1.3.2 Objects of professional activity of EP graduates

- Chemical technology of inorganic compounds;
- Mineral natural and technogenic raw materials;
- Processes and apparatuses of chemical technology;
- Chemical reagents;
- Waste of chemical manufactures;
- Development documentation;
- Analytical devices and methods of analysis of chemical systems;
- Technological scheme.

1.3.3 Subjects of professional activity

Subjects of professional activity of bachelor of specialty 6B07160 – Chemical technology of inorganic substances are:

- Improvement of chemical-technological processes and apparatuses;
- Industrial designing;
- Ensuring of safety of chemical manufactures;
- Concentration of mineral raw materials;
- Processing of mineral and secondary raw materials, industrial wastes;
- Control and management of a production process;
- Control of raw materials and products quality;
- Experimental studying of chemical compounds;
- Industrialwater treatment;
- Development of a technological scheme.

1.3.4 Kinds of professional activity

A bachelor of specialty 6B07160– Chemical technology of inorganic substances can realize the following kinds of professional activity:

- industrial-technological activity;
- organizational and administrative activity;

- experimental and research activity;
- design activity.

2. EP learning outcomes

After termination of EP graduates should:

PO1 Possess information and computing skills, ability to generalize, analyze and apprehend the information; fluently communicate in the professional environment and the society in Kazakh, Russian and English languages.

PO2 Use natural-scientific, mathematical, public, social and economic and engineering knowledge, standard documents and elements of economic analysis in professional activity.

PO3 Know laws of development of nature and society, basic stages of development of Kazakh statehood, possess elements of spiritual, aesthetic and ethical culture.

PO4 Estimate critically the modern condition of manufacture of inorganic compounds, analyze and choose ways of improvement of operating technological processes and development of new ones on the basis of modern achievements of science and technology.

PO5 Choose a rational manufacturing scheme on the basis of regularities of processes of processing of mineral and technogenic raw materials.

PO6 Calculate material and thermal balances of chemical technological processes, calculate and choose capital and auxiliary equipment.

PO7 Plan and implement theoretical and experimental investigations, interpret the obtained results with application of methods of mathematical data processing and formulate conclusions.

PO8 Manage technological processes of manufacturing inorganic compounds, raw materials and production quality control, develop actions for increase of production safety and solving environmental problems.

PO9 Use research and business abilities and skills of operation under the conditions of indeterminacy; continuously improve qualification during all life.

PO10 Work individually and in a team, persist correctly in one's opinion, make independent decisions during problem industrial situations showing analytical and logic thinking.

3 COMPETENCES OF EP GRADUATES

3.1 Successful completion of EP promotes formation of the following core competences (CC):

Core competencies:

Linguistic competence(CC1)

- Ability to voice and understand concepts, thoughts, feelings, facts and opinions, including in the field of chemical engineering, in written and oral forms in Kazakh, Russian and foreign languages, to own communication skills in the professional area in a foreign language and intercultural understanding in the international environment.

Social competence(CC2)

- Ability to own social-ethical values based on public opinion, traditions, customs, norms and to be guided by them in the professional work; to know tendencies of social development of the society; to be able to behave adequately in various social situations; to correlate own opinion with a collective opinion; to aspire to professional and personal growth; to work in a team, to persist correctly in one's opinion, to show tolerance in relation to other individuals; to be capable to innovation.

Cultural competence(CC3)

- Ability to know and understand culture of Kazakhstan peoples and to observe their traditions, to show tolerance to traditions and culture of other nations of the world; to possess

high spiritual qualities, to be an intelligent person with skills of critical thinking, interpretation, creativity, with active stand in life; to own ethical and legal norms of behavior; to observe bases of Kazakhstan legal system and legislation including the field of chemical manufacture.

Natural-scientific and technical competence(CC4)

- Ability to apply the educational potential, obtained knowledge in the field of chemistry and chemical technology, experience and personal qualities in professional work; ability to apply basic concepts, laws and theories for solving chemical technological problems, performance of calculations, development of mathematical and natural-scientific thinking; to carry out the research worksuccessfully, to analyze results and to draw conclusions; to own skills of acquisition of the new knowledge necessary for professional work and further education;

Computer competence(CC5)

- Ability to use with confidence the modern information and digital technologies for work, leisure and communications, to own skills of use, recovery, estimation, storage and interchange of information in the professional area by means of a computer, communication and participation in collaborative networks using the Internet.

Economic, administrative and business competence(CC6)

- Ability to know and understand the purpose and methods of government economic regulation, a role of a public sector of the economy; to own bases of economic knowledge; to operate technological processes and projects for achievement of professional tasks, to show business skills, to estimate the production efficiency, to make decisions on professional questions under the conditions of indeterminacy and risk.

3.2 Matrix of correlation of EP learning outcomes in general with modules formed competencies

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
KK1	+	+	+	+		+			+	
KK2	+	+	+			+		+	+	+
KK3			+	+		+	+	+	+	+
KK4	+	+		+	+	+		+	+	+
KK5	+	+	+	+	+	+				+
KK6		+	+	+	+			+		+

**4.SUMMARY TABLE REFLECTING THE VOLUME OF MASTERED CREDITS
BROKEN DOWN EDUCATION PROGRAM MODULES**

Course of Study	Semester	The number of mastered modules	The number of studied disciplines			Number of KZ credits				Total hours	Total KZ credits	The number of	
			CK	BK	EC	Theoretical training	Study practice	Industrial practice	Writing and defense of degree work			exam	Diff. pass
1	1	7	7	-	-	30	-	-	7	630	30	6	1
	2	8	3	2	3	29	1	-	8	870	30	6	2
2	3	8	4	3	1	30	-	-	8	870	30	7	1

	4	7	-	3	4	27	-	3	8	900	30	7	1
3	5	5	-	1	4	31	-		5	930	31	5	-
	6	6	-	2	4	24	-	6	6	810	30	5	1
4	7	4	-	-	4	30	-	-	4	600	30	4	-
	8	4	-	-	-	20	-	-	4	420	20	4	-
	9	2				12	-	8	2	600	20	1	1
Total										6630	241		

5. Information about disciplines

Module title	Cycle	UC/EC	Component title	Brief discipline description (30-50 words)	Number of credits	Formed PO(codes)
Cycle of general education discipline disciplines						
University component						
Public sciences	GED	CC	Contemporary History of Kazakhstan	Examines the socio-economic situation in Kazakhstan – the prerequisites for the struggle for independence, the origins of the national movement of the Kazakh people, the formation of the state structure of the Republic of Kazakhstan. Forms the skills of historical knowledge that meet the strategic objectives of strengthening the sovereign statehood of Kazakhstan and national security, to provide objective information and possess real scientific and historical knowledge of the events of national history.	5	PO2 PO3
	GED	CC	Philosophy	Examines the history of philosophical thought, the main problems, concepts and categories of philosophy. social philosophy, relationship between philosophy and the individual Sciences. philosophy of the Ancient East, ancient philosophy, philosophy of the middle ages East and West, philosophy of modern times. It forms the skills of philosophical dialogue and debate on environmental protection.	5	PO1 PO3
	GED	CC	Social and	Examines the General concepts of	4	PO2

			Political Studies	sociology, history of formation and development of sociology and political science, modern sociological and political theories, problems of applied sociology, the structure of the political sphere of society, methodology and methodology of sociological research, sociology of labor and Economics. Forms the skills to independently analyze social and political events in society, independently solve professional problems on the basis of socio-political knowledge.		PO3 PO10
Module of socio-political knowledge	GED	CC	Cultural Studies and Psychology	Considers the main provisions of cultural studies, elements of spiritual, aesthetic and ethical culture, the tasks and role of psychology in the system of Sciences, psychological methods and means to improve the efficiency and quality of activity in modern conditions. Forms the skills of presenting objective information and possession of real scientific and historical knowledge of the events of national culture.	4	PO1, PO2 PO3
	GED	CC	Ecology and Fundamentals of Life Safety	Examines the global environmental problems of our time, water resources and their protection, the maximum permissible concentrations of harmful substances in water bodies, soil and their rational use, safety in industry, occupational safety management system, fire safety in enterprises. Forms the skills of analysis of environmental conditions and working conditions in industrial enterprises.	3	PO2 PO4 PO8
Elective component						
	GED	EC	Fundamentals of Economics and Law	Studies economic and legal categories, legal regulation of economy, organizational and legal forms of business, taxes, bases of financial and tax law. It forms the skills to critically assess the current economic situation, develop analytical thinking, analysis of events and actions in terms of legal regulation and the ability to handle the necessary regulations.	3	PO2, PO3 PO4 PO10
	GED	EC	Fundamentals of entrepreneurship skills and anti-	Forms knowledge about the organization of the company, doing business. Develops skills of	3	PO2, PO3, PO4

			corruption culture	business planning of production and sales, market analysis; calculation of profit, income, profitability, solvency, liquidity of the company. Examines the nature, factors of corruption. It forms anti-corruption worldview, culture, civil position to corruption, realizes values of moral consciousness of anti-corruption. Instills skills of critical analysis of corruption phenomena.		PO10
Cycle of basic disciplines University component						
	GED	CC	Kazakh (Russian) language	Forms communicative competence - the ability to solve by linguistic means real communicative tasks in specific speech situations of social and scientific spheres. Develops the culture of speech, intercultural and communicative competence, the skills of translation of texts of medium complexity, the application of the basic rules of sentence formation, analysis, synthesis and synthesis of information; competently build communication, based on the goals and situation of communication.	10	PO1 PO3 PO7
	GED	CC	Foreign Language	Forms intercultural and communicative competence, lexical, grammatical and phonetic structure of the foreign language. It allows you to master the grammar of writing in a foreign language, the skills of reading technical texts of medium complexity without a dictionary, understanding the spoken language of medium complexity on technical topics, to translate, to use a foreign language in the provision and documentation of information.	10	PO1, PO3, PO7
Module of communicative mobility	BD	UC	Professional Kazakh (Russian) Language	Studies the structural features of the scientific work, the principles of selection of literature on the topic of research, General characteristics of the scientific style of speech as a language specialty ChTIS, terms ChTIS in popular science texts, especially their education in Russian and Kazakh languages. Forms skills to search for scientific information in Russian and Kazakh languages and use scientific literature in the specialty.	3	PO1 PO3 PO7 PO10
		UC	Professionally Oriented Foreign	Studies the development of English terminology in the field of chemical	3	PO1 PO7

			Language	engineering, evaluation of semantic accuracy of scientific and technical translation, requirements for the preparation of reports on educational and research work in English, the development of practical skills of spoken English. Forms the skills to search for scientific information on the specialty in a foreign language, skills of commenting, abstracting and translating scientific literature.		PO10
	GED	CC	Information and Communication Technologies	Forms knowledge of computer systems, software, methods and means of information protection; design and creation of websites, multimedia presentations, Considers information technologies in the professional sphere, mobile services. Develops skills in the use of information resources for the search and storage of information, working with electronic databases, electronic textbooks, the use of forms of e-learning for professional knowledge.	5	PO1 PO2 PO7 PO9
Fundamentals of Engineering and Technical Sciences	BD	UC	Higher Mathematics	Considers linear and vector algebra, analytic geometry; introduction to mathematical analysis; differential calculus of a single variable function. Studies indefinite and definite integrals; analyzes the application of the function of several variables, ordinary differential equations, calculations of series theory, probability theory, forms the skill to solve typical mathematical problems, use the concepts of higher mathematics to acquire new knowledge.	4	PO1 PO2 PO6 PO7 PO9
	BD	UC	Physics	Considers the kinematics and dynamics of a material point. Studies the laws of conservation in mechanics, analyzes mechanical vibrations and waves, characteristics of direct current, elements of the physics of the atomic nucleus, elements of quantum electronics. Teaches skills to solve typical problems in physics, to synthesize, generalize and interpret the results of experimental research, to apply knowledge of the laws of physics to the study of special disciplines.	4	PO2 PO5 PO7
	BD	UC	Engineering computer	Studies the basic provisions of engineering graphics, practical	3	PO1 PO2

			graphics	implementation of General technical and specialized drawings in accordance with the State educational standard, instills skills with modern computer programs in the computer-aided design AutoCAD, 3D modeling, skills of construction and reading technical drawings, computer graphics system and the ability to create design documentation in AutoCAD		PO5 PO6
Chemical engineering	BD	UC	Chemistry	Studies the laws of chemistry, General laws of chemical processes, chemical bond, energy and kinetics of chemical processes, chemical equilibrium, classes of chemical compounds and types of reactions, the basics of electro-chemical processes. Forms skills to use the acquired knowledge in the analysis of chemical processes occurring in technological objects; analyze the dependence of the properties of substances on the composition and structure.	4	PO1 PO3 PO5 PO7
	BD	UC	Standardization, certification and metrology	Studies the principles of standardization, types of standards, quality management functions, quality standards of raw materials and products, certification of production, measurement methods and calibration and verification of measuring instruments. Analyzes statistical methods of quality management, quality management in the enterprise. Teaches conducting metrological control analysis of raw materials and products, conformity assessment of products, processes, works in testing laboratories.	3	PO2 PO7 PO8
	BD	UC	Industrial chemistry	Studies inorganic substances and compounds obtained in an industrial scale enterprises producing phosphorus, ammonia, mineral acids, alkalis and salts. Examines chemical and physical properties of oxides, acids, bases and salts, the role of oxygen in chemical technology, especially chemistry of metals and nonmetals. Forms skills to use the acquired knowledge in study and analysis of chemical-and-technological processes.	6	PO2 PO7 PO8
Fundamentals of speciality	SD	UC	Introduction to the speciality	Examines the characteristics of the educational program "Chemical technology of inorganic	3	PO2 PO4 PO10

				substances", interdisciplinary communication, the rules of the educational process on credit technology, qualification characteristics of bachelor specialty, the emergence and main stages of development of chemical technology, the history of the main production technology of inorganic substances. Instills an understanding of the nature of the future activities of the bachelor of engineering and technology, the basic requirements for professional training of the bachelor.		
	BD	UC	Technology of mining and preparation of mineral and secondary raw materials	Studies the characteristics of mineral deposits, development of overburden operations, methods of mining. Analyzes the importance of preparation and enrichment of various types of minerals, the efficiency of raw material enrichment by flotation, gravity, electromagnetic and electrostatic separation. It allows you to acquire the skills of calculating the main indicators of enrichment of raw materials, the processes of preparation of raw materials for technological processing.	4	PO4 PO5 PO7 PO8
Cycle of basic disciplines						
University component						
Fundamentals of Engineering and Technical Sciences	BD	EC	Higher Mathematics II	He studies double and triple integrals, types of random variables, the law of probability distribution of discrete and continuous random variables, statistical estimates of distribution parameters, sample regression equations, determination of linear and nonlinear regression parameters by the least squares method. Forms skills in methods of solving mathematical problems, select appropriate algorithms for solving problems, apply them in professional activities.	4	PO1 PO2 PO6 PO7 PO9
			Probability theory and mathematical statistics	Studies elementary probability theories, conditional probability and independence of events, random variables and distribution functions, construction of probability models using distribution functions. It analyzes vector random variables, independence of random variables, multinomial and multidimensional normal distributions. Forms the skills to carry out technical calculations,		

				select the appropriate probabilistic methods and algorithms for solving problems, to conduct qualitative statistical research.		
	BD	EC	Physics II	Studies electromagnetism, electromagnetic oscillations and waves, the role of geometric optics in the development of technology, the laws of light propagation in matter, the laws of thermal radiation wave-particle dualism, elements of the physics of the atomic nucleus. Forms the skills of analysis of the physical situation and solving typical problems in physics, apply knowledge and understanding of the basic physical phenomena and laws in practice.	3	PO2 PO6 PO7
			Applied mechanics	Studies statics - bringing the system of forces to the simplest form, the conditions of equilibrium of bodies, kinematics equation of motion, speed, acceleration, the foundations of dynamics, the foundations of the resistance of materials, strength, stiffness, fatigue and stability. Forms the skills necessary for the subsequent study of special disciplines in the design and determination of critical loads for the calculation of production equipment.	3	PO2 PO6 PO7
Chemical engineering	BD	EC	Physical and colloid chemistry	He studies the basics of chemical thermodynamics, phase equilibria in solutions, the basic laws of electrochemical processes, colloidal disperse systems and surface phenomena occurring at the interface, adhesion, coagulation, wetting. Forms skills to evaluate the results of thermal analysis, build a diagram to form a chemical compound; apply the laws of thermodynamics, Hess's law for the analysis of technological processes.	4	PO2 PO4 PO8
			Analytical chemistry	Considers methods of control of chemical composition of substances in production and research, metrological basis of quantitative and qualitative analysis, theory and practice of sampling and sample preparation, analytical control of technological processes and product quality. It teaches to apply the skills of analytical experiments in professional activities, to determine the chemical composition and structure of the object.		PO2 PO5 PO8

	BD	EC	Fundamentals of Chemical Technology	Studies the structure of the criteria of efficiency of chemical production, methods of chemical technology, analysis and synthesis of chemical-technological systems. Considers the basic laws of homogeneous, heterogeneous and heterogeneous catalytic processes, chemical reactors, mathematical models of ideal and real reactors. Instills the skills to calculate and analyze the material and thermal balances of chemical processes, to describe the elements of technological schemes, to analyze the models of CTS.	6	PO2 PO4 PO5 PO6
			Regularities of technological processes	Considers the theoretical foundations of chemical technology, the General characteristics of chemical processes, thermodynamic analysis of CTS, restrictions in the principle of Le Chatelier, the kinetics of homogeneous and heterogeneous chemical processes, methods of intensification, factors limiting chemical processes. Teaches analysis of physical and chemical laws of chemical processes, technological schemes, calculation of the equilibrium composition of the reaction mixture and the material balance of the process.		PO2 PO4 PO5 PO6
	BD	EC	Processes and apparatuses of chemical technology	Studies the basics of chemical technology processes: hydro-mechanical, mechanical, processes; basics of heat transfer; evaporation; basics of mass transfer, mass transfer processes - absorption; simple distillation and rectification; extraction; adsorption; drying; dissolution and crystallization. Forms the skills of solving problems in the calculation of hydro-mechanical, heat and mass transfer processes and mass transfer; the calculation of the main and auxiliary equipment in the design of chemical plants.	5	PO2 PO4 PO5 PO6 PO10
			Heat and mass transfer	Studies theoretical bases of processes of chemical technology, thermal processes, bases of heat transfer, industrial methods of heat transfer in chemical equipment, evaporation, mass transfer processes, molecular and convective mass transfer, the basic equation of mass transfer. Systematizes knowledge of heat and		PO2 PO4 PO5 PO6 PO10

				<p>mass transfer processes, chemical technology, forms the skills to calculate the basic and auxiliary equipment of typical chemical industries;</p> <p>apply the knowledge gained in the team in the calculation and design of basic chemical equipment.</p>		
	SD	EC	Engineering Economics and Entrepreneurship	<p>Studies social production - the basis of the development of society, the types of economic systems and the laws of the transition economy, the essence and mechanism of the market economy, the basics of the theory of supply and demand, entrepreneurship, costs and income of the enterprise. Teaches independently to make informed decisions based on economic calculations, to clearly formulate conclusions and suggestions.</p>	3	PO1 PO2 PO4 PO10
			Organization of production and management	<p>Studies the content and distinctive features of the organization of technological production and management in market economy conditions, the role of production organization and management in the intensification of the chemical industry. Teaches himself to make informed decisions, taking into account the calculations, to clearly formulate conclusions and proposals for the results obtained. Describes the main economic categories and patterns of economic development.</p>		PO1 PO2 PO4 PO10
	BD	EC	Biochemistry	<p>Studies biochemical objects biochemical studies - static and dynamic, functional and physiological. Discusses the concepts of assimilation and dissimilation, anaerobic metabolism of carbohydrates and plant respiration, fermentation processes, oxidative and metabolic processes, conditions of reversibility of enzymatic reactions. It forms the ability to analyze biochemical processes in biological objects, independently organize and conduct experiments to study biochemical processes.</p>	3	PO2 PO9 PO10
			Industrial organic chemistry	<p>It studies the types of chemical bonds in molecules of organic compounds. Examines the methods of production, chemical properties and the use of organic compounds: hydrocarbons and derivatives; oil, its composition and methods of processing; polymers,</p>		PO2 PO7 PO8 PO10

				halohydrocarbons. It instills the ability to solve creative problems in organic chemistry, compare methods for the isolation and purification of organic compounds, solve environmental problems.		
Fundamentals of speciality	BD	EC	Content and Language Integrated Learning	Studies basic terms used in inorganic technology in three languages. It considers the characteristics of the main chemical-technological processes, finished products, raw materials and production wastes, used equipment in Russian, Kazakh and English. It allows you to get the skills of a free dialogue on professional topics, to understand and translate annotations and small texts on the subject of the specialty.	4	PO1 PO3 PO7 PO9
			Chemical industry of Kazakhstan	Studies the chemical industry of Kazakhstan, the raw material base and the principles of classification of raw materials for the chemical industry by industry. Examines the production of organic and inorganic synthesis, silicate and ceramic materials, mining and processing factories for the preparation of mineral raw materials. Forms an understanding of the chemical industry and its development in Kazakhstan.		PO2 PO4
Fundamentals of applied Sciences	BD	EC	Energy - technological systems in the technology of inorganic substances	Studies ways of energy saving, energy technology systems, types of exergy. Considers a thermodynamic analysis of energy technology systems; ways to reduce fuel consumption and energy in the technology of inorganic substances, methods to improve the energy and environmental efficiency of the production of inorganic substances. Instills skills to carry out heat and power calculation and analysis of the operation of technological installations, the calculation of material and heat fluxes in heat-using devices.	4	PO5 PO6 PO8 PO9
			Heat transfer	Studies the laws of thermodynamic processes and cycles of thermal power and refrigeration units, heat transfer, the processes of spontaneous heat distribution in space, methods for calculating boiler installations, the composition and main characteristics of the fuel, methods for burning them. Forms the skills of calculating the material and heat fluxes in heat-		PO5 PO6 PO8 PO9

				using devices, analysis of thermodynamic cycles of heat and refrigeration machines.		
	BD	EC	The technique of experimental studies	Examines the planning of experimental work, stages of implementation, criteria for evaluating measurement results, accuracy and reproducibility of research results; the use of computers in research; chemical and physico-chemical methods of analysis. Teaches the selection and preparation of samples, the processing of research results and analysis and their interpretation; draw conclusions on the results of the experiment; evaluate the experimental error and the reliability of the results.	4	PO7 PO8 PO9
			Fundamentals of modeling chemical technology objects	Studies methods of modeling chemical-technological processes, a scheme for constructing mathematical models, methods for checking the adequacy of a model and an object, optimization of chemical-technological processes, principles of computer modeling of processes. It allows you to master the methods of implementing models of technological processes using computer-aided mathematical systems; the basics of processing the results of active experiments and optimal planning of experiments.		PO1 PO6 PO7 PO9
	BD	EC	Mineral raw materials of Kazakhstan	It considers the geographical location of mineral deposits of Kazakhstan, its varieties, evaluates the reserves of mineral raw materials, its properties, chemical and mineralogical composition, occurrence conditions and availability for development. It determines the ways to solve actual problems of processing Kazakh raw materials, the advantages and disadvantages of known methods for processing raw materials. Teaches you how to calculate the mineralogical composition of natural raw materials.	4	PO5 PO6 PO8
			Industrial raw material base of Kazakhstan	Studies the principles of classification of minerals, technological types of ores and differentiation of deposits according to the scale of reserves, features of geological and industrial assessment of nonmetallic mineral deposits, consumer requirements for the quality of raw materials. Teaches		PO5 PO6 PO8

				the evaluation of the most important industrial-genetic types of mineral deposits, the use of acquired knowledge in production activities.		
Fundamentals of scientific research	BD	EC	Industrial water treatment	Studies the main stages of industrial water treatment, wastewater of chemical enterprises. Considers the preliminary purification of water by the method of coagulation, liming, sedimentation and filtration, water desalination; methods for preventing scale formation in evaporation and boiler installations, methods for cooling the circulation water of heat exchange equipment. Teaches skills in wastewater treatment, the choice of a rational water treatment system.	4	PO4 PO8 PO10
			Physico-chemical methods of water purification	It characterizes natural waters, indicators of the quality of natural and process waters, requirements for the quality of water at chemical plants, methods of wastewater treatment. Considers the physico-chemical principles of the ion-exchange method of water desalination, membrane and thermal methods of water purification. Forms the skills of choosing a rational water treatment system taking into account the requirements, calculating and analyzing the stages of water preparation.		PO4 PO8 PO10
	BD	EC	Fundamentals of design and equipment of plants	Studies the design principles of industrial facilities, the main regulatory documents governing the design work; design stages; the use of programs for the optimal design of chemical-technological production, instrumentation technology design, basic process flow diagrams. Forms the skills to independently perform the calculation of the main, auxiliary equipment; perform engineering network design; placement of equipment and layout of production facilities.	6	PO4 PO5 PO6 PO7 PO10
			Layout solutions for designing equipment and enterprises	Studies the principles of layout solutions for designing equipment and enterprises of the chemical industry, the layout of production premises and the principles of placement of technological equipment, assembly study. Forms the skills to independently perform technological calculations of the main and auxiliary equipment, make models of chemical-technological		PO2 PO4 PO5 PO6 PO8 PO10

				processes, know the requirements for the organization of safe production of inorganic compounds, and estimate roughly the technical and economic efficiency of building a new production.		
Theory and technology of PMTRM	BD	EC	Technology of soda ash and soda products	Studies of raw materials, the concept and process conditions of the main stages of soda ash production by ammonia. Compare calcareous, ferritic and electrochemical diaphragm and mercury methods for caustic soda production. Allows you to acquire skills to justify the need for a cyclic scheme for the production of soda ash, to apply knowledge of phase equilibria in the system to determine the optimal conditions for the carbonization process.	7	PO4 PO5 PO8 PO10
			Technology of mineral fertilizers	Studies the physicochemical principles of phosphoric acid decomposition of natural phosphates, the physicochemical principles of obtaining ammonium phosphates, the technological schemes for the production of ammophos, especially the production of ammophosphate, nitroammophosphates and nitramofosok, the technology of liquid nitrogen and complex fertilizers. It forms the skills for choosing the optimal technological scheme for the production of ammophos, solving problematic issues of production, and evaluating the quality of complex mineral fertilizers.		PO4 PO5 PO8 PO9 PO10
	BD	EC	Theory of solutions	Studies the properties of aqueous solutions of inorganic compounds; solubility diagrams of water-salt systems; heat capacity of solutions, thermal effect of dilution processes, mixing, concentration of electrolyte solutions, crystallization from solutions. It forms skills to evaluate the results of calculating processes according to state diagrams, to control the technological process of processing halurgic raw materials, to apply knowledge of phase equilibria when performing experimental studies.	5	PO6 PO7 PO8 PO9
			Theory and technology of mineral-salt processes	Studies solubility diagrams of binary and ternary water-salt systems, the calculation of evaporation and crystallization processes using solubility diagrams. Examines		PO6 PO7 PO8 PO9

				technologies of salt, boric acid, mineral fertilizers by mineral-salt method, methods of separation of natural salts. It forms the skills for calculating salt crystallization processes using phase diagrams, using them in scientific research, choosing rational ways to process mineral raw materials.		
	BD	EC	Laboratory practicum on specialization 1	Studies the stages of students' research work, methods for analyzing the composition of raw materials and products, processing research results, formulating conclusions and formatting research results; processing of experimental data by formal kinetics equations. It forms the skills to correctly formulate the formulation of research tasks, conduct experiments, critically analyze research results, clearly formulate conclusions on the results obtained.	5	PO4 PO5 PO7 PO9 PO10
			Laboratory practicum on specialization 2	Studies the stages of students' research work, methods for analyzing the composition of raw materials and products, processing research results, formulating conclusions and formatting research results; processing of experimental data by formal kinetics equations. It forms the skills to correctly formulate the formulation of research tasks, conduct experiments, critically analyze research results, clearly formulate conclusions on the results obtained.	5	PO4 PO5 PO7 PO9 PO10
Cycle of special disciplines						
Elective component						
Fundamentals of speciality	SD	EC	Chemical technology of Inorganic substances	Considers the production of basic industrial gases, technology of ammonia, nitric acid, used catalysts, physical and chemical bases of production of sulfuric acid, hydrochloric acid, phosphorus, thermal and extraction phosphoric acid, production of phosphoric, nitrogen and potash fertilizers, condensed phosphates, chromium compounds. It forms the skills to choose raw materials and a rational technological scheme of production, to calculate the material and heat production flows.	7	PO4 PO5 PO6 PO7 PO8 PO9
			Technology of inorganic gases and acids	Studies technology of obtaining hydrochloric, phosphoric, sulfuric,	7	PO5 PO6 PO7

				nitric, boric acids, production of phosphorus, dry- and wet-process phosphoric acid, technology of sulfur compounds, production of industrial gases in the technology of inorganic substances, conversion of natural gas, obtaining ammonia and nitric acid, production of sulfuric acid from sulfur-containing gases. It forms the skills to choose rational technological schemes for the production of gases and acids.		PO8 PO9
Fundamentals of scientific research	SD	EC	Environmental problems in the technology of inorganic substances	Examines ways to reduce and eliminate harmful emissions, the properties of air polluting substances, methods for cleaning exhaust gases, gaseous and vapor impurities, used equipment. Analyzes the conditions for the release of wastewater into reservoirs, methods of disposal and processing of solid waste, the integrated use of raw materials components, methods of cleaning and recovery. Teaches to independently calculate the material balances of industrial waste treatment, to evaluate the effectiveness of various methods of industrial waste treatment.	4	PO6 PO8 PO9
			Environmentally safe technologies	Considers the relevance and importance of environmentally friendly (low-waste and waste-free) technologies, principles of organization of waste-free production: consistency, the integrated use of raw materials, the cyclical nature of material flows, environmental safety, combination and inter-industry cooperation of production. Forms the skills to independently calculate the material balances of industrial waste treatment; evaluate the effectiveness of various methods of cleaning industrial waste and recycling valuable components.		PO6 PO8 PO9
	SD	EC	Chemical kinetics and catalysis	Considers the kinetic analysis of simple irreversible, reversible and complex reactions, the method of determining the order and reaction rate constants, the relationship of kinetics and thermodynamics, the	5	PO2 PO6 PO7 PO10

				principles of activation in catalysis, the kinetics of catalytic reactions, poisoning, promotion, modification of the catalyst, scientific foundations of heterogeneous catalysis. Forms the skills of calculating the kinetic characteristics using mathematical methods, to determine the technological characteristics of solid catalysts.		
			Materials science	Studies of the structure of solid materials, the relationship between the structure and properties, the electrical conductivity of dielectrics, the essence of polymerization and polycondensation, magnetic permeability, properties of semiconductor materials, mechanisms of intrinsic and impurity conductivity. Allows you to master the methods of physico-chemical analysis of solids and materials, the determination of hardness and strength. Forms the skills to independently make informed decisions and draw conclusions.		PO4 PO7 PO8 PO10
	SD	EC	Extraction and ionexchange processes	Studies of extraction processes, distribution laws, methods of extraction and leaching, the mechanism of ion-exchange processes, chemical equilibrium between the ion exchanger and chemical compounds in aqueous solution, the sorption capacity of the ion exchangers, the effectiveness of the ion-exchange process. Forms skills in calculating extractors and ion exchange columns, applying the knowledge gained in leaching technology of uranium ores, calculating technological indicators of extraction and ion exchange processes.	5	PO2 PO6 PO8 PO10
			Technology of feed phosphates	Studies the production of feed precipitate, thermal and free from phosphate, monocalcium phosphate, diammonium phosphate and disodium phosphate. Describes the main processes associated with the production of food and feed salts and technological schemes of production. Forms the skills of assessing the composition and	5	PO4 PO5 PO7 PO8 PO9

				properties of feed phosphates, taking into account the requirements of the standards, propose new ways to obtain high quality feed phosphates.		
Theory and technology of PMTRM	SD	EC	Theoretical bases technology of inorganic substances	Studies of physico-chemical and thermodynamic characteristics of systems, approximate methods for calculating heat capacities, calculation of thermodynamic potentials, thermodynamics of gas-phase transformations, principles for improving chemical-technological processes in the technology of inorganic substances. Generates skills to use the thermodynamic characteristics of the state of the system to determine the likelihood and direction of the processes, to make decisions on the optimization and improvement of existing technologies.	5	PO4 PO5 PO7 PO9
			Theoretical bases of mineral and technogenic raw materials processing	Studies the thermodynamic probability of chemical-technological processes, theoretical substantiation of the processes of processing mineral and technogenic raw materials, the production of mineral fertilizers using industrial waste. It forms the skills to summarize the results of theoretical studies of chemical transformations, the improvement of existing industries processing mineral and technogenic raw materials and evaluate their effectiveness.	5	PO4 PO5 PO7 PO9
	SD	EC	Technology of mineral salts and fertilizers	Considers deposits of sodium and potassium-containing natural salts of Kazakhstan, physical and chemical bases and technological regimes of processing natural salts by halurgic and conversion methods, technological schemes for the production of mineral fertilizers, sulfates, chlorides and nitrates of sodium, magnesium and potassium. It allows the company to manage the technological process of obtaining mineral fertilizers and salts, to carry out material and thermal calculations of production.	5	PO5 PO6 PO8

			Technogenic chemical waste	Considers the characteristics of technogenic chemical wastes, chemical and mineralogical composition of solid chemical wastes, thermal neutralization of toxic industrial wastes, environmental problems in the processing and disposal of phosphorus-containing wastes, waste products from the production of phosphorus, phosphoric acid and phosphoric fertilizers. Forms skills to assess the composition of technogenic chemical wastes by chemical and physico-chemical methods of analysis.		PO4 PO5 PO7 PO8
Research module TIC	SD	EC	Electrotechnology in the production of inorganic substances	Studies the electrothermal production of inorganic substances, their safety, the principles of thermal calculation of electrical resistance furnaces; device, principle of operation and calculation of electric ore-smelting furnaces, calculation of the composition of the charge. Analyzes the processes occurring during electrothermal sublimation of phosphorus, production waste, agglomeration of small fractions, sintering process, production of calcium carbide, ferrosilicon and electrocorundum.	5	PO5 PO6 PO8 PO10
			Complex processing of technogenic waste	Considers technologies for the complex processing of chemical waste, the use of solid industrial waste from chemical production containing nutrients as additives in the production of mineral fertilizers, a comprehensive resource-saving technology for processing waste from the production of phosphorus, extraction phosphoric acid and fertilizers. It forms the skills to analyze technogenic chemical wastes, to solve problematic issues of processing technogenic wastes.		PO5 PO6 PO8 PO10
	SD	EC	Uranium chemistry and technology	Studies uranium extraction methods, uranium ore deposits in Kazakhstan, physicochemical principles of uranium ore leaching, instrumentation of all stages of uranium ore processing, sorption and extraction methods of uranium solutions, environmental safety of production. Forms the skills of calculating the technological indicators of the processes of	5	PO4 PO5 PO8 PO10

			processing uranium-containing solutions, refining and extraction of uranium concentrate, determining the optimal production parameters.		
		Nuclear chemical technology	Studies the chemistry of radioactive elements, chemical consequences of nuclear transformations, the nuclear fuel cycle, thermonuclear reactions, methods of utilizing the energy of nuclear reactors; neutralization of uranium industry wastes, environmental protection and radiation safety. It forms the skills to analyze scientific and technical problems and prospects for the development of nuclear chemical technology, to apply the knowledge gained in the field of uranium concentrate technology in professional activities.		PO4 PO5 PO8 PO10
SD	EC	Bases of scientific research (1)	Studies goal setting research in the field of technology of inorganic compounds. Examines the methods of physical and chemical research, the methodology of scientific and technical creativity, the methodology for choosing the direction of scientific research and assess the relevance of the topic. It forms the skills to independently perform experiments, process new data, including using mathematical methods, make informed decisions and draw conclusions on the results obtained.	5	PO4 PO5 PO7 PO9 PO10
		Educational practice	Acquaints with main production of inorganic substances, characteristics of raw materials, requirements for quality of raw materials and produced products. Forms skills of presenting main stages of inorganic compounds production according to individual task, requirements for quality of raw materials and products of a certain production, environmentally safe production.		
		Industrial practice 1	Allows practically consolidate basic laws of technology on chemical enterprises, main methods of mineral raw materials processing, secondary materials and wastes of production at enterprises producing mineral fertilizers, apply on practice knowledge of work of main and auxiliary technological equipment, requirements for environmental safety of production,		

				solving problematic production issues.		
			Industrial practice 2	Considers productions at chemical enterprises, technological schemes and regulations production of inorganic acids, salts and mineral fertilizers. Analyzes work of main technological equipment. Allows take possession practical skills of workshop management, working control panel production, maintain norms of technological regime; requirements for quality of produced products; compliance with safety regulations.		
			Pre-degree practice	Provides practical skills for detailed study and analysis of production technology, working principle and equipment, calculation of material and heat production flows. Allows acquire problem solving skills to suggest ways to eliminate them; production planning, introduction of new techniques and technology, opportunities to improve the economic performance of production.		
			Writing and defense of degree work (project)	Allows acquire practical skills in conducting an analytical review and patent search, doing experimental or project work, process, discuss research results and draw conclusions, independently represent the technology being investigated. Builds skills to choose ways to improve existing technologies and technological processes in order to ensure high quality produced products.		

Взаимосвязь результатов обучения и модулей образовательной программы бакалавриата «Химическая технология неорганических веществ»

	Наименование модуля	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
1	Higher Mathematics		V	V				V			
2	Higher Mathematics II		V	V		V		V			
	Probability theory and mathematical statistics										
3	Physics		V			V					
4	Physics II		V	V		V					

	ОСНОВЫ КВАНТОВОЙ МЕХАНИКИ										
5	Applied mechanics		V	V		V					
6	Engineering computer graphics		V	V		V	V				
7	Chemistry		V	V		V					
8	Physical and colloid chemistry		V	V		V					
	Analitical chemistry										
9	Industrial chemistry		V	V	V		V				V
10	Fundamentals of Chemical Technology		V	V		V		V		V	
	Regularities of technological processes										
11	Processes and apparatuses of chemical technology		V	V			V		V	V	V
	Heat and mass transfer										
12	Engineering Economics and Entrepreneurship		V		V				V		
	Organization of production and management										
13	Standartization, certification and metrology		V	V		V	V			V	
14	Biochemistry/		V	V		V		V	V		
	Industrial organic chemistry										
15	Introduction to the specialty		V	V		V		V			
16	Chemical technology of Inorganic substances		V		V	V	V		V	V	
	Technology of inorganic gases and acids										
17	Training Practice		V	V		V		V			
18	Technology of mining and preparation of mineral and secondary raw materials		V	V		V		V	V	V	
19	Content and Language Integrated Learning	V	V	V							V

	Chemical industry of Kazakhstan										
20	Industrial practice 1		V	V		V		V		V	V
21	Energy - technological systems in the technology of inorganic substances		V	V		V	V	V		V	
	Heat transfer										
22	The technique of experimental studies		V	V		V		V	V	V	
	Fundamentals of modeling chemical technology objects										
23	Mineral raw materials of Kazakhstan		V	V		V		V	V	V	V
	Industrial raw material base of Kazakhstan										
24	Industrial practice 2		V	V		V		V	V	V	
25	Industrial water treatment				V	V			V		
	Physico-chemical methods of water purification										
26	Fundamentals of design and equipment of plants		V				V	V		V	
	Layout solutions for designing equipment and enterprises										
27	Environmental problems in the technology of inorganic substances						V	V		V	
	Environmentally safe technologies										
28	Chemical kinetics and catalysis		V	V		V			V		
	Materials science										
29	Extraction and ionexchange processes		V	V		V		V	V	V	
	Technology of feed phosphates										
30	Theoretical bases					V		V		V	

	technology of inorganic substances										
	Теоретические основы электрохимии										
31	Technology of mineral salts and fertilizers		V	V		V		V	V	V	
	Основы технологии новых материалов										
32	Technology of soda ash and soda products				V	V	V	V	V	V	
	Химические источники тока										
33	Электротехнология в производстве неорганических веществ		V	V		V		V	V	V	
	Коррозия и защита металлов										
34	Theory of solutions		V	V					V	V	
	Технология гальванических покрытий										
35	Uranium chemistry and technology		V	V		V		V	V	V	
	Прикладная электрохимия										
36	Bases of scientific research (1)		V	V		V		V	V	V	
	Bases of scientific research (2)										
37	Laboratory practicum on specialisation 1		V	V		V		V	V	V	V
	Laboratory practicum on specialisation 2										
38	Predegree practice		V		V		V	V	V	V	V
39	Writing and defence of degree work (project) or passing a graded exam		V		V		V	V	V	V	V

ЛИСТ СОГЛАСОВАНИЯ
по Образовательной программе Технология неорганических соединений
шифр «6В071- Инженерия и инженерное дело»

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