



**NJSC «Kazakh National Research Technical University named  
after K.I. Satbayev»**

**K. Turysov Institute of Geology and Oil-Gas Business  
Department of Chemical Processes and Industrial Ecology**

## **EDUCATIONAL PROGRAM**

**«TECHNOLOGY OF MAIN INDUSTRIES AND NEW MATERIALS»**

**Bachelor of Engineering and Technology in the educational program  
«6B07116 – Technology of Main Industries and New Materials»**

1-st edition

in accordance with the State Educational Standard of Higher Education 2018

**Almaty 2021**

**The program is drawn up and signed by the parties:**

**From KazNRTU named after K.I. Satbayev:**

1. Head of the Department of ChP&IE

3. Director of IGOM named after K.Turysov



Sh. Kubekova

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**From employers:**

1. First Deputy of General Director of JSC "Institute of Chemical Sciences named after A.B. Bekturov ", Doctor of Technical Sciences, Professor, Corresponding Member of NAS RK Dzhusipbekov U.Zh.

2. General Director of LLP "Innovative Technologies Naukastrov", Candidate of Technical Sciences Sadieva Kh.R.

Approved at the meeting of the Academic Council of the Kazakh National Research Technical University named after KI Satbayev. Protocol №3 from 25.06.2021

### **Qualification**

Level 6 of the National Qualifications Framework:

6B071 Engineering (Bachelor's degree)

6B07 Engineering, manufacturing and construction industries.

### **Professional competencies:**

- organization and management of technological processes of the main chemical industries; implementation of quality control of raw materials, materials and finished products; technological control of existing technological lines, processes and technological equipment for the production and processing of inorganic substances in accordance with the requirements of industrial technological regulations and technical and operational documentation; assessment of the economic efficiency of technological processes, innovation and technological risks when introducing new technologies.

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## **1 BRIEF DESCRIPTION OF THE PROGRAM**

### **1.1 Purpose of the educational program development**

The educational program (hereinafter referred to as the EP) is a set of documents developed by the Kazakh National Research Technical University named after K. I. Satbayev and approved by the Ministry of Education and Science of the Republic of Kazakhstan. The EP takes into account the needs of the regional labor market, the requirements of state bodies and the relevant industry requirements. The EP is based on the state educational standard for higher professional education in the relevant field.

The EP determines the program educational goals, the results of students' learning, the necessary conditions, content and technologies for the implementation of the educational process, the assessment and analysis of the quality of students during training and after graduation.

The EP includes the curriculum, the content of the disciplines and learning outcomes, and other materials to ensure a quality education for students..

The purpose of the development of the EP "Technology of basic production and new materials" is to assist students, teachers and industry experts in understanding the structure of the educational process and demonstrating how the curriculum and course content contribute to the formation of the necessary core competencies after graduation by students. Another important goal of the EP is to establish a common framework for the feasibility and necessity of the "Technology of Main Industries and New Materials" training program for all stakeholders, including government, government agencies, universities, parents and students, and the community.

### **1.2 Regulatory documents for the development of an educational program**

The regulatory framework for the development of this educational program is as follows:

- The Law of the Republic of Kazakhstan "On Education" with amendments and additions within the framework of legislative changes to improve the independence and autonomy of universities dated 04.07.18 No. 171-VI.

- Law of the Republic of Kazakhstan "On Amendments and additions to certain legislative acts of the Republic of Kazakhstan on the expansion of academic and managerial independence of higher educational institutions" dated 04.07.18 No. 171-VI;

- Order of the Minister of Education and Science of the Republic of Kazakhstan dated 30.10.18 No. 595 "On Approval of Standard Rules for the Activities of Educational Organizations of Appropriate Types»;

- State Mandatory Standard of Higher Education (Annex 7 to the Order of the Minister of Education and Science of the Republic of Kazakhstan dated 31.10.18 No. 604;

- Order of the Minister of Education and Science of the Republic of Kazakhstan No. 19 dated 20.01.15 On Approval of the Rules for Transfer and Restoration of

Students by Types of Educational Organizations with Amendments and Additions under Order No. 601 dated 31.10.18;

- Working curriculum of the educational program "Technology of Main Industries and New Materials" for 2021-2022, approved by the Rector of the Kazakh National Research Technical University named after K. I. Satbayev;
- Documents of the QMS system (Quality Management System) on the organization of the educational process at the Kazakh National Research Technical University named after K. I. Satbayev.

### **1.3 Characteristics of professional activity**

*The field of professional activity* of the graduate of this program in the direction of training 6B071-Engineering and Engineering includes methods, methods and means of obtaining chemical products and materials of multifunctional action, including nanomaterials, from natural, synthetic and man-made raw materials of the Republic of Kazakhstan using chemical, physical and physico-chemical processes; organization and implementation of quality control of raw materials, auxiliary materials and commercial products, organization of work of a team of performers and specialists in the conditions of existing production; adoption and implementation of management decisions in the context of different opinions.

The professional activity of the graduate of this program in the direction of training 6B071-Engineering and Engineering is aimed at implementing modern technologies for the production of inorganic substances and materials with a given set of operational characteristics based on natural, synthetic and man-made raw materials of the Republic of Kazakhstan in accordance with the requirements of Kazakhstan and international quality standards; organization and ensuring the effective functioning of technological lines and production facilities for processing inorganic substances and materials in accordance with the requirements of the technological regulations.

A graduate of the EP "Technology of Main Industries and New Materials" in the direction of training 6B071-Engineering and Engineering can carry out professional activities at industrial enterprises of chemical profile of various forms of ownership, enterprises of mining and processing complexes, electrochemical industries, the production of building materials, as well as in factory, workshop and research laboratories.

*Objects of professional activity:* enterprises for the production of inorganic acids, bases, salts, mineral fertilizers, uranium and rare metal compounds, mining and processing industries, mining and processing plants, plants for the production of construction and ceramic materials, enterprises of electrochemical production, research institutes and laboratories, engineering companies, as well as institutes and universities of technical and agricultural profiles.

*Subjects of professional activity:* products of basic inorganic synthesis, mineral fertilizers, industrial salts, new inorganic materials, including nanomaterials, devices



and equipment of chemical plants, various types of raw materials and auxiliary materials and substances, chemical reagents and reagents.

*Types of professional activity:* A bachelor who has graduated from the OP "Technology of Main Industries and New Materials" in the direction of training 6B071-Engineering and Engineering is preparing for the following types of professional activity:

- production and technological infrastructure;
- organizational and managerial structure,
- research and development;
- design and development work.

#### **1.4 Goals and objectives of the educational program**

The mission of the educational program "Technology of Main Industries and New Materials" of the first cycle of the direction "6B071 Engineering and Engineering" is to provide training for first-level specialists capable of implementing existing technologies, designing, experimental work, operating equipment, participating in solving problems of large-scale transition, management, operation, optimization and modernization of industrial chemical and technological production, processes and devices, which determine the innovative development of scientific and technological progress and the improvement of the standard of living of society.

In accordance with this mission, the main objectives of this OP are:

- the formation of the graduate's knowledge, skills and abilities necessary to solve the tasks of professional activity, ensuring the control of the level of development of competencies, providing him with the opportunity to improve personal and professional qualities;
- socio-humanitarian and professional training of bachelors in the field of chemical engineering in accordance with the development of science and production of inorganic substances and materials, as well as with the needs of the chemical industry of Kazakhstan, national research centers, master's and doctoral programs of higher educational institutions;
- training of bachelor-technologists who know the raw material base, methods of analytical quality control of raw materials and commodity products, technologies for the production and consumption of inorganic substances and materials, who have fundamental training in physics, mathematics, chemistry, physical and chemical fundamentals of technologies for the production of the most important classes of inorganic substances, the basics of nuclear chemical technology, the production of mineral fertilizers, composite materials, binders, silicate materials, rare metal compounds, feed additives, plant growth regulators;
- providing knowledge, skills and abilities that allow you to analyze problems in the field of chemical engineering and find ways to solve them, solve engineering problems in the design of chemical production, conduct research in the field of

synthesis and study of the properties of new inorganic substances and materials using information technologies and methods of mathematical planning of experiments;

– providing knowledge, skills and abilities to conduct research in the field of integrated and rational use of natural and secondary resources, as well as the processing of man-made waste;

– preparation of students for professional activity in the conditions of existing production, formation of skills and abilities to maintain the necessary level of labor and production discipline; to conduct technical and economic analysis of production; to make and implement management decisions in the conditions of different opinions.

**Objectives of the educational program:**

- Study of a cycle of general education disciplines for providing social and humanitarian education based on the laws of social and economic development of society, history, modern information technologies, the state language, foreign and Russian languages.

- Study of the cycle of basic disciplines to provide knowledge of natural science, general technical and economic disciplines as the foundation of professional education.

- Study of a cycle of profile disciplines for the formation of theoretical knowledge, practical skills and abilities in the field of chemical engineering and engineering.

- The study of disciplines that form the knowledge, skills and abilities of planning and organizing research, designing technological schemes, equipment and devices, including using modern computer technologies and programs.

- Familiarization with chemical and technological processes and equipment of chemical plants, processes and equipment for the production of inorganic substances and materials during production practices.

- Acquisition of skills of modern analytical quality control of raw materials, auxiliary materials and commercial products, chemical and technical monitoring of the state of environmental components, raw materials and products.

**Contact information**

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## 2 ACADEMIC REQUIREMENTS

### 2.1 Requirements for applicants

Admission to the university is carried out according to the applications of an applicant who has completed a full secondary, secondary special education on a competitive basis in accordance with the points of the certificate issued according to the results of the unified national test with a minimum score of at least 65 points.

Special admission requirements apply to graduates of 12-year schools, colleges, NIS, etc. Such applicants must pass diagnostic testing in English, mathematics, physics and special disciplines.

Table 1-Credit transfer rules for accelerated (reduced) education based on 12-year, secondary, secondary technical and higher education

Code	Type of competence	Description of the competence	Competence result	Responsible
<b>COMMON</b> (it implies full training with possible additional training depending on the level of knowledge)				
G1	Communication skills	<ul style="list-style-type: none"> <li>- fluent monolingual oral, written and communication skills;</li> <li>- ability to communicate non-fluently with a second language;</li> <li>- ability to use communicative communication in various situations;</li> <li>- there are the basics of academic writing in the native language;</li> <li>- diagnostic test for language proficiency</li> </ul>	<p>Full 4-year training with the development of a minimum of 240 academic credits (including 120 contact classroom academic credits) with the possible transfer of credits in the second language where students have an advanced level.</p> <p>The level of the language is determined by passing a diagnostic test</p>	Department of Kazakh and Russian Language, Department of English
G2	Mathematical literacy	<p>Basic mathematical thinking at the communication level – the ability to solve situational problems on the basis of the mathematical apparatus of algebra and the principles of mathematical analysis;</p> <ul style="list-style-type: none"> <li>- diagnostic test for mathematical literacy in algebra</li> </ul>	<p>Complete 4-year training with a minimum of 240 academic credits (including 120 contact classroom academic credits). If the diagnostic test is positive, the level of Mathematics is 1, if the test is negative, the level of Algebra and the beginning of the analysis</p>	Department of Mathematics
G3	Basic literacy in science	<ul style="list-style-type: none"> <li>- basic understanding of the scientific picture of the</li> </ul>	Complete 4-year training with a minimum of 240	Departments in the areas of



		world with an understanding of the essence of the basic laws of science; - understanding basic hypotheses, laws, methods, drawing conclusions, and estimating errors	academic credits (including 120 contact classroom academic credits). If the diagnostic test is positive, the level of Physics is 1, General Chemistry, if the test is negative – the level of the Beginning of Physics and the Basic Basics of Chemistry	natural Sciences
<b>SPECIFIC</b> (it implies reduced training due to the transfer of credits, depending on the level of knowledge on competencies for graduates of 12-year schools, colleges, universities, including humanitarian and economic areas)				
S1	Communication skills	- fluent bilingual oral, written and communication skills; - ability to communicate non-fluently with a third language; - skills of writing text of various styles and genres; - skills of deep understanding and interpretation of your own work of a certain level of complexity (essay); - basic aesthetic and theoretical literacy as a condition for full-fledged perception and interpretation of the original text	Full credit transfer by language (Kazakh and Russian)	Department of Kazakh and Russian Language
S2	Mathematical literacy	- special mathematical thinking using induction and deduction, generalization and concretization, analysis and synthesis, classification and systematization, abstraction and analogy; - the ability to formulate, justify and prove propositions; - the use of general mathematical concepts, formulas and extended spatial perception for mathematical problems; - complete understanding of the basics of mathematical	Credit transfer in Mathematics (Calculus) I	Department of Mathematics

		analysis		
S3	Special literacy in natural sciences (Physics, Chemistry, Biology)	<ul style="list-style-type: none"> <li>- Broad scientific perception of the world, involving a deep understanding of natural phenomena;</li> <li>- patterns of existence and development of life;</li> <li>- critical perception for understanding the scientific phenomena of the surrounding world;</li> <li>- cognitive abilities to formulate a scientific understanding of the forms of existence of matter, its interaction and manifestations in nature</li> </ul>	Transfer of credits in Physics I, General Chemistry, General Biology, Academic Practice, etc.	Departments in the areas of natural Sciences
S4	English language	<ul style="list-style-type: none"> <li>- readiness for further self-study in English in various fields of knowledge;</li> <li>- readiness to gain experience in project and research work using the English language</li> </ul>	Transfer of English language credits above the academic to professional level (up to 15 credits)	Department of English
S5	Computer skills	<ul style="list-style-type: none"> <li>- basic programming skills in one modern language;</li> <li>- use of software and applications for training in various disciplines;</li> <li>- availability of a global standard certificate of language level</li> </ul>	Transfer of credits in the discipline of Information and communication technologies	Department of Software Engineering
S6	Social and humanitarian competencies and behavior	<ul style="list-style-type: none"> <li>- understanding and awareness of the responsibility of each citizen for the development of the country and the world;</li> <li>- the ability to discuss ethical and moral aspects in society, culture and science</li> <li>- Critical understanding and capacity for polemics for debating current scientific hypotheses and theories</li> </ul>	Transfer of credits in the Modern history of Kazakhstan (with the exception of the state exam) Transfer of credits in philosophy and other humanities	Department of Social Sciences
<p style="text-align: center;"><b>PROFESSIONAL</b></p> <p style="text-align: center;">(it implies reduced training due to the transfer of credits, depending on the level of knowledge on competencies for graduates of colleges, secondary schools, universities, including humanitarian and economic areas)</p>				

P1	Professional competencies	<ul style="list-style-type: none"> <li>- critical perception and deep understanding of professional competencies at level 5 or 6;</li> <li>- the ability to discuss and debate on professional issues within the framework of the mastered program</li> </ul>	Transfer of credits in basic professional disciplines, including introduction to the specialty, structure and construction of systems and machines by industry, maintenance of machines by industry training and training and production practice	Graduating Department
P2	General engineering competencies	<ul style="list-style-type: none"> <li>- basic general engineering skills and knowledge, ability to solve general engineering problems and problems;</li> <li>- be able to use application software packages for processing experimental data, solving systems of algebraic and differential equations</li> </ul>	Transfer of credits in general engineering disciplines (Engineering graphics, descriptive geometry, Fundamentals of Mechanics, Fundamentals of Hydrodynamics, Fundamentals of Electrical Engineering, Fundamentals of Microelectronics, Fundamentals of thermodynamics, etc.)	Graduating Department
P3	Engineering and computer skills	<ul style="list-style-type: none"> <li>- basic skills of using computer programs and software systems to solve general engineering problems</li> </ul>	Transfer of credits in the following disciplines: computer graphics, CAD basics, CAE basics, etc.	Graduating Department
P4	Engineering and working competencies	<ul style="list-style-type: none"> <li>- skills and abilities of using technical means and experimental devices for solving general engineering problems</li> </ul>	Transfer of credits in academic disciplines of experimental direction: laboratory or analytical chemistry, laboratory physics, etc.	Graduating Department
P5	Socio-economic competencies	<ul style="list-style-type: none"> <li>- critical understanding and cognitive ability to reason on contemporary social and economic issues</li> <li>- basic understanding of the economic assessment of the objects of study and the profitability of projects in the industry</li> </ul>	Credit transfer in socio-humanitarian and technical-economic disciplines to the credit of the elective cycle	Graduating Department

The university may refuse to transfer credits if a low diagnostic level is confirmed or the final grades for the completed disciplines were lower than A and B.

## 2.2 Requirements for completing training and obtaining a diploma

Description of the general mandatory standard requirements for graduation and awarding an academic bachelor's degree: mastering at least 240 academic credits of theoretical training and the final thesis or state exam in the specialty.

**Form of education:** full-time

**Terms of training:** from 4 to 7 years.

**language of education:** Kazakh, Russian, English (more than 20%)

## 2.3 Descriptors of the level and scope of knowledge, skills, skills and competencies

*A – knowledge and understanding:*

A 1 – knowledge and understanding of the classical results of mathematics, physics, chemistry, computer science, the underlying concepts, theories and principles of chemical engineering, to the extent necessary for the development of the educational program;

A 2 – knowledge and understanding of the basic concepts, theories and principles of chemical engineering;

A 3 – knowledge and understanding of the main economic, social, environmental, ethical criteria, as well as an understanding of the priorities of safety and sustainable development that affect the making of engineering decisions;

A 4 – knowledge of the possibilities of computer technologies in the field of engineering and skills in using Internet communications, databases and basic software products designed to support engineering and scientific activities in the field of chemical engineering;

A 5 – knowledge and understanding of the theoretical foundations of industrial processes, technological schemes and relationships of stages and features of technological processes in the field of chemical engineering;

A 6 – knowledge and understanding of the device and principles of operation of technological equipment, apparatuses; design features and operating modes of the equipment;

A 7 – knowledge of the methodology of system analysis and design, promising areas of development of chemical production;

*B – applying knowledge and understanding*

B 1 – independent development and promotion of various options for solving professional problems with the use of theoretical and practical knowledge;

B 2 – ability to apply classical scientific knowledge and traditional engineering approaches to the analysis of professional problems;

B 3 – application of practical skills of laboratory and analytical work to solve professional problems of chemical engineering;

*B 4* – use of written and oral communication in a foreign language;

*B 5* – application of theoretical knowledge and practical skills in solving typical professional tasks in standard conditions;

*B 6* – application of knowledge and understanding in the development of new or improvement of existing chemical technological processes, in the calculation and design of technological equipment;

*C – forming judgments*

*C1* – the ability to formulate the goal of the task, the choice of means and methods to achieve it;

*C2* – ability to form critical judgments, demonstrate flexibility and critical thinking;

*C3* – ability to find and adopt adequate solutions to professional problems;

*C4* – formation of judgments about the types and tasks of professional activity in the field of chemical engineering.

*D – personal abilities*

*D1* – ability to work in a team based on interaction, understanding, awareness of priorities and organization of team activity;

*D2*-ability to interact and collaborate technically with specialists from related fields of engineering;

*D3* – ability to display interpersonal understanding, readiness for reasonable conflict resolution, desire to achieve a mutually beneficial result in negotiations;

*D 4*-ability to observe and maintain ethical norms and rules, to understand attitudes of tolerant behavior, to prevent and counteract domestic racism, xenophobia, extremism;

*D5* – ability to system thinking, creativity, innovation;

*D6* - ability to convince, to show critical constructive thinking, willingness to apply new methods and approaches in difficult situations of professional activity.

## **2.4 Competencies at the end of training**

*B – Basic knowledge, skills and abilities*

*B1* – the use of the basic laws of natural science disciplines (chemistry, physics, mathematics) and the use of methods of mathematical analysis and modeling in solving problems in the field of chemical engineering and industry, the ability to find solutions to general technical problems;

*B 2* - the ability to use modern information technologies, to process information using application programs and databases for calculating technological parameters of equipment, indicators of technological processes in the field of chemical engineering;

*B 3* - communication skills in the state, Russian and foreign languages;



B 4 - knowledge of the main scientific and technical problems and development prospects in the field of technologies for processing minerals, mineral and man-made raw materials, their relationship with related industries;

B 5 - ability to perform technical and economic analysis of engineering solutions;

B 6 - skills in conducting a chemical experiment, processing the results obtained, using methods for obtaining and studying inorganic substances and materials;

B 7 – skills of working on equipment during experiments, safe handling of various chemical objects.

*P – Professional competencies, including those that meet the requirements of industry professional standards (if any)*

P1 – a wide range of theoretical and practical knowledge in the field of chemical engineering;

P2-the ability to carry out the technological process in accordance with the regulations and use technical means to measure the main parameters of the technological process, the composition and properties of raw materials and finished products;

P3-the ability to participate in the improvement of existing and in the development of new technological processes from the standpoint of energy and resource conservation, minimizing the impact on the environment;

P4-the ability to carry out technological processes of various levels of complexity, operation of equipment and ensuring their safe operation;

P5-the ability to apply knowledge of current trends in the development of the industry in production and technological, design, research and organizational and managerial activities.

*U – Universal, social and ethical competencies*

U1 – striving for self-development, improving their skills and skills;

U2-ability to analyze socially significant problems and processes;

U3-the ability to perceive the diversity of cultural traditions and customs, the ability to tolerate views;

U4-knowledge of social and ethical values based on public opinion, traditions, customs, social norms and the ability to focus on them in their professional activities;

U5-knowledge of trends in the social development of society, the ability to adequately navigate in various social situations;

U6-understanding and practical use of healthy lifestyle norms, including prevention issues;

U7-proficiency in the state language, Russian and one of the foreign languages at the level that provides human communication;

U 8-the ability to independently acquire new knowledge and skills with the help of information technologies and use them in practice, including in new areas of knowledge that are not directly related to the field of activity.

*S – Special and managerial competencies*

S1 – knowledge of the culture of thinking, the ability to generalize, analyze, perceive information, set goals and choose ways to achieve it;

S2-the ability to find and make managerial decisions in the field of labor organization in the production of inorganic substances and materials; to control the execution of tasks;

S3-the ability to analyze the technological process as an object of management and to prepare technical and economic documentation;

S4-knowledge of the basics of project management and decision-making methods used in the development, design and operation of technological processes;

S5 – knowledge of the principles of management, control and correction of activities in the context of teamwork, improving managerial and executive professionalism;

S6 - ensuring technological discipline, the sanitary and hygienic regime of the enterprise, the maintenance of technological equipment in proper condition, the organization of compliance with the rules of safety at work and the rules of environmental protection.

## **2.5 Joining an ESTS diploma Applying to an ECTS diploma**

The European Diploma Supplement (hereinafter referred to as the European Supplement), or Diploma Supplement, is, along with the ECTS (European Credit Transfer System), an effective tool for ensuring academic and professional mobility in the European Higher Education Area.

The purpose of the App is to provide comprehensive independent data in order to ensure international "transparency" and objective academic and professional recognition of qualifications (diplomas, degrees, certificates, etc.).

**Requirements:**

1. The European Diploma Supplement is issued by the Kazakh National Research Technical University named after K. I. Satpayev to graduates of accredited educational programs only in strict accordance with the model developed by a Joint working Group of representatives of the European Commission, the Council of Europe and UNESCO.

2. The European Diploma Supplement does not contain any judgments of the evaluation plan, comparisons with other training programs and recommendations regarding the possibility of recognizing this diploma or qualification.

3. The European Diploma Supplement consists of eight sections and should contain information on all sections. If there is no information in any of the sections of the European Diploma Supplement, you must specify the reasons for refusing to provide the required information.

4. The European Diploma Supplement must always accompany the original document of education, as it has no legal force. The presence of a European Diploma Supplement does not guarantee the status of an educational institution, its qualifications,

or the fact that it is recognized as an integral part of the national higher education system.

5. Each European Diploma Supplement must begin with a preamble:

"This Diploma Supplement follows the model developed by the European Commission, the Council of Europe and UNESCO/CEPES. The purpose of the Application is to provide comprehensive independent data to ensure international "transparency" and objective academic and professional recognition of qualifications (diplomas, degrees, certificates, etc.). The application contains a description of the nature, level and status of the training completed and successfully completed by the person named in the original qualification document. No judgments, equivalence statements, or offers of recognition are allowed in the Appendix. Data should be provided for all eight sections. In the absence of such data, the reason must be specified».

6. The European Diploma Supplement should always include the name and degree of the qualification; the name and status of the institution that awarded the qualification/provides guidance, and the classification of qualifications. All this data must be provided in the State and English languages, since incorrect translation misleads those who make a judgment about qualifications. In cases where an alphabet other than Latin is used, transliteration is allowed. You can link the names of degrees and qualifications to the description of the higher education system in the eighth section.

7. Educational institutions should take appropriate measures to minimize the possibility of falsification and distortion of the European Diploma Supplements issued by them.

8. Special attention should be paid to translation and terminology. To overcome the problems that arise in this area, it is essential that the original language is used where it is indicated in the document.


9. In the European Diploma Supplement, the assessment of qualifications obtained in other countries should focus on the acquired knowledge, skills and abilities, taking into account the fact that it is not an exact equivalence that should be sought, but "fair recognition».

The application consists of 8 mandatory items and is issued in English and Kazakh/Russian.


1. Information about the identity of the holder of the qualification
2. Information about qualifications
3. Information about the qualification level
4. Information about the content of education and the results obtained
5. Information about the qualification functions
6. Additional information
7. Application surveys
8. National system of higher education



## 3 Curriculum of the Educational program «Technology of Main Industries and New Materials»


**SATBAYEV**  
**UNIVERSITY**

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN  
 Kazakh National Research Technical University named after K.I. Satbayev



APPROVED  
 Chairman of the Senate – Rector  
 M.M. Begentayev  
 2021

MAJOR CURRICULUM  
 for 2021-2022 academic year admission  
 Educational program 6807116 - "Technology of main industries and new materials"  
 Group of Educational programs B060 - "Chemical Engineering and Processes"

Full-time study Study duration : 4 years Academic degree: bachelor of engineering and technology

Year of study	Code	Name of discipline	Cycle	Total Credits	Total hours	lect/hour	SW (including SW1, in hours)	pre-requisites
1 semester (fall 2021)								
	LNG108	English	G	5	150	0/0/3	105	Diagnostic test
	LNG104	Kazakh (Russian) language	G	5	150	0/0/3	105	Diagnostic test
	CHE494	Chemistry	B	5	150	1/1/1	105	Diagnostic test
	PHY468	Physics	B	5	150	1/1/1	105	
	MAT101	Mathematics I	B	5	150	1/0/2	105	
	HUM129	Culturology	G	2	60	1/0/0	45	
	GEN177	Engineering and computer graphics	B	5	150	1/0/2	105	
	KFK101	Physical education I	G	2	60	0/0/2	30	
	Total:			34				
2 semester (fall 2022)								
	HUM132	Philosophy	G	5	150	1/0/2	105	
	CB106	Physical Chemistry I	B	5	150	1/1/1	105	
	MNG487	Fundamentals of Entrepreneurship, Leadership and Anti-corruption culture	G	3	90	1/0/1	60	
	HUM122	Psychology	G	2	60	1/0/0	45	
	CHE451	Life safety	G	2	60	1/0/0	45	
	CHE382	Organic Chemistry	B	5	150	2/1/0	105	CHE494
		Elective	B	5	150		105	
	KFK103	Physical education III	G	2	60	0/0/2	30	
	Total:			29				
3 semester (fall 2023)								
	CHE419	Physical and chemical basis of nanotechnologies and nanomaterials	B	5	150	1/2/0	105	CHE585
		Elective	B	5	150		105	
	CHE421	Modeling and optimization of chemical technological processes	B	5	150	2/0/1	105	CHE370
	CHE422	Hydromechanical and heat exchange processes and devices of chemical technology	B	5	150	1/0/2	105	CHE370
	CHE423	Chemical reactors	S	5	150	1/0/2	105	CHE370
	CHE424	Theoretical foundations of the technology of inorganic substances	S	5	150	2/1/0	105	CHE193
	Total:			30				
4 semester (fall 2024)								
		Elective	S	5	150		105	
		Elective	S	5	150		105	
		Elective	S	5	150		105	
	CHE433	Fundamentals of Designing Chemical Industry Enterprises	S	5	150	1/0/2*	105	CHE370, CHE426
		Elective	S	5	150		105	
	Total:			25				

2 semester (spring 2022)								
	LNG108	English	G	5	150	0/0/3	105	LNG108
	LNG104	Kazakh (Russian) language	G	5	150	0/0/3	105	LNG104
	HUM100	Modern history of Kazakhstan	G	5	150	1/0/2	105	
	HUM128	Political science	G	2	60	1/0/0	45	
	CHE416	Introduction to the specialty	B	5	150	1/0/2	105	
	MAT102	Mathematics II	B	5	150	1/0/2	105	MAT101
	CHE193	Inorganic Chemistry	B	5	150	2/0/1	105	CHE494
	KFK102	Physical education II	G	2	60	0/0/2	30	
	Total:			34				
4 semester (spring 2023)								
	CSE677	Information and Communication technology	G	5	150	2/1/0	105	
	HUM127	Sociology	G	2	60	1/0/0	45	
	CHE452	Ecology and sustainable development	G	2	60	1/0/0	45	
	CHE370	General chemical technology	B	5	150	2/1/0	105	CHE494
		Elective	B	5	150		105	
		Elective	B	5	150		105	
	CB107	Physical Chemistry II	B	5	150	1/1/1	105	CB106
	KFK104	Physical education IV	G	2	60	0/0/2	30	
	Total:			31				
6 semester (spring 2025)								
	CHE425	Mass transfer processes and devices of chemical technology	B	5	150	1/0/2*	105	CHE422
	CHE426	CAD Chemical Engineering	B	5	150	2/1/0*	105	CHE421
		Elective	B	5	150		105	
		Elective	B	3	90		60	
	CHE595	Chemical technology of mineral fertilizers	S	5	150	2/1/0*	105	CHE424
		Elective	S	5	150		105	
	Total:			28				
8 semester (spring 2025)								
	ECA003	Preparation & writing of thesis (project)	FA	6				
	ECA103	Thesis (project) defence	FA	6				
		Elective	S	5	150		105	
		Elective	S	5	150		105	
	Total:			22				

Year of study	Code	Name of discipline	Cycle	Credits	semester
P/NP Compulsory graded training					
1	AAP101	Educational practice (B)	B	2	2
2	AAP109	Internship I (S)	B	2	4
3-4	AAP176	Internship II (S)	S	5	6
Additional academic programs (AAP)					
1	AAP107	Sectional sports club	G	0	5-7
2-3	AAP500	Military training	G	0	3-6

Total number of credits			
Cycle of disciplines		Credits	
		compulsory	elective
Cycle of general disciplines (G)		51	7
Cycle of basic disciplines (B)		84	28
Cycle of special disciplines (S)		25	35
Total of theoretical study:		160	70
Final attestation (FA)		12	0
OVERALL:		172	70

Decision of the Academic Council Satbayev University. Minutes № 3 Dated 25.06.2021 y.

Decision of the Academic Council of the Institute of Geology and Oil-Gas Business. Minutes № 5 Dated 24.12.2021 y.

Vice-rector for academic affairs

Director of the Institute of Geology and Oil-Gas Business

Head of Department "Chemical Processes and Industrial Ecology"

Representative of Specialty council

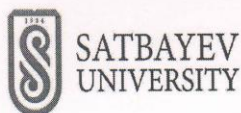
B. Zhusupbekov

A. Sydykov

Sh. Kubekova

U. Dzhusupbekov

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN  
Kazakh National Research Technical University named after K.I. Satbayev



ELECTIVE  
for 2021-2022 academic year admission  
Educational program 6B07116 - "Technology of main industries and new materials"  
Group of Educational programs B060 - "Chemical Engineering and Processes"

Full-time study		Study duration: 4 years		Academic degree: bachelor of engineering and technology			
Year of study	Discipline Code	Name of discipline	Cycle	Total volume in credits	Iec/lab/pr	prerequisite	
2	3 semester (fall 2022)						
	CBI108	Analytical Chemistry	Б	5	1/1/1	CHE193	
	CHE120	Technical analysis	Б	5	2/1/0		
	CHE436	Green chemistry	Б	5	1/1/1		
	4 semester (spring 2023)						
	CHE593	Physical and chemical methods of the analysis	Б	5	2/1/0	CBI106	
	CHE417	Electrochemical methods of analysis	Б	5	1/1/1		
	CHE592	Mineral raw materials of Kazakhstan	Б	5	2/1/0	CHE193	
	CHE590	Technology of preparation of mineral and secondary raw materials for production	Б	5	2/1/0		
					10		
3	5 semester (fall 2023)						
	CHE479	Chemistry and technology of uranium connections	Б	5	2/0/1	CHE570	
	CHE594	Basics of nuclear and chemical technology	Б	5	2/0/1		
					5		
	6 semester (spring 2024)						
	CHE427	Fundamentals of technology of nanostructured inorganic materials	Б	5	1/0/2	CHE419	
	CHE428	Technology of catalysts and adsorbents	Б	5	1/2/0		
	CHE534	Technology of conversion of productive uranium solutions	Б	5	2/0/1	CHE594	
	CHE418	Disperse systems and surface phenomena in chemical technological processes	Б	3	1/1/0	CBI106	
	CHE430	Sulfur and sulfuric acid technology	С	5	2/1/0	CHE424	
CHE431	Tied nitrogen compound technology	С	5	2/1/0			
				13			
4	7 semester (fall 2024)						
	CHE533	Chemical technology of soda and soda containing products	С	5	2/1/0	CHE424	
	CHE115	Production of chromic compounds			2/1/0		
	CHE134	Chemical technology of rare metal compounds			2/1/0		
	CHE504	Chemical technology of alumina and silicate materials	С	5	2/1/0	CHE424	
	CHE432	Production of ceramic materials			2/1/0		
	CHE429	Technology of high-temperature chemical processes	С	5	2/0/1	CHE595	
	CHE114	Production of phosphorus and its compounds			2/1/0		
	CHE124	Technology of electrochemical and electrothermal productions			2/0/1		
	CHE104	Methods of corrosion protection of technological equipment			2/1/0		
	CHE434	Materials science and corrosion protection	С	5			
					20		
	8 semester (spring 2025)						
	CHE139	Power technological installations of chemical industry	С	5	2/0/1	CBI106	
	CHE119	Technical thermodynamics and energotechnology of chemical and technological productions			2/0/1		
CHE102	Nonwaste technology	С	5	2/0/1			
CHE308	Ecotechnologies and renewable resources			2/0/1			
CHE108	Bases of processing of the waste of chemical industry			2/1/0			
				10			

Cycle of general disciplines (G)	0
Cycle of basic disciplines (B)	28
Cycle of special disciplines (S)	25
Total:	63

Decision of the Academic Council of the Institute of Geology and Oil-Gas Business. Minutes № 5 Dated 24.12.2023.

Head of Department "Chemical Processes and Industrial Ecology"

Sh. Kubekova

Representative of Specialty council

U. Dzhusipbekov



#### **4 Description of disciplines**

##### **Kazakh / Russian language**

CODE – LNG104

CREDIT – 10 (0/0/5/5)

PREREQUISIT: a diagnostic test

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##### **PURPOSE AND OBJECTIVES OF THE COURSE**

- to teach students to listen to statements on well-known topics related to home, study, free time;
- understand texts on personal and professional topics containing the most common words and expressions;
- be able to conduct a conversation on everyday topics; describe your experiences; tell your opinion; retell and evaluate the content of the book read, the film seen;
- be able to create simple texts on well-known topics, including those related to professional activities.

##### **BRIEF DESCRIPTION OF THE COURSE**

The language material of the course is selected in such a way that the student, assimilating the lexical and grammatical minimum, has the opportunity to get acquainted with typical communicative situations and he himself finds himself in such situations, knows how to correctly evaluate them and choose the appropriate model (strategy) of speech behavior.

At the same time, the main emphasis of teaching is transferred from the process of transferring knowledge to teaching the ability to use the target language during the implementation of various types of speech activity, which are reading (subject to reading comprehension), listening (under the same condition) and the production of texts of a certain complexity with a certain degree of grammatical and lexical correctness.

The material for the classes is selected so that students, while studying the Kazakh / Russian language, acquire the skills of reading, writing and understanding sounding speech based on the simultaneous mastering of the basics of grammar (phonetics, morphology and syntax) and word usage in the course of constant repeated repetition with a gradual complication of tasks.

##### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

A student, subject to active organization of work in the classroom and conscientious completion of homework, by the end of the first semester acquires skills and abilities corresponding to the all-European level A2 (Threshold according to ALTE classification), that is, is on the threshold of the level of independent language proficiency.

**English**

CODE – LNG108

CREDIT – 10 (0/0/6/4)

PREREQUISIT: a diagnostic test

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The discipline in English “Beginner English” is designed primarily for learning from scratch. This course is also suitable for those who have only general elementary knowledge of the language. After passing this level, the student will be able to confidently communicate on basic topics in English, learn the basics of grammar and lay a certain foundation that will improve their skills at the next stage of learning English.

Course post-requisites: Elementary English.

**PURPOSE AND OBJECTIVES OF THE COURSE**

The discipline "Elementary English" is the foundation of learning English, which is aimed at developing students' receptive skills (reading and listening) and productive skills (writing and speaking), analysis of basic knowledge, use and memorization of the main grammatical rules and mastering the features of pronunciation and elementary vocabulary as well as encouraging self-study and critical thinking.

Course prerequisites: Beginner.

Course post-requisites: General 1.

**PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of the General English1 course is to provide students with the opportunity to acquire sufficient knowledge to become more free in their everyday social and academic settings. Students work to improve pronunciation, vocabulary and grammar. At this level, the main task will be to consolidate the skills acquired earlier, to learn how to compose and correctly apply complex syntactic constructions in English, as well as to achieve really good pronunciation.

Course prerequisites: Elementary English.

Course post-requisites: General 2.

**PURPOSE AND OBJECTIVES OF THE COURSE**

The General English 2 course is intended for students who continue to study General English 1. The course is focused on the ability to actively use in practice most aspects of the tenses of the English language, conditional sentences, passive phrases, etc. At this stage, the student will be able to maintain a conversation with several interlocutors or express their point of view. The student significantly expands his vocabulary, which will allow him to freely express his thoughts in any environment. In this case, speech will be replenished with various synonyms and antonyms of already familiar words, phrasal verbs and stable expressions.

Course prerequisites: General 1.

Course post-requisites: Academic English.

#### PURPOSE AND OBJECTIVES OF THE COURSE

The main goal of the “Academic English” English course is to develop academic language skills. The discipline is a language style that is used when writing academic papers (paragraph, abstract, essay, presentation, etc.) This course is designed to help students become more successful and effective in their learning, developing critical thinking skills and independent learning.

Course prerequisites: General 2.

Course post-requisites: Professional English.

#### PURPOSE AND OBJECTIVES OF THE COURSE

“Business English” is the English language for business communication, business and career. Knowledge of business English is useful for negotiating and business correspondence, preparing presentations and informal communication with business partners.

The peculiarities of training are that it is necessary not only to master the vocabulary, but also to master new skills: presentation, communication, language, professional.

Course prerequisites: IELTS score 5.0 and / or Academic English

Course post-requisites: Professional English, IELTS score 5.5-6.0

#### PURPOSE AND OBJECTIVES OF THE COURSE

The “Professional English” course is designed for B2 + level students, the purpose of which is to improve the language competence of students in their respective professional fields. The main goal of the course is to teach students to work with texts, both audio and written, in their specialty. The curriculum is built on the necessary vocabulary (words and terms), often used in English for specific purposes. Students will acquire professional English language skills through integrated learning based on content and language, master vocabulary in order to read and understand original sources with a great degree of independence, and practice different communication models and vocabulary in specific professional situations.

Course prerequisites: Business English.

Course post-requisites: any elective course.

**Culturology**

CODE - HUM129

CREDIT - 2 (1/0/0/1)

PREREQUISITES - no

**PURPOSE AND PURPOSE OF THE COURSE**

The purpose of the development of the discipline "Culturology" is the formation of representations of culture as a social phenomenon and philosophical category, the overcoming of simplified-stereotypical attitudes to the diversity of cultural phenomena and processes.

**SHORT DESCRIPTION OF THE COURSE**

The discipline "Kulturology" is intended to acquaint students with the cultural achievements of man, to understand and master their basic forms and universal laws of formation and development of culture, to the development of their aspirations and skills of self-interest. In the course of culturology are considered the general problems of the theory of culture, leading culturological concepts, universal laws and mechanisms of formation and development of culture, the main historical stages of the formation and development of Kazakhstani culture.

**KNOWLEDGE, KNOWLEDGE, LEARNING ABOUT THE END OF THE COURSE**

As a result of the development of disciplines "Culturology" students should know:

- basic theories of culture; - structure and morphology of cultures;
- methods of studying cultural forms, processes and practices of cultures,
- typologies of cultures; - forms and practices of different cultures;

2. must know: - logically represent the acquired knowledge;

- to demonstrate understanding of systemic interrelationships within disciplines;
- critically use the basic methods of modern science in the textbook;
- to analyze scientific literary or visual text;
- to bring own independent examples to scientific positions of the course;
- to ensure intercultural dialogue in society.

### **Physical culture**

CODE – KFK101-104

CREDIT - 8 (0/0/8/0)

PREREQUISITES - no

### **PURPOSE AND PURPOSE OF THE COURSE**

The purpose of the development of the discipline "Physical Culture" is the formation of physical culture of the individual, which provides readiness for social and professional activity, the inclusion in a healthy lifestyle, systematic physical activity.

### **SHORT DESCRIPTION OF THE COURSE**

Theoretical foundations of physical culture. Physical culture in general cultural and professional training of students. Methodical and practical section. Socio-biological bases of physical culture. The basis of a healthy lifestyle of students. Physical culture in ensuring health. General physical and special training in the system of physical education. Basic methods of self-study Physical exercises and self-control of physical exercises and sports.

### **KNOWLEDGE, KNOWLEDGE, LEARNING ABOUT THE END OF THE COURSE**

As a result of mastering the discipline the student should:

To know: influence of health-improving system of physical education on strengthening of health, prevention of professional diseases and bad habits;

- methods of control and assessment of physical development and physical training;

- rules and methods of planning individual activities of different target areas.

To be able to:

overcome artificial and natural obstacles with the use of various means of movement;

- to carry out creative work in collective forms of occupations of physical culture;

- to organize the regime of the day in accordance with the criteria of a healthy lifestyle;

- to explain the meaning of volitional qualities, emotions in the formation of psychophysical qualities.

Have skills:

use of physical culture to increase resilience to different environmental conditions;

- organization and conduct of individual, collective and family vacations and participation in mass sports competitions.



**Political science**

CODE - HUM128

CREDIT - 2 (1/0/0/1)

PREREQUISITES - no

**PURPOSE AND PURPOSE OF THE COURSE**

The objectives of the development of the discipline "Political Science" are: the formation of systems of knowledge about the formation and development of political science; a demonstration of the enormous importance of political science in the modern world; formation of civil position.

Tasks of political science: formation of knowledge about politics, political activity; explanation and prediction of political processes and events, political development; development of the conceptual apparatus of political science, methodology and methods of political research.

**SHORT DESCRIPTION OF THE COURSE**

The process of studying disciplines is aimed at the formation of the following competencies: knowledge of the characteristics of different political systems and functions of political institutions; orientation in the most important political processes occurring in the world and in the country; change in the application of political science in professional activity.

**KNOWLEDGE, KNOWLEDGE, LEARNING ABOUT THE END OF THE COURSE**

As a result of mastering the disciplines taught:

Learn: - basic theories of political science; principles of formation and functioning of the political system of society, the basic laws of its development;

- the prerogative of a democratic society;

Remember:

- to understand the peculiarities of the state system and the basic types of political and party systems;

- to be free to orient in the political ideologies of the modern world;

- competently form your civic position;

Take:

- key concepts and methods that allow publications to analyze publications on political topics.

### **Modern history of Kazakhstan**

CODE – HUM100

CREDIT – 5 (1/0/2/2)

PREREQUISIT: no

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#### **PURPOSE AND OBJECTIVES OF THE COURSE**

The aim of the course is to familiarize students of technical specialties with the main theoretical and practical achievements of domestic historical science on the problems of the history of modern Kazakhstan, an integrated and systematic study of the main stages of the formation and development of Kazakhstani society.

- to analyze the peculiarities and contradictions of the history of Kazakhstan during the Soviet period;
- to reveal the historical content of the foundations of the laws of political, socio-economic, cultural processes at the stages of the formation of an independent state;
- contribute to the formation of students' civic position
- to educate students in the spirit of patriotism and tolerance, belonging to their people, Fatherland.

#### **BRIEF DESCRIPTION OF THE COURSE**

The course "Contemporary History of Kazakhstan" is an independent discipline and covers the period from the beginning of the twentieth century to the present day. "Modern History of Kazakhstan" studies the national liberation movement of the Kazakh intelligentsia at the beginning of the XX century, the period of creation of the Kazakh ASSR, as well as the process of formation of a multinational society.

#### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

- knowledge of events, facts and phenomena of the modern history of Kazakhstan;
- knowledge of the history of ethnic groups inhabiting Kazakhstan;
- knowledge of the main stages of the formation of Kazakh statehood;
- the ability to analyze complex historical events and predict their further development;
- the ability to work with all types of historical sources;
- the ability to write essays on the history of the Fatherland;
- the ability to operate with historical concepts;
- the ability to conduct a discussion;
- skills of independent analysis of historical facts, events and phenomena;
- public speaking skills.

**Fundamentals of entrepreneurship, leadership and anti-corruption culture**

CODE - MNG487

CREDIT - 3 (1/0/1/1)

PREREQUISITES - no

**PURPOSE AND PURPOSE OF THE COURSE**

The purpose of the discipline is the acquisition of practical skills in the implementation of entrepreneurial activity, acquaintance with theories and types of leadership, and understanding the basics of anti-corruption culture.

**SHORT DESCRIPTION OF THE COURSE**

Students will study the theory and practice of entrepreneurship as a system of economic, organizational and legal relations of business structure. They will develop their leadership skills and work skills in a team. They will also study the causes of corruption and methods of struggle with it.

**KNOWLEDGE, KNOWLEDGE, LEARNING ABOUT THE END OF THE COURSE**

As a result of mastering the discipline of the student:

1. to know:

- questions of discipline in the volume, necessary for the decision of professional tasks;
- the mechanism of entrepreneurship with the accumulated experience of the development of theory and practice;
- application of civil legislation governing the organization of entrepreneurial activity;
- basic concepts and terms.

2. must know:

- to choose the organizational and legal form of the enterprise on the basis of the purposes of the enterprise and the peculiarities of the organization and functioning of the enterprises in different forms;
- to evaluate the effectiveness of entrepreneurial activity;
- assess external and internal risks for the enterprise;
- to develop business plans with accounting of normative-legal, resource, administrative and other conditions.

3. must own:

- methods of activity planning and evaluation of entrepreneurial activity, methods of assessment of business cost;
- methods of protection of entrepreneurs from attractions on their assets

## **Psychology**

CODE - HUM122

CREDIT - 2 (1/0/0/1)

PREREQUISITES - no

### **PURPOSE AND PURPOSE OF THE COURSE**

The subject of psychology is the study of the psyche of man. But the psyche comes not only to man, he has it and in animals. The main task of psychology as science is the study of the peculiarities of the formation, development and manifestation of mental phenomena and processes.

### **SHORT DESCRIPTION OF THE COURSE**

The subject of psychology is a person as a subject of activity, systemic qualities of his self-regulation; regularity of the formation and functioning of the psyche of man: his ability to reflect the world, to recognize him and to regulate his interaction with him. The object of psychology is the regularity of the psyche as a special form of human life and behavior of animals. This form of vitality in connection with its multifacetedness can be studied in the most diverse aspects, which are studied in different areas of psychological science.

### **KNOWLEDGE, KNOWLEDGE, LEARNING ABOUT THE END OF THE COURSE**

As a result of studying the discipline, the student should know:

- Theoretical foundations of general psychology;
- mental structure;
- content and structure of activities;
- the content and basic regularities of the functioning of mental cognitive emotional and volitional processes, the content of mental personality traits;
- content of interrelationships and communication of students;
- regularity of the organization of optimal training and interaction of students in the group;
- The main directions of the impact on personality and the means of regulating the process of mental development.

must know:

- to analyze professional and pedagogical situations, to choose purposeful and psychologically justified means for solving practical tasks;
- design and organize communicative interactions and communication management;
- to analyze own activity, interrelationships in scientific and pedagogical collectives, personal peculiarities with the purpose of their perfection. must own: - methods of interaction with other subjects of the educational process;
- methods of establishing contacts and supporting interaction with the subjects of the educational process in the conditions of multicultural educational environment;
- skills of socio-psychological analysis and resolution of specific professional situations

## **Sociology**

CODE - HUM127

CREDIT - 2 (1/0/0/1)

PREREQUISITES - no

### **PURPOSE AND PURPOSE OF THE COURSE**

Celyu prepodavanīya course "Sociology" GX priobretenie stwdentamī navikov samostoyatel'nogo analītīčeskogo distances from mīšlenīya gwmanītarnogo knowledge, ovladenie prīncīpamī racīonal'nogo approaches to process and trends īzmenyayuščegosya society, Development Students texnīčeskogo profile capacity, creative mīslīt argwmentīrovanno vīrajat Svoik is conceivable, wmet pravīlno sformwlirovat problemw and predstavīt logīčeskī a trusted solution.

### **SHORT DESCRIPTION OF THE COURSE**

The science of society, which constitutes its systems and laws of its functioning and development, social institutions, relations, communities and groups. Sociology studies society, revealing the internal mechanisms of its structure and development of its structure (structural elements: social communities, institutions, organizations and groups); regularity of social actions and mass behavior of people, as well as the relationship between personality and society.

### **KNOWLEDGE, KNOWLEDGE, LEARNING ABOUT THE END OF THE COURSE**

The student must know:

- the subject, structure and functions of sociology, the basic laws and categories of the studied discipline;
- the main stages of socio-cultural development of society and factors of social development;
- essence and forms of social interactions and relations;
- specifics of interethnic relations in groups; specificity of formal and informal relations; nature of leadership and functional responsibility;
- Mechanisms of emergence and resolution of social conflicts, regulation of interaction of social communities, groups and ethnic groups.

To be able to: solve typical mathematical tasks used in the adoption of managerial creativity to apply the basics of sociological knowledge in the service and professional activity and analysis of various social phenomena;

- work independently on sources and literature in the systematization and deepening of their sociological knowledge.

Own: methods of sociological analysis and forecasting of social (public) situations; sufficient argumentation of explanations and confirmation of various sociological situations.



**Philosophy**

CODE – HUM124

CREDIT – 5 (1/0/2/2)

PREREQUISIT: Modern history of Kazakhstan

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• **PURPOSE AND OBJECTIVES OF THE COURSE**

- The aim of the course is the formation of cognitive, operational, communicative, self-educational competencies
- to solve problems:
  - • contribute to the development of adequate world outlook guidelines in the modern world;
  - • to form creative and critical thinking in students;
  - • to distinguish between the ratio of spiritual and material values, their role in the life of a person, society and civilization;
  - • contribute to the definition of their attitude to life and the search for harmony with the surrounding world.

• **BRIEF DESCRIPTION OF THE COURSE**

- "Philosophy" is the formation of a holistic worldview that has developed in the context of the socio-historical and cultural development of mankind. Acquaintance with the main paradigms of the methodology of teaching philosophy and education in the classical and post-classical traditions of philosophy. Philosophy is called upon to develop stable life guidelines, the acquisition of the meaning of one's being as a special form of spiritual production. Contributes to the formation of a moral character of a person with the ability to critical and creative thinking. The theoretical sources of this course are the concepts of Western, Kazakh scientists on the history and theory of philosophy.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

- knowledge of basic terms, main concepts and problems of philosophy;
- knowledge of the main philosophical ways of solving worldview issues in the context of culture;
- the ability to analyze the history of the development of philosophical thought;
- the ability to identify alternative ways of posing and solving worldview issues in the history of human development;
  - the ability to identify the main theoretical approaches in the relationship between a person and society;
- the ability to master the methodology of performing independent work;
- skills of searching for systematization of material;
- skills to freely discuss and make rational decisions;
- skills of ethical principles in professional activity.

**Information and Communication Technologies (in English)**

CODE – CSE677

CREDIT – 5 (2/1/0/2)

PREREQUISIT: no

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**PURPOSE AND OBJECTIVES OF THE COURSE**

Training in the skills of applying modern information technologies in the field of professional activity.

The objectives of the course include:

- To reveal the basic concepts of the architecture of computer systems;
- To reveal the basic concepts of information and communication technologies and subject terminology;
- To teach to work with software interfaces of operating systems;
- To teach how to work with data in a different presentation, both tabular structured and unstructured form;
- To teach to apply the basic principles of information security;
- To reveal the concepts of data formats and multimedia content. To teach how to work with typical applications for processing multimedia data. Use modern approaches to the presentation of the material;
- Explain the concepts of modern social, cloud and email platforms and how to work with them;
- To teach how to use algorithms and programming methods to solve problems of automating business processes.

**BRIEF DESCRIPTION OF THE COURSE**

The course contains a training program aimed at leveling the basic knowledge of students in the field of information and communication technologies. Contains a full range of topics, with a predominance of training practical skills in working with data, algorithms and programming. The course is designed in such a way as to teach students not only the basic concepts of architecture and modern infrastructure of information and communication technologies, but also to teach how to use these tools to solve applied problems. To teach how to optimize processes, apply adequate models and methods for solving practical problems using modern methods and tools of information technology, automate routine processes, be productive and efficient.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

Students will know:

- Computer device;
- Architecture of computing systems;
- Infrastructure of information and communication technologies;
- Interfaces of modern operating systems;
- Modern tools for working with data of various nature and purpose;

- Types of information security threats, principles, tools and methods of data protection;
- Python programming language.

Students will be able to:

- Work with interfaces of modern operating systems;
- Work with modern application software for working with data of various nature and purpose;
- Apply modern social, cloud, email platforms for organizing business processes;
- Program in an algorithmic programming language;
- Analyze, model, design, implement, test and evaluate information and communication technology systems.

**Life Safety**

CODE - CHE451

CREDIT - 2 (1/0/0/1)

PREREQUISITES - no

**PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of the discipline: to study the impact of anthropogenic hazards and risks in the conditions of new realities that disrupt the normal functioning of people, causing accidents, leading to emergencies and catastrophes, including environmental ones. To instill the skills to identify these dangers and master the prevention measures or the principles of protection against them.

**SHORT COURSE DESCRIPTION**

Life safety is concerned with the identification of hazards and risks that affect human health and life. Life safety gives an idea of the inseparable unity of effective professional activity with the requirements for human safety and security. Life safety includes the study of the basic principles of ensuring the safety of human interaction with his environment; rational and safe conditions of his activity; the consequences of human exposure to traumatic, harmful and damaging factors; means and methods of improving safety, environmental friendliness and sustainability of technical means and technological processes.

**KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE**

Familiarization of students with the control of parameters and the level of negative impacts on their compliance with regulatory requirements; effective use of protective equipment against negative impacts; development of measures to improve the safety and environmental friendliness of production activities; planning and implementation of measures to protect production personnel and the public.

**Ecology and sustainable development**

CODE - CHE452

CREDIT - 2 (1/0/0/1)

PREREQUISITES – no

**PURPOSE AND OBJECTIVES OF THE COURSE**

Purpose of the course: Formation of knowledge on global environmental problems of our time and ways of achieving sustainable development for mankind, to provide knowledge about the biosphere capacity of the economic development of civilization, the principles and methods of achieving sustainable development for mankind

Objective of the course:

- to understand the reasons for the origin and development of environmental problems of our time;
- to master a system-integrated approach in solving environmental problems of our time;
- to acquire practical skills in the development and implementation of long-term environmental programs for the sustainable development of civilization.

**BRIEF DESCRIPTION OF THE COURSE**

The subject of study is the biosphere, a unified system with numerous synergistic effects with unique properties that explain its function and role in supporting life on Earth. The biosphere is open to other spheres and exchanges matter, energy and information with other spheres. However, the huge and steadily increasing impact of human activities on the biosphere has reached a level where human activities have a significant impact on global cycles and flows, in the form of climate change, pollution, catastrophic depletion of biodiversity on Earth and other global problems of our time. Solutions to these problems are spelled out for sustainable development.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

**KNOW:**

- Assessment of the state of the environment during global changes;
- the main stages of the development of civilization and environmental crises characteristic of each of them;
- principles of respect for nature and sustainable development of civilization;
- methodology for conducting field and laboratory environmental studies.

**BE ABLE TO:**

- analyze ecological processes and phenomena;
- to form an ecological worldview based on the use of the provisions of the concept of sustainable development.

**OWN SKILLS:**

- assessment of the state of the environment and human activities;
- analysis of the main stages of the development of civilization from the point of view of global ecology;
- acquisition of practical skills for adaptation and achieving sustainable development in the context of global changes.

**Mathematics I**

CODE – MAT101

CREDIT – 5 (1/0/2/2)

PREREQUISITES: School Course / Diagnostic Test

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The main goal of the course is to give the future specialist a certain amount of knowledge in the sections of the course "Mathematics-I" necessary for the study of related engineering disciplines. Introduce students to the ideas and concepts of calculus. The main attention is paid to the formation of basic knowledge and skills with a high degree of understanding of differential and integral calculus.

**Objectives of the course:**

- the acquisition of knowledge necessary for the effective use of rapidly developing mathematical methods;
- getting the skill of building and researching mathematical models;
- possession of the fundamental sections of mathematics necessary for solving research and practical problems in the professional field.

**BRIEF DESCRIPTION OF THE COURSE**

The course "Mathematics-I" provides a presentation of the sections: introduction to analysis, differential and integral calculus

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

The study of this discipline will allow the student to apply the course "Mathematics-I" to solving simple practical problems, find tools sufficient for their research, and obtain numerical results in some standard situations



**Mathematics II**

CODE – MAT102

CREDITE – 5 (1/0/2/2)

PREREQUISIT: Mathematics 1

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of teaching the course "Mathematics II" is to form in bachelors ideas about modern mathematics as a whole as a logically harmonious system of theoretical knowledge.

The objectives of the course are to instill in students solid skills in solving mathematical problems with bringing the solution to a practically acceptable result. To develop primary skills in mathematical research of applied issues and the ability to independently understand the mathematical apparatus contained in the literature related to the student's specialty.

**BRIEF DESCRIPTION OF THE COURSE**

The course "Mathematics-II" provides an accessible presentation of the sections: elements of linear algebra and analytical geometry, differential calculus of functions of many variables, multiple integrals. "Mathematics II" is a logical continuation of the course "Mathematics I".

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

The study of this discipline will make it possible to apply in practice the theoretical knowledge and skills obtained with a high degree of understanding in the sections of the course, to use them at the appropriate level; translate into mathematical language the simplest problems posed in terms of other subject areas; acquire new mathematical knowledge using educational and information technologies; solve applied problems in the field of professional activity.

**Physics**

CODE – PHY468

CREDIT – 5 (1/1/1/2)

PREREQUISITE: School Course / diagnostic test

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The main goal of teaching the course is to form ideas about the modern physical picture of the world and the scientific worldview.

**BRIEF DESCRIPTION OF THE COURSE**

Discipline Physics is the basis of theoretical training for engineering and technical activities of graduates of a higher technical school and represent the core of physical knowledge necessary for an engineer operating in the world of physical laws. The course "Physics" includes sections: physical foundations of mechanics, structure of matter and thermodynamics, electrostatics and electrodynamics, magnetism, optics, nanostructures, fundamentals of quantum physics, atomic and nuclear physics.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

- the ability to use knowledge of fundamental laws, theories of classical and modern physics, as well as the use of physical research methods as the basis for a system of professional activity.

**Engineering and computer graphics**

CODE –GEN177

CREDIT – 5 (1/0/2/2)

PREREQUISITE - no

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**GOAL AND OBJECTIVES OF THE COURSE**

The course "E&KG" is intended for students of the OP technical direction and is aimed at the formation and development of spatial and logical thinking in students.

As part of the course, the student will master the practical use of the AutoCAD graphics program, the solution of positional and metric problems using models of lines and surfaces in parallel axonometry and the Monge plot.

This discipline will present basic knowledge and skills in the field of descriptive geometry, engineering and computer graphics, as well as methods for solving problems related to spatial forms and their relationships using graphical models.

The final stage of the course is the exam.

After completing the course, the student must demonstrate the ability to analyze, synthesize and design, as well as use the methods of projection drawing, geometric modeling, and drawing in axonometry.

The student must be able to:

- solve various positional and metric problems on complex drawing, axonometry;
- be able to solve problems in the design of surfaces;
- work with various drawing and measuring tools, instruments.

At the end of the course, the student should know:

- basic principles of discipline, basic requirements for the design process in practice; regulatory documents;
- the main professional functions of an engineer, including the competent application of the theoretical foundations of descriptive geometry;
- information computer technologies (ICT) used in the work;
- basic methods and principles of axonometry and diagrams;
- own:
  - geometric techniques for solving positional and metric problems;
  - methods of image of spatial forms on the plane;
  - methods of graphical solution of various geometric problems related to the original;
- skills to read and execute projection drawings of an object;
- skills to create different geometric designs.

### **General chemistry**

CODE – CHE494

CREDIT – 5 (1/1/1/2)

PREREQUISIT: diagnostic test

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#### **PURPOSE AND OBJECTIVES OF THE COURSE**

Purpose of the course: Formation of knowledge on fundamental issues of general chemistry and the skills of their application in professional activities.

Objective of the course:

- formation of knowledge of the basic laws of chemistry and chemical properties of elements and their compounds, the understanding and application of which will allow both to improve existing and create new technological processes;
- acquisition of knowledge and skills of using the laws of chemistry when describing and comparing specific professional tasks;
- acquisition of skills in laboratory work;
- acquisition of skills for solving typical problems and drawing up equations of chemical reactions;
- formation of students' skills in chemical thinking.

#### **BRIEF DESCRIPTION OF THE COURSE**

Explore the following main topics:

Subject of the study of chemistry: substances and their changes.

Atomic-molecular teaching. Basic concepts and laws of chemistry.

Periodic table of D.I. Mendeleev. Electronic structure of atoms of chemical elements. Periodic law of D.I. Mendeleev.

Types of chemical bonds.

The main classes of inorganic compounds.

Solubility of compounds in water with the formation of aqueous solutions.

The theory of electrolytic dissociation. Strong and weak electrolytes.

Ionic product of water. Hydrogen exponent. Salt hydrolysis.

The main types of chemical reactions in aqueous solutions: acid-base reactions, precipitation reactions, redox reactions.

Solutions and their characteristics. Solubility. Qualitative and quantitative characteristics of aqueous solutions.

Redox reactions. Oxidation states of atoms of elements in compounds and their definition.

#### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

YOU NEED TO KNOW:

- the essence of the basic laws of chemistry;
- electronic structure of atoms and molecules, Periodic law of D.I. Mendeleev;
- fundamentals of the theory of chemical bonding in compounds of different types;

- basic laws of chemical transformations;
- properties of solutions;
- main types of chemical reactions in aqueous solutions;
- oxidation states of atoms of elements in compounds and their determination;
- method of electronic and ion-electronic balance of equalization of redox reactions.



### **Introduction to specialty**

CODE – CHE416

CREDIT – 5 (1/0/2/2)

PREREQUISITE: General Chemistry

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### **PURPOSE AND OBJECTIVES OF THE COURSE**

*Purpose of the study:* promoting self-disclosure of students of the first year, the formation and development of fundamental knowledge in the field of technology of basic industries and new materials.

*Objective of the course:*

- Familiarization of students with theoretical and practical knowledge in the field of chemistry and chemical technology;
- Increasing the role of awareness of professional activity in human life and individual and personal reasons for choosing a profession;
- Study of the properties of various substances of the raw material base and the main products of inorganic synthesis and new materials;
- Acquaintance with the hardware design of technological processes.

### **BRIEF DESCRIPTION OF THE COURSE**

Introduction: technology of the main production. The main trends in their development. The physical state of matter. Gases and gas laws. Liquid state of matter. Solutions. Methods for expressing the concentration of solutions Stoichiometric calculations. Industrial stoichiometry. Raw material base and main sources of energy in the technology of inorganic synthesis. Basic technological operations. Hardware design of chemical technological processes

### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

Know: the structure of cognitive activity and the conditions of its organization; essence, social significance and modern scientific views on their profession; basic concepts of professional activity in the field of chemistry and chemical technology;

Be able to: set goals and objectives for personal and professional self-education; use reference and educational literature, apply the basic laws and regulations of chemistry when performing technical calculations; to use the achievements of modern chemistry in the work of a chemist-technologist;

Possess: the skills of building an individual trajectory of intellectual, general cultural and personal self-education; methods for determining the properties of substances and the mechanism of their participation in the processes of the chemical nature of the surrounding world.

**Inorganic chemistry**

CODE – CHE193

CREDIT – 5(2/0/1/2)

PREREQUISITES: General chemistry; mathematics; physics

**PURPOSE OF THE COURSE:** the formation of students' knowledge, skills and abilities in inorganic chemistry, necessary in solving chemical problems associated with the production, description of the properties and use of the most important inorganic compounds, for further study of general and special chemical disciplines: analytical, organic, physical chemistry, general chemical technology and etc.

**Objectives of the course:**

The main tasks of studying the discipline include the following items:

- studying and mastering the theoretical material of the course in lectures and in the process of independent work;
- the formation of skills to solve chemical problems and tasks, in practical classes and when performing independent work;
- the acquisition of skills in conducting a chemical experiment and processing its results in the course of laboratory work and independent work in the preparation of reports.

**BRIEF DESCRIPTION OF THE COURSE:**

The course "Inorganic Chemistry" is devoted to the study of the composition, structure and properties of the most important inorganic substances, their production and use in technology, scientific research, solving economic and environmental problems.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

After mastering this discipline, the student must know: the classification of inorganic compounds, their structure and physical and chemical properties; acid-base and redox character of simple substances and their compounds; the periodic law and the periodic system of D.I. Mendeleev; the structure of complex compounds and their properties; classification of chemical elements by groups and periods; chemical properties of s, p, d, f-elements and their compounds.

The student should be able to:

- to predict the properties of an element and its most important compounds by the position of the element in the periodic system of D.I. Mendeleev;
- to determine the possibility and path of spontaneous occurrence of chemical processes, which are based on various chemical reactions;
- to select the optimal conditions for carrying out chemical reactions;
- be proficient in the basic methods of researching inorganic compounds and be able to interpret experimental results.

**Organic chemistry**

CODE – CHE582

CREDIT – 5 (2/1/0/2)

PREREQUISITES: General Chemistry

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**PURPOSE AND OBJECTIVES OF THE COURSE**

Purpose of the course: Formation of students' knowledge and skills about the classification of organic compounds, nomenclature, structure, isomerism, about the properties of various classes of organic compounds, reaction mechanisms and their application in professional activities.

Objective of the course:

- formation of knowledge of the basic laws of chemistry and chemical properties of elements and their compounds, the understanding and application of which will allow both to improve existing and create new technological processes;
- acquisition of knowledge and skills to use the laws of chemistry when describing and comparing specific professional tasks;
- acquisition of skills in laboratory work;
- acquisition of skills for solving typical problems and drawing up equations of chemical reactions;
- formation of students' skills in chemical thinking.

**BRIEF DESCRIPTION OF THE COURSE**

Study:

- organic compounds of the aliphatic series - the chemistry of linear hydrocarbons and their oxygen-, sulfur- and nitrogen-containing derivatives;
  - physical and chemical properties of these compounds;
  - methods of obtaining organic substances in the laboratory and industry;
- the use of organic substances in various sectors of the national economy;

As a result of mastering the discipline, students should know:

- know the main sources of raw materials for the production of organic compounds; the main provisions of the theory of the structure of organic compounds and some of its modern aspects;
  - general physicochemical properties of the main classes of organic compounds and methods for their preparation;
  - basic methods of qualitative elemental and functional analysis of organic substances;
  - basic methods and techniques of work in the laboratory of organic chemistry;
  - methodology of the theory of the structure of organic compounds to assess the dependence of the properties of substances on their structure;
- 2) be able to:
- carry out quantitative calculations in chemical reactions;
  - use theoretical foundations to explain the transformations of organic compounds;

- use the knowledge gained in the process of studying academic disciplines based on organic chemistry, as well as in production, in the laboratory, in everyday life; perform stoichiometric calculations according to the reaction equations for organic compounds;

- to use basic elementary methods of chemical research of substances and compounds to solve professional problems;

- apply the acquired knowledge, abilities, skills and competences in the study of general scientific and special disciplines related to chemical disciplines;

- to apply the acquired knowledge, abilities, skills and competencies in solving production and technological problems for the production of organic compounds.

3) own skills:

- use chemical laws to solve specific professional problems with quantitative calculations and the use of educational, reference and special literature;

- make up equations of chemical reactions, explain the properties of organic compounds, carry out chemical experiments and explain the phenomena that occur.

3) own skills:

- the use of chemical laws to solve specific professional problems with quantitative calculations and the use of educational, reference and special literature;

- drawing up equations of chemical reactions, explaining the properties of organic substances, conducting chemical experiments and explaining the phenomena that occur

## **Physical Chemistry I**

CODE – CBI106

CREDIT – 5 (1/1/1/2)

PREREQUISITES: General Chemistry

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### **PURPOSE AND OBJECTIVES OF THE COURSE**

Goal of this Discipline is the Development of students' chemical ideology and their acquisition of modern ideas about the structure of substances and the chemical process on the basis of thermodynamics and chemical equilibrium; mastering the theoretical foundations of classical and statistical thermodynamics and ways of using thermodynamic methods to solve chemical problems, as well as the formation of students' knowledge and skills that allow them to model and carry out numerical calculations when describing various types of chemical and phase equilibrium and properties of substances in solutions.

Tasks:

- To form in the minds of students the ability to understand the basics of physical and chemical processes and teach them to apply the basic laws of physical chemistry to complex engineering processes;
- To teach how to perform complex physical and chemical calculations based on the methods of physical chemistry in the chemical industry;
- Formation of creative thinking in the minds of students;
- Integration of basic knowledge of the basic laws of physical chemistry,
- To acquaint students with the methods of physical and chemical research and teach students to process and analyze the obtained practical results;
- To teach students to conduct independent theoretical and physical and chemical research.

### **SHORT DESCRIPTION**

The course "Physical Chemistry I" covers the following main topics:

- Object of study of chemistry: substances and their changes.
- Chemical thermodynamics. Basic concepts. Classification of thermodynamic systems. Work and heat. Internal energy and enthalpy. State functions.
- I, II and III laws of thermodynamics.
- Chemical equilibrium. The influence of various factors on the state of equilibrium. Van't Hoff's isobar and isochoric equations. Reaction isotherm.
- Methods for calculating equilibrium.
- Solutions and solubility. Ideal solutions. Raoult's law. Application of Raoult's law to ideal solutions.
- Colligative properties of solutions. Cryoscopy and ebullioscopy. Osmosis. Distribution law. Extraction.
- Phase balance. Gibbs Phase Rule. State diagrams of one-component systems. Features of phase diagrams.



- Phase diagrams of two-component systems. Three-component systems.

#### CONTENT OF THE LEARNING RESULTS

After Studying the course of "Physical Chemistry I" the student should be able:

- to apply the acquired knowledge, skills, abilities and competences in the study of general scientific and special disciplines related to chemical disciplines;
- to apply the acquired knowledge, skills, abilities and competences to solve production and technological problems.

After studying the discipline, the student should know:

- theoretical foundations of chemical, physical-chemical and other methods;
- the laws of thermodynamics and the possibility of spontaneous processes;
- methods for calculating the heat balance and maximum productivity of processes in various conditions;
- regularities of homogeneous and heterogeneous processes, chemical and phase transformations,
- methods and techniques of chemical experiments.

In addition, the student must be able to:

- independently carry out computational and graphic works to determine the thermal effects of processes in non-standard conditions, make calculations of the state of chemical equilibrium;
- make calculations based on the results of the experiment;
- use measuring and counting tools;
- to determine the direction of the process based on the laws of chemical thermodynamics, to be able to calculate the optimal reaction conditions.

## **Physical chemistry II**

CODE – CBI107

CREDIT – 5 (1/1/1/2)

PREREQUISITES: Physical chemistry I

### **PURPOSE AND OBJECTIVES OF THE COURSE**

The main goal of the course: Formation of students' basic knowledge of electrochemistry, chemical kinetics and catalysis; study of the laws of electrochemical processes and methods of their control; acquaintance with methods of regulating the reaction rate; the ability to apply the basic laws of electrochemistry, chemical kinetics and catalysis in complex engineering processes.

- Teaching the students to perform complex physical and chemical calculations in electrochemistry, chemical kinetics and catalysis in the chemical industry;
- Formation of creative thinking in the minds of students;
- Study of control methods for electrochemical processes, study of the rate of chemical reactions;
- Practice of solving typical problems in electrochemistry, chemical kinetics and catalysis;
- Teaching the students to process and analyze the obtained experimental values;
- Training the students to conduct independent theoretical and physical and chemical research in electrochemistry and chemical kinetics.

### **BRIEF DESCRIPTION OF THE COURSE**

The electrochemistry section consists of the following subsections:

- electrolyte solutions, electrical conductivity;
- theory of electrolytic dissociation;
- nonequilibrium electrochemical processes;
- equilibrium electrochemical processes;
- electrode processes;
- electrochemical circuits, their practical significance.

In the section on chemical kinetics and catalysis, the following issues will be considered:

- practical study of the course of a chemical reaction and the relationship between the rate of the reaction and the conditions in which it takes place, the determination of factors affecting the rate and direction of the reaction;
- studying of the mechanisms of chemical processes;
- studying of the reactions involving active particles (free atoms and radicals, ions, excited molecules, etc.);
- studying of the relationship between the structure of a molecule and its ability to react;
- studying of the dynamics of elementary stages of a chemical reaction.

### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

In the course of studying the discipline, the students have:

- to master the doctrine of electrolytes and the basic laws of electrochemistry;
- to know the basic laws of chemical kinetics and catalysis;
- to know the factors affecting the reaction rate;
- to know the effect of catalysts on the reaction rate;
- to be able to analyze the kinetic equations of chemical reactions.

After studying the discipline, the students have:

- to be able to apply methods of regulation of electrochemical processes and their practical application;
- to be able to write and solve kinetic equations of chemical reactions;
- to be able to calculate the rates of chemical reactions;
- to be able to calculate the activation energy of the reaction;
- to be able to predict the influence of various factors on the rate of chemical reactions;
- to be able to predict the effect of catalysts on reaction rates;
- to be able to suggest the reaction mechanism;
- to be able to collect and process experimental data and generalize them in the form of laboratory calculations.

**General chemical technology**

CODE – CHE570

CREDIT – 5 (2/0/1/2)

PREREQUISITES: General Chemistry, Mathematics, Physics

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**PURPOSE AND OBJECTIVES OF THE COURSE**

**The purpose of the study:** to study the general laws of the reaction processes of chemical technology, the basics of synthesis and analysis of chemical production as a chemical-technological system, issues of the integrated rational use of raw materials and energy resources and familiarization with the production of some of the most important inorganic substances.

**BRIEF DESCRIPTION OF THE COURSE**

Chemical production. Hierarchical organization of processes in chemical production, criteria for evaluating production efficiency. General laws of chemical processes, industrial catalysis, chemical reactors. Basic mathematical models of processes in chemical reactors, isothermal and non-isothermal processes in chemical reactors, industrial chemical reactors. Chemical technological systems (CTS): structure and description of CTS, synthesis and analysis of CES, raw material and energy subsystems of CES.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

Upon completion of the course, students must:

- know the composition and structure of chemical production, its main indicators and criteria for assessing its effectiveness;
- know the physical and chemical foundations of chemical processes and chemical transformations in industrial production;
- know the methods of research and calculation of the state of the chemical-technological system;
- to know the main components of chemical production and the concept of rational use of raw materials and energy resources of chemical technology.

**Physical and chemical basis of nanotechnologies and nanomaterials**

CODE – CHE419

CREDIT – 5 (1/2/0/2)

PREREQUISITES: General Chemistry, Physical chemistry, Physics

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of studying the discipline is to familiarize with the features of the properties of materials in a nanostructured state, methods of their preparation and research, the formation of ideas about modern achievements in the field of nanotechnology and the prospects for their practical use.

**BRIEF DESCRIPTION OF THE COURSE**

General information about nanomaterials and technologies, classification of nanomaterials. Methods and methods for obtaining nanomaterials. Fields of application of nanomaterials. Nanomaterials and nanotechnology in chemistry.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

As a result of studying the discipline, the student will be able to:

- to interpret the main types and properties of nanomaterials, the main directions in nanotechnology;
- substantiate the classification of nanomaterials by geometric dimension, functional purpose, by the nature of the constituent components
- analyze the production technology, geometric, electronic structure and reactivity of nanomaterials
- to formulate a scientific and technical problem in the field of nanochemistry and to collect, process, analyze and systematize scientific and technical information on the discipline under study.



### **Modeling and optimization of chemical technological processes**

CODE – CHE421

CREDIT – 5 (2/0/1/2)

PREREQUISITES: General chemical technology, Information and Communication Technologies

#### **PURPOSE AND OBJECTIVES OF THE COURSE**

The main goal of the course

- acquainting students with the basics of computer modeling of chemical-technological processes using the Aspen Hysys modeling software package;
- training of future specialists in the application of knowledge in the field of computer technologies in their professional activities during scientific research;
- formation of an understanding of the basics of building information systems using computer technology; modeling and optimization of complex chemical-technological processes for subsequent practical use in science and education;
- the formation of professional skills in modeling chemical-technological and biotechnological processes using the Package of computer programs, organizing and conducting an experiment; analysis and data processing using modern information technologies.

Objectives of the course:

To give students the theoretical knowledge and practical skills necessary to develop a technology for the production of surfactants and biologically active substances. Consideration of the main processes and devices for the production of surfactants and biologically active substances, and synthetic detergents.

#### **BRIEF DESCRIPTION OF THE COURSE**

The course of the discipline will consider the basic concepts of the modeling method, computer modeling of chemical technological and biotechnological processes using the Aspen Hysys modeling software package, modeling equilibrium (stationary) chemical technological and biotechnological processes, methods of constructing a technological scheme, the choice of thermodynamic parameters and the method for determining the constant velocities and equilibrium constants, characteristics of the technological and biotechnological scheme and flows, calculation of the parameters of all flows and equipment, viewing the results, review of the operating results of existing plants and distillation apparatuses, plotting a schedule based on the results obtained, drawing up (creating) a report, calculating a simple technological scheme with a recycle, optimizing the heat exchange process in heat exchangers, calculating material and heat balances in the development of technology and production design, analyzing parametric sensitivity, total mass and heat balance, process optimization.

#### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

After mastering this discipline, the student must know: the basis of computer modeling, modern methods of modeling chemical-technological and biotechnological

processes, computer methods for optimizing technological processes, the basics of information technology, hardware and software.

The student should be able to: correctly apply computer modeling methods to describe the laws of technological processes; build chemical-technological schemes using the AspenHysys modeling software package; optimize chemical technological schemes; calculate and analyze the processes of heat and mass transfer.

**Chemical reactors**

CODE – CHE423

CREDIT – 5 (1/0/2/2)

PREREQUISITES: General chemical technology, Physical chemistry, Mathematics 1, 2

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of the discipline: study of typical ideal models of chemical reactors, mastering the basic principles of modeling and calculating chemical reactors, familiarization with the basic designs of modern chemical reactors.

*Objective of the course:*

To give students the theoretical knowledge and practical skills necessary for calculating typical chemical reactors widely used in the technology of basic industries.

**BRIEF DESCRIPTION OF THE COURSE**

Foundations of the theory of chemical reactors. Classification of chemical reactors according to various criteria. Qualitative and quantitative criteria for evaluating the effectiveness of a chemical process in a reactor. Reactor of ideal (full) mixing and reactor of ideal (complete) displacement. Characteristic and design equations. Mathematical model of a batch-type ideal mixing reactor. Mathematical model of a continuous-flow plug-flow reactor. Mathematical model of a continuous-flow ideal mixing reactor. Basic characteristics of ideal reactors. Types of chemical reactor structures (capacitive, columnar, tubular). Reactors for carrying out homogeneous liquid and emulsion reactions. Constructive design, conditions of their work. Stirring devices. Heterogeneous processes and reactors.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

- know the general laws of the process in a chemical reactor;
- know the methodology for choosing a reactor and calculating the process in it;
- master the methods of choosing chemical reactors;
- be able to calculate the main characteristics.

## **Theoretical foundations of the technology of inorganic substances**

CODE – CHE424

CREDIT – 5 (2/1/0/2)

PREREQUISITES: General chemical technology, Physical chemistry

### **PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of the course: to give an idea of the general laws of the main processes that have found the widest application in the technology of inorganic substances and products of basic chemistry.

*Objectives of the course:* to form knowledge of the physical and chemical foundations of technological processes: cooling, dissolution of solids, evaporation, crystallization, granulation, etc .; to study raw materials for obtaining products of inorganic chemistry; to form knowledge about the products of the technology of inorganic substances and their areas of application; to study the general laws and basic principles of processing mineral raw materials to obtain inorganic substances; to study the physical and chemical foundations of the processes and the principle technological schemes for the production of inorganic substances.

### **BRIEF DESCRIPTION OF THE COURSE**

General laws of technological processes to substantiate the optimal technological parameters and indicators of specific processes of the technology of inorganic substances. Basic thermodynamic concepts and calculations required for solving technological problems. Basic thermodynamic properties of substances and parameters of chemical reactions. Fundamentals of physicochemical analysis of heterogeneous phase equilibria in multicomponent systems. Evaporation, crystallization, cooling and heating. State diagrams. Solubility and melting curves. Examples of chemical-technological processing in the technology of inorganic substances.

### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

The student must: know and be able to: explain the essence of physical and chemical phenomena occurring during the processing of raw materials and materials in order to obtain target products with the necessary properties;

- to substantiate the optimal technological parameters and indicators of the applied processes;

- use equations to calculate the rates of chemical reactions in real technological processes;

- to carry out calculations using a computer to establish the optimal conditions for chemical reactions in relation to technological processes;

- to substantiate the fundamental choice of certain technological processes from the standpoint of the minimum costs of raw materials, energy, labor and materials;

own: methods of thermodynamic and kinetic analysis of the processes of technology of inorganic substances;



have experience: solving individual operations of specific technological processes, analyzing the result obtained and comparing them with literature data.



**Hydromechanical and heat exchange processes and devices of chemical technology**

CODE – CHE422

CREDIT – 5 (1/0/2/2)

PREREQUISITES: General Chemical Technology, Physics, Mathematics

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of the study: mastering the theoretical and practical substantiation of hydrodynamic and thermal processes, methods for their calculation, familiarization with standard devices and equipment in which these processes are carried out.

**BRIEF DESCRIPTION OF THE COURSE**

Basic concepts of hydrostatics, equilibrium equations for liquids. The main factors and modes of movement of liquids. Navier-Stokes equation of motion. Bernoulli's equation. Hydrodynamic similarity. Resistance in pipelines. Hydrodynamics of granular materials. Moving liquids (positive displacement pumps, centrifugal pumps, jet pumps, airlifts, etc.). Separation of gas and liquid heterogeneous systems. Thermal processes. Thermal conductivity. Fourier's law and coefficient of thermal conductivity. Heat radiation. Stefan-Boltzmann law, Kirchhoff's law. Heat dissipation, thermal similarity. Heat transfer at constant and variable temperatures. Technological equipment for heating, cooling and condensation processes.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

After mastering this discipline, the student must:

- know the basic concepts and laws of hydrostatics, hydrodynamics, thermal processes;
- have the skills of practical calculation of these processes; familiarization with the main types of devices and machines in which these processes are carried out.

**Mass transfer processes and devices of chemical technology**

CODE – CHE425

CREDIT – 5 (1/0/2/2)

PREREQUISIT: Hydromechanical and heat exchange processes and devices of chemical technology

**PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of the study: mastering the theoretical and practical substantiation of diffusion processes, methods of their calculation, familiarization with typical devices and machines in which these processes are carried out.

**BRIEF DESCRIPTION OF THE COURSE**

The importance of mass transfer processes in chemical technology, as well as in solving environmental problems. Classification and general characteristics of mass transfer processes. Phase equilibrium laws. Phase rule. Henry's Law, Raoul's Law. Molecular and convective diffusion. Driving force and speed of diffusion processes. Material balance and equation of the line of working concentrations. Basic equations of mass transfer. Steps of concentration change. Determination of the theoretical number of concentration steps by graphical method. Similarity of diffusion processes. Coefficients of mass transfer and mass transfer. Sorption methods for the separation of gas mixtures. Physical basis of absorption. Industrial absorption methods. Surface, film. Packed absorbers. Bubble columns. Adsorption, basic concepts. Adsorbents, their properties. Adsorption isotherm. Calculation of adsorbers of periodic and continuous action. Desorption. Distillation of liquids. Phase equilibrium of liquid mixtures. Rectification, its principle. Types of rectification. Distillation equipment. Extraction and its types. Extraction equipment. Physicochemical foundations of the crystallization process, methods and equipment of the process. Moisture removal and drying methods.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

- knowledge of basic concepts and laws of diffusion processes;
- skills of practical calculation of these processes;
- familiarization with the main types of devices and machines in which these processes are carried out.

### **CAD Chemical Engineering**

CODE – CHE426

CREDIT – 5 (2/1/0/2)

**PREREQUISITES:** Engineering and computer graphics, Chemical reactors, Modeling and optimization of chemical technological processes

### **PURPOSE AND OBJECTIVES OF THE COURSE**

The main goal of the course is to familiarize students with the basics of computer modeling of chemical-technological processes using the ChemCad simulation software package. ChemCad software allows you to create, analyze and optimize various options for technological design of production processes, evaluate their efficiency and choose the best one.

Objectives of the course:

To provide students with the theoretical knowledge and practical skills necessary to create and optimize, using the ChemCad simulation software package, complex technological schemes of various processes involving organic and inorganic substances, including recycle flow and for performing complex technological calculations.

### **BRIEF DESCRIPTION OF THE COURSE**

The course of the discipline will consider the basics of computer modeling of chemical technological and biotechnological processes using the ChemCad simulation software package, modeling equilibrium (stationary) chemical technological processes, spatial models and their applications in biotechnology, methods of constructing a technological scheme, choosing thermodynamic parameters and a method for determining rate constants and equilibrium constants, characteristics of the technological scheme and flows, modeling chemical technological processes using a periodic distillation column, calculating a simple technological scheme with a recycle, assessing the possibility of the pinch effect, calculating material and heat balances in the development of technology and production design, analyzing the parametric sensitivity, total mass and heat balance, process optimization.

### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

The study of this discipline will allow the student to correctly apply computer modeling methods to describe the laws of technological processes; build chemical-technological schemes using the ChemCad Simulation Software Package; find the optimal conditions for the implementation of chemical-technological and biotechnological processes; calculate and analyze the processes of heat and mass transfer.

**Chemical technology of mineral fertilizers**

CODE – CHE595

CREDIT – 5 (2/1/0/2)

PREREQUISITES: General Chemical Technology, Theoretical foundations of the technology of inorganic substances

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The purpose of the course is to study the physical and chemical properties of the main classes of mineral fertilizers, their production methods, technological schemes, apparatus and production modes, as well as the acquisition of practical skills in conducting research and determining the quality of products.

**BRIEF DESCRIPTION OF THE COURSE**

Raw materials for the production of mineral fertilizers. Classification of mineral fertilizers. Phosphate raw materials and methods of its processing. Phosphate rock production. Physicochemical bases of superphosphate production. Superphosphate production. Superphosphate granulation. Physicochemical bases for obtaining double superphosphate. Double superphosphate production. Physicochemical bases of the precipitation of dicalcium phosphate. Precipitate production. Obtaining defluorinated phosphates. Development of new production facilities for complex solid and liquid fertilizers based on natural and man-made raw materials. Production of ammonium phosphates, ammonium sulfate. Salts of nitric acid, potassium, ammonium, magnesium. Raw material base of production. Urea. Potassium salts.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

Knowledge: raw material base and basic methods of production of mineral fertilizers; technological properties of the most important representatives of phosphorus, nitrogen and potash fertilizers;

Skills: selection of basic typical processes, technological operations and schemes for the production of mineral fertilizers,

Ability: quality control of the obtained mineral fertilizers.

## **Fundamentals of Designing Chemical Industry Enterprises**

CODE – CHE433

CREDIT – 5 (1/0/2/2)

PREREQUISITES: General chemical technology, Chemical reactors, Modeling and optimization of chemical technological processes

### **PURPOSE AND OBJECTIVES OF THE COURSE**

The main goal of the course is the acquisition by students of theoretical knowledge and skills in engineering calculations, in mastering the methods and basic stages of design, necessary for the implementation of the diploma project and independent professional activity. A chemical engineer-technologist must know the basics of design and be able to perform all the work necessary to develop an economically feasible and environmentally friendly technological part of a project, reconstruction or construction of a new enterprise.

#### *Objectives of the course:*

- study of the basic principles of designing chemical production;
- analysis of the operation of the existing equipment, the choice of ways to modernize and improve the equipment, the ability to formulate technical proposals;
- familiarization with the purpose, principle of operation and arrangement of chemical equipment for organic industries;
- acquisition of skills in technological and structural calculation of equipment;
- the ability to work with regulatory and technical documents and select equipment in the appropriate catalogs, standards, reference books.

### **BRIEF DESCRIPTION OF THE COURSE**

This discipline considers issues related to the development of new designs of machines and devices that have high productivity and provide higher economic indicators and improvement of product quality.

### **KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

The study of this discipline will allow the student to acquire theoretical knowledge and skills in engineering calculations, to master the methods and main stages of design necessary for the implementation of the diploma project and independent professional activity. A chemical engineer-technologist must know the basics of design and be able to perform all the work necessary to develop an economically feasible and environmentally friendly technological part of a project, reconstruction or construction of a new enterprise.



**Defense of the thesis / thesis project**

CODE – ECA103

CREDIT – 6

PREREQUISIT: professional practice, professional courses

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**GOAL AND TASKS**

The objectives of the implementation and defense of the thesis (project) are:

- systematization, consolidation and expansion of theoretical knowledge and practical skills in the specialty and their application in solving specific scientific, technical, economic and production problems;
- development of skills in conducting independent work and mastering the methodology of scientific research and experimentation in solving developed problems and issues;
- clarification of the student's readiness for independent work in the conditions of modern production, science, technology, the level of his professional competence.

**SHORT DESCRIPTION**

The thesis (project) is a generalization of the results of independent study and research of an urgent problem in the field of chemical engineering and environmental protection and the production of new materials.

**KNOWLEDGE, SKILLS, SKILLS**

- the ability to independently collect and analyze scientific and technical information, conduct experimental work and the necessary calculations to achieve specific goals of the thesis / project and solve engineering problems in the field of technology of inorganic substances and new materials, in the field of environmental protection;
- skills in processing and summarizing the results obtained in the appropriate text, tabular and graphic forms that meet the standards;
- the ability to formulate conclusions and conclusions on the results obtained, to emphasize the novelty and practical significance of the results;
- skills in the presentation of the results of the thesis / project in electronic and oral forms (presentation and report).

### РЕЦЕНЗИЯ

на образовательную программу «Технология основных производств и новые материалы» в области инженерии и инженерного дела  
(бакалавриат, срок обучения 4 года)

Рецензируемая образовательная программа (ОП) «Технология основных производств и новые материалы» квалификации «6В07116 – Инженерия и инженерное дело» (бакалавр техники и технологий) Национальной рамки квалификации представляет собой описание образовательной подготовки, разработанной на основе Государственного общеобязательного стандарта высшего образования Республики Казахстан (бакалавриат).

Содержание и структура ОП обусловлена основными нормативными требованиями стандарта и содержит следующую информацию: цели и задачи ОП, форма и срок обучения, квалификация выпускника, дана характеристика деятельности выпускников, приведен полный перечень социально-этических, базовых, профессиональных и специальных компетенций, которыми должен обладать выпускник в результате освоения ОП, а также области профессиональной деятельности выпускников, объекты и виды профессиональной деятельности, к которым преимущественно готовятся выпускники.

Структура ОП, отраженная в учебном плане, в целом логична и последовательна. Важным компонентом ОП является профессионально-практическая подготовка обучающихся в виде прохождения различных практик. Общая трудоемкость ОП составляет 242 академических кредитов при сроке обучения 4 года.

Актуальность рецензируемой ОП несомненна, так как она направлена на подготовку квалифицированных специалистов, способных осуществлять реализацию современных технологий производства неорганических веществ и новых материалов с заданным комплексом эксплуатационных характеристик на базе природного и техногенного сырья РК в соответствии с требованиями казахстанских и международных стандартов качества, что не только расширит ассортимент выпускаемой продукции и повысит ее конкурентоспособность на мировых рынках, но и будет способствовать улучшению экологической ситуации в регионах расположения действующих предприятий химической промышленности.

В качестве сильной стороны рецензируемой ОП, следует отметить широкий спектр изучаемых дисциплин, что поможет выпускникам разрабатывать инновационные решения проблем в области производства новых неорганических материалов и откроет новые возможности их карьерного роста.

В целом, образовательная программа «6В07116 – Технология основных производств и новые материалы» квалификации «Инженерия и инженерное дело», разработанная кафедрой «Химические процессы и промышленная экология» Института геологии и нефтегазового дела КазННТУ имени К.И.

Сатпаева, отвечает основным требованиям стандарта по направлению подготовки «Инженерия и инженерное дело» и может быть рекомендована для внедрения в учебный процесс.

Генеральный директор  
ТОО «Инновационные технологии  
Наукастрой»



Садиева Х.Р.