

**NJSC «Kazakh National Research Technical University  
named after K.I. Satbayev»  
Institute of Chemical and Biological Technologies**

## **CURRICULUM PROGRAM**

**«CHEMICAL AND BIOCHEMICAL ENGINEERING»**



**Bachelor of Engineering and Technology  
in field of engineering and engineering business**

2-nd edition  
in accordance with the State Educational Standard of Higher Education 2018

**Almaty 2020**

Developed by:	Reviewed: meeting of the Institute's AC	Approved by: EMC of KazNRTU	Page 1 of 75
---------------	--	-----------------------------	--------------

The program is compiled and signed by the parties:  
from KazNRTU named after K.I. Satbayev:

1. Head of the Department of C&BT  G.Zh. Yeligbayeva
2. Director of the Institute of C&BT  Z.K. Tuiebakhova

Жұмыс берушілерден:

1. «А.Б. Бектуров атындағы химиялық ғылымдар институты» АҚ,  
ҚР ҰҒА корр-мүшесі, т.ғ.д., профессор  У.Ж.Джусипбеков
2. «Organic» мұнай өнімдерін сараптаудың тәуелсіз орталығы» ЖШС, Директоры  А.А. Калмуратова
3. «Қазақстан Қолданбалы Экология Агенттігі» ЖШС, бас маманы  
ҒТК Ғылыми хатшысы, т.ғ.к.  Ж.А. Дюсенова

Қ.И.Сәтбаев атындағы Қазақ ұлттық техникалық зерттеу университетінің Оқу әдістемелік кеңесі отырысында бекітілген. Хаттама №4 14.01.2020 ж.

### Qualification:

Level 6 of National Qualifications Framework:

- 6B071 Engineering and Engineering business (Bachelor)
- 6B07 Engineering, manufacturing and construction industries
- 6B051 Biological and related sciences (Bachelor)
- 6B052 Environment (Bachelor)
- 6B05 Natural sciences, mathematics and statistics

### Professional competence:

- Organization and management of technological processes of chemical production; quality control of raw materials and finished products; assessment of the economic efficiency of technological processes. Innovation and technological in the introduction of new technologies;

- operation and quality management of biotechnological production with the usage of biosynthesis, biocatalysis, gene and cell engineering; quality control of raw materials and products; obtaining, research and usage of enzymes, viruses, microorganisms, cell cultures of plants and animals, products of their biosynthesis and biotransformation;
- environmental management, environmental monitoring, environmental engineering, environmental design and expertise, assessment of environmental and economic efficiency and environmental risks.

## Content

1	BRIEF PROGRAM DESCRIPTION	5
1.1	The purpose of the development of educational program	5
1.2	Regulatory documents for the development of educational program	5
1.3	Specification of professional activity	6
1.4	Aims of the educational program	7
2	ACADEMIC REQUIREMENTS	11
2.1	Entry requirements	11
2.2	Requirements to complete the course and receive a diploma	15
2.3	Descriptors of the level and volume of knowledge, skills and competencies	15
2.4	Competence on completion of training	17
2.5	Further education policy Minor	19
2.6	ECTS Diploma Supplement	19
3	Major curriculum and elective disciplines of the Educational Program "Chemical and Biochemical Engineering"	22
4	Discipline description	28
	Attachment 1	73
	Attachment 2	74
	Attachment 3	75

## **1 BRIEF PROGRAM DESCRIPTION**

### **1.1 The purpose of the development of educational programs**

The educational program (abbreviated as “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 agencies and relevant industry requirements. EP is based on the state of educational standard for higher education in the relevant field.

EP determines program educational objectives, students' learning outcomes, necessary conditions, content and technologies for the implementation of the educational process, assessment and analysis of the quality of knowledge during and after study.

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

The purpose of the development of the study program “Chemical and Biochemical Engineering” is to assist students, teachers and industry experts in understanding the structure of the educational process and demonstrate how the curriculum and course content contribute to the formation of necessary core competencies after the graduation of learning. Also, an important goal of the EP is to justify the need of this program «Chemical and Biochemical Engineering» for all interested sides, including the government, state agencies, universities, parents and students, and the community.

### **1.2 Regulatory documents for the development of educational programs**

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

The legal framework for the development of this educational program consists:

- the Law of the Republic of Kazakhstan “About Education” with changes and additions within the framework of legislative changes to increase the self-sufficiency and autonomy of universities from 04.07.18, No. 171-VI;

- the 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” from 04.07.18, No. 171-VI;

- Order of the Minister of Education and Science of the Republic of Kazakhstan from 30.10.18, No. 595 “On Approval of the Model Rules for the Activities of Educational Organizations of corresponding types”;

- State compulsory standard of higher education (Annex 7 to the order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 188, No. 604);

- Order of the Minister of Education and Science of the Republic of Kazakhstan from January 20, 2015 No. 19 “On Approval of the Rules for Transfer and Reinstatement of Students by Type of Educational Organization with Amendments with additions” by order No. 601 from 10/31/18;

- The working curriculum of the educational program "Chemical and Biochemical Engineering" for 2019-2020, 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 in the Kazakh National Research Technical University named after K.I. Satbayev.

### 1.3 Specification of professional activity

The area of professional activity of the graduate of this program in the direction of preparation 6B071 - Engineering and engineering business includes methods, ways and means of obtaining organic and inorganic substances and materials of multifunctional action, as well as nanomaterials, from natural, synthetic and technogenic raw materials of the Republic of Kazakhstan with usage of chemical, physical and physical-chemical processes; synthesis, researching and usage of enzymes, viruses, microorganisms, cell cultures of plants and animals, products of their biosynthesis and biotransformation in bioconstructive, bioindustry, bioenergetic and bioreconstruction processes and technologies, organization and conduction of the quality control of raw materials and products, as well as ecological-regulatory design of production, including ecology monitoring service and environmental quality control in the field of "green" environmental protection.

Professional activity of the graduate of this program in the direction of training 6B071 - Engineering and engineering business is aimed at implementation modern technologies for the production of organic and inorganic substances and materials with a given set of operational characteristics based on natural, synthetic and technogenic raw materials of the Republic of Kazakhstan; on the implementation of technologies for synthesis of products with usage of biosynthesis, biocatalysis, gene and cell engineering in accordance with the requirements of Kazakhstan and international quality standards; planning, organization and management of services for monitoring of objects that pose a potential threat to the state of the environment, as well as for development of practical recommendations for regulation of the quality of the natural environment



in order to prevent the degradation of ecosystems, desertification and preservation of biological diversity.

Graduate at the end of the EP "Chemical and Biochemical Engineering" in the direction of training 6B071 - Engineering and engineering business will allow to carry out professional activities at industrial enterprises of chemical and petrochemical profile of various forms of ownership, enterprises of biotechnological production, as well as in the sector of environmental monitoring and ecological-regulatory projecting of enterprises of various industries.

Objects of professional activity: enterprises for the production of inorganic acids, bases, salts, mineral fertilizers, uranium and rare earth compounds, mining industries, national and foreign enterprises of the oil, gas and petrochemical industries, research institutes and laboratories, engineering companies, and also institutes and universities of biotechnological, biological, medical, agricultural and technical profiles; industrial enterprises and laboratories of the mining, metallurgical, oil and gas, chemical, agricultural, food and processing, microbiological, pharmaceutical and cosmetic industries, customs, sanitary and public utilities.

*Subjects of professional activity:* products of basic petrochemical, organic and inorganic synthesis, new inorganic materials, apparatuses and equipment of chemical and petrochemical plants, various types of raw and auxiliary materials and substances, chemical reagents; biological objects of microbial, plant, animal origin for usage in biotechnology, biologically active substances of organic and inorganic origin; biomass, installations and equipment for carrying out biotechnological processes based on natural and man-made raw materials, means of controlling the quality of raw materials and products; facilities that pose a potential threat to the state of the environment, to develop practical recommendations for rationing the quality of the environment.

*Professional activities:* Bachelor during graduation the educational program "Chemical and Biochemical Engineering" in the direction of specialty 6B071 - Engineering and Business Engineering will be prepared for the following professional activity:

- production and technology;
- organizational and managerial
- science research;
- projective constructive.

#### **1.4 Aims of the educational program**

The mission of the educational program Chemical and Biochemical Engineering of the first cycle of the direction 6B071 Engineering and Engineering business is to provide training for first-level specialists capable of implementing new technologies, designing, experimental work, operating equipment, and

participating in solving of problems of large-scale transfer, management, optimization and modernization of industrial petrochemical, chemical-technological, biotechnological productions, biotechnological processes, materials and equipment. All of this determines the innovative development of scientific and technical progress and the improvement of living standards of society.

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

- the formation of the graduate knowledge and skills necessary to solve the problems of professional activity, ensuring control of the level of development of competencies, which giving him the opportunity to choose the field of professional activity and improve personal and professional qualities;

- socio-humanitarian and professional training of bachelors in the field of chemical and biochemical engineering in accordance with the development of science and production of various industries, as well as the needs of the chemical, petrochemical and biotechnological industries of Kazakhstan, national research centers, magistracy and doctoral higher educational institutions

- preparation of bachelors - technologists who know the raw material base, methods of analytical control of the quality of raw materials and commercial products, technologies for obtaining and the field of consumption of inorganic and organic substances and materials, and complete fundamental training in physics, mathematics, chemistry, physical-chemical fundamentals of technology for synthesis the most important classes of organic and inorganic substances, the bases of nuclear chemical technology, the production of mineral fertilizers, composite materials, binders, silicate materials, compounds of rare earth metals, production of solvents, lacquers, dyes, synthetic fuels, starting compounds for the preparation of drilling fluids and tamponage solution, polymers, pharmaceuticals, food and feed additives, plant growth regulators;

- preparation of bachelors with knowledge of methods of critical analysis and who is able to use them practically in solving ecological problems in enterprises of various industries; who knows the technique of calculation the basic parameters of technological systems in the development of environmental protection measures, with the aim of justifying the choice of measures, as well as having appropriate training for laboratory research;

- preparation of bachelors who are able to organize and conduct technological processes at biotechnological enterprises, develop and design of biotechnological schemes at enterprises of various industries in accordance with the requirements of legislative and regulatory acts; conduct research in the field of biology, biotechnology and ensuring biological and chemical safety of the country;

- providing knowledge, skills and abilities to analyze problems in the field of chemical engineering and find ways to solve them, solve engineering problems of projecting chemical and petrochemical industries, conduct research in the field of synthesis and study the properties of new inorganic and organic substances and



materials with the usage of information technologies and methods of mathematical planning of experiments;

- providing knowledge, skills and abilities, that allows with help the methods of molecular and cellular biotechnology to conduct an experimental study of the properties and life processes of biological objects;

- analysis and selection of optimal conditions for the cultivation of biological objects; development of measures to improve and improve the efficiency of biotechnological methods and processes; application of the achievements of biotechnology for environmental protection;

- providing knowledge, skills and abilities that allow to navigate in various situations in solving environmental issues, the ability to solve engineering problems in the design of environmental measures for various sectors of the industrial sector of the economy of the Republic of Kazakhstan, to conduct research in the field of integrated and rational usage of natural and secondary resources, as well as the processing of industrial waste;

- preparation of students for professional activity in the current production conditions, the formation of skills and abilities to maintain the necessary level of labor and production discipline; on the technical and economic analysis of production; on the adoption and implementation of management decisions in the context of different opinions.

**Tasks of the educational program:**

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

- The study of the cycle of basic disciplines to ensure knowledge of natural science, general technical and economic disciplines as the foundation of vocational education.

- The study of the cycle of major disciplines for the formation of theoretical knowledge, practical skills in the field of chemical engineering and engineering business; in the field of biosynthesis, isolation, identification and analysis of products of biosynthesis and biotransformation, obtaining new biologics and identifying the best ways to use them; in the field of environmental protection and industrial safety.

- 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.

- Acquaintance with chemical-technological processes and equipment of chemical and petrochemical plants, processes and equipment of biotechnological production during the period of production practices.

- Providing of knowledge and skills of modern analytical control of the quality of raw materials and commercial products, chemical and technical, biochemical and biological monitoring of the state of environmental components, raw materials and products.

- Acquisition of skills for assessing the impact of economic and other activities on ecosystems, for environmental impact assessment and environmental risk assessment, for the preparation of environmental regulatory documents and all types of environmental reporting.

**Contact Information**

Gulzhakhan Yeligbayeva, Head of Department of Chemical and Biochemical Engineering, KazNRTU named after K.I. Satbayev

Satbayev st. 22, Main educational building, 1031-cab.

tel.: 8-727-257-7061

email: [Gulzhakh@yandex.ru](mailto:Gulzhakh@yandex.ru)

## 2 ACADEMIC REQUIREMENTS

### 2.1 Entry Requirements

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

Special requirements for admission to the program are used to graduates of 12-year-old schools, colleges, NIS, etc. Such applicants must undergo diagnostic testing in English, mathematics, physics and special disciplines.

Table 1 - Rules for reevaluation of credits for accelerated (reduced) training on the basis of 12-year, secondary, secondary technical and higher education

Cod e	Type of competence	Description of competence	Result of competence	Responsible person
<b>GENERAL</b>				
(Implies full education with possible additional ones 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 of not fluent communication with a second language</li> <li>- Ability to use communication in different situations</li> <li>- to have the basics of academic writing on native language</li> <li>- language level diagnostic test</li> </ul>	Full 4 year study with obtaining at least 240 academic credits (including 120 contact auditorial academic credits) with possible recredit on the second language where students have advanced level. The language level is determined by a diagnostic test.	Department of Kazakh and Russian languages, Department of English language
G2	Mathematical literacy	<ul style="list-style-type: none"> <li>- Basic mathematical intellect at the communication level</li> <li>- the ability to solve situational problems based on the mathematical apparatus of algebra and the beginning of mathematical analysis</li> <li>- diagnostic test on mathematical literacy</li> </ul>	Full 4 year study with obtaining at least 240 academic credits (including 120 contact auditorial academic credits). If the diagnostic test is passed good, the mathematics level is 1, if it is unsatisfactory - the algebra level and the beginning of analysis	Department of Mathematics

		in algebra		
G3	Basic Literacy in Natural Sciences	<ul style="list-style-type: none"> <li>- a basic understanding of the scientific picture of the world with an understanding of the essence of the basic laws of science</li> <li>- understanding of basic hypotheses, laws, methods, formulation of conclusions and assessment of errors</li> </ul>	Full 4 year study with obtaining at least 240 academic credits (including 120 contact auditorial academic credits). If the diagnostic test is passed good, the physics level is 1, General chemistry, with unsatisfactory result - the level of the Beginning of Physics and the Basic Foundations of Chemistry	Department in the areas of natural sciences
<b>SPECIFIC</b>				
(implies reduced education due to the recredit depending on the level of knowledge on competencies for graduates of 12-years schools, colleges, universities, including humanitarian and economic areas)				
S1	Communication skills	<ul style="list-style-type: none"> <li>- Fluent bilingual oral, written and communication skills</li> <li>- ability of not fluent communication with a third language</li> <li>- writing skills of different styles and genres</li> <li>- skills of deep understanding and interpretation of own work of a certain level of complexity (essay)</li> <li>- basic aesthetic and theoretical literacy as a condition for full perception, interpretation of the original text</li> </ul>	Full re-evaluation of languages (Kazakh and Russian)	Department of Kazakh and Russian languages
S2	Mathematical literacy	<ul style="list-style-type: none"> <li>- Special mathematical intellect with usage of induction and deduction, generalization and concretization, analysis and synthesis, classification and systematization, abstraction and analogy</li> <li>- ability to formulate, substantiate and prove provisions</li> </ul>	Re-evaluation of the discipline Mathematics (Calculus) I	Department of Mathematics

		<ul style="list-style-type: none"> <li>- the use of general mathematical concepts, formulas and extended spatial perception for mathematical problems</li> <li>- complete understanding of the basics of mathematical analysis</li> </ul>		
S3	Special literacy in natural sciences (Physics, Chemistry, Biology and Geography)	<ul style="list-style-type: none"> <li>- A broad scientific perception of the world, a fundamental understanding of natural phenomena</li> <li>- critical perception for understanding the phenomena of the world</li> <li>- cognitive abilities to formulate a scientific understanding of the forms of matter existence, its interaction in nature</li> </ul>	Re-evaluation on Physics I, General Chemistry, General Biology, Introduction to Geology, Introduction to Geodesy; Educational practice, etc.	Department 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</li> <li>- readiness to gain experience in project and research work using English language</li> </ul>	Re-evaluation of English language above academic level to professional ones (up to 15 credits)	Department of English language
S5	Computer skills	<ul style="list-style-type: none"> <li>- Basic programming skills in one modern language</li> <li>- Usage of software and applications for teaching various disciplines</li> </ul>	Re-evaluation of the discipline Introduction to information and communication technologies,	Department of Software Engineering
S6	Socio-humanitarian competences and behavior	<ul style="list-style-type: none"> <li>- understanding and perception of the responsibility of every citizen for the development of the country and the world</li> <li>- ability to discuss ethical and moral aspects in society, culture and science.</li> </ul>	Re-evaluation of Modern history of Kazakhstan (except for the state exam)	Department of Social disciplines
		<ul style="list-style-type: none"> <li>- critical understanding and ability to debate for debating on modern scientific hypotheses and theories.</li> </ul>	Recredit on philosophy and other humanitarian disciplines	

<b>PROFESSIONAL</b>				
(implies reduced education due to recredit depending on the level of knowledge on competencies for college graduates, AV schools, universities)				
P1	Professional competencies	<ul style="list-style-type: none"> <li>- critical perception and depth understanding of professional competencies at level 5 or 6</li> <li>- ability to discuss and argue on professional issues within the framework of the mastered program</li> </ul>	Re-evaluation on basic professional disciplines, including introduction to the specialty, engineering ethics, technology of robotic production, technological objects of automation, theoretical foundations of electrical engineering, technological measurements and devices, mathematical principles of control theory, electronic automation devices.	Graduate department
P2	General engineering competence	<ul style="list-style-type: none"> <li>- basic general engineering skills and knowledge, ability to solve general engineering tasks and problems</li> <li>- be able to use application packages for experimental data processing, solving systems of algebraic and differential equations</li> </ul>	Re-evaluation of general engineering disciplines (engineering graphics, descriptive geometry, fundamentals of electrical engineering, fundamentals of microelectronics.)	Graduate department
P3	Computer engineering competence	<ul style="list-style-type: none"> <li>- basic skills of the usage of computer programs and software systems for solving general engineering tasks</li> </ul>	Re-evaluation of the discipline of computer graphics, computer modeling and programming in the MatLab environment	Graduate department
P4	Socio-economic competence	<ul style="list-style-type: none"> <li>- critical understanding and cognitive abilities to argue on modern social and economic issues</li> <li>- a basic understanding of the economic evaluation of objects of the study and projects profitability.</li> </ul>	Re-evaluation of social and humanitarian and technical and economic disciplines for the elective cycle credit	Graduate department
P5	Socio-economic competencies	<ul style="list-style-type: none"> <li>- critical understanding and cognitive abilities to reason on contemporary social and economic issues</li> <li>- a basic understanding of the</li> </ul>	Transfer credits for social-humanitarian, technical and economic disciplines into the elective cycle	Graduate department



		economic valuation of objects of study and the profitability of industry projects		
--	--	---	--	--

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

## 2.2 Requirements to complete the course and receive a diploma

Description of obligatory standard requirements for graduation and assignment of an academic degree of bachelor: mastering at least 240 academic credits of theoretical studies and final thesis or the state exam in the specialty.

**Form of study:** full-time

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

**Language of instruction:** Kazakh, Russian, English (more than 50%)

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

*A – knowledge and understanding:*

A1 – knowledge and understanding of the classical results of mathematics, physics, chemistry, biology and computer science, the underlying concepts, theories and principles of chemical and biochemical engineering, to the extent necessary to master the educational program;

A2 – knowledge and understanding of basic concepts, theories and principles of chemical and biochemical engineering;

A3 – knowledge and understanding of basic economic, social, environmental, and ethical criteria, as well as understanding of safety and sustainable development priorities affecting engineering decisions;

A4 – knowledge of computer technology capabilities in the field of engineering and the availability to use of Internet communications, databases and basic software products designed to support engineering and scientific activities in the field of chemical and biochemical engineering;

A5 – knowledge and understanding of the theoretical foundations of industrial processes, technological schemes and interrelations of stages and features of technological processes in the field of chemical and biochemical engineering;

A6 – knowledge and understanding of the device and principles of operation of technological equipment, devices; design features and operating modes of equipment;

A7 – knowledge of the methodology of system analysis and design, promising directions for the development of chemical and biochemical industries;

A8 – knowledge and understanding of basic calculations of the basic parameters of technological systems in the development and justification of the choice of environmental protection measures.

*B – application of knowledge and understanding*

B1 – independent development and promotion of various options for solving professional problems using theoretical and practical knowledge;

B2 – the ability to apply classical scientific knowledge and traditional engineering approaches to the analysis of professional problems;

B3 – the application of practical skills in laboratory and analytical work to solve professional problems of chemical and biochemical engineering;

B4 – use of written and oral communication in a foreign language;

B5 – application of theoretical knowledge and practical skills in solving typical professional tasks under standard conditions; monitoring of technological equipment to ensure the safety of industrial production;

B6 – application of knowledge and understanding in the development of new or improvement of existing chemical and biochemical technological processes in the calculations and design of process equipment;

B7 – knowledge of the levels of development of the main branches of biotechnology in the world; modern methods of obtaining biotech drugs and products; the ability to choose the optimal paradigm of the specific application of biotechnological methods to achieve the objectives; use of a complex of physical, biological, chemical knowledge for solving biotechnological problems.

*C – forming judgments*

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

C2 – ability to form critical judgments, demonstration of flexibility and critical thinking;

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

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

*D – personality abilities*

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

D2 – interoperability and technical cooperation with specialists from related fields of engineering;

D3 – ability to show interpersonal understanding, readiness for a rational resolution of conflicts, striving in negotiations to achieve a mutually beneficial result;

D4 – the ability to observe and maintain ethical norms and rules, to understand the attitudes of tolerant behavior, the prevention of domestic racism, xenophobia, extremism and countering them;

D5 – ability to system thinking, creativity, innovation;

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

## 2.4 Competence on completion of training

### *B – Basic knowledge and skills*

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

B2 – the ability to use modern information technologies, to process information using application programs and databases to calculate the technological parameters of equipment, indicators of technological processes in the field of chemical and biochemical engineering and monitoring of natural environments;

B3 – communication skills in the state, Russian and foreign languages;

B4 – knowledge of the main scientific and technical problems and prospects of development in the field of technologies for processing hydrocarbon, mineral and biological raw materials, their relationship with related industries;

B5 – ability to carry out a feasibility and environmental analysis of engineering solutions;

B6 – skills of conducting a chemical experiment, methods of obtaining and researching substances and materials, studying biochemical and biological patterns of biosynthesis processes, skills of cultivating plant and animal cells in vitro;

B7 – skills of working on equipment when conducting experiments, safe handling of various chemical and biological objects;

B8 – knowledge of the basic methods and methods of developing environmental protection measures; Understanding the nature and significance of the relationship of production processes and their impact on the efficiency of industrial production, allowing rational use of natural resources and reducing the negative impact on the environment.

*P – Professional competencies, in accordance with the requirements of the industry professional standard (if applicable)*

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

P2 – the ability to carry out the technological process in accordance with the regulations and usage of 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 saving, minimizing the impact on the environment;

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

P5 – the ability to apply knowledge of modern trends in the industry in manufacturing and technology, design, research, organizational and management activities;

P6 – ability to apply biotechnological processes to create low-waste and non-waste technologies, knowledge of the basic laws on biosafety and the methodology for creating constructed genes and genotypes;

P7 – the ability to carry out environmental monitoring of the state of the environment with the use of innovative methods and means of control, independently prepare environmental passports, fill out environmental reporting forms; ability to analyze and apply at work the Environmental Code and other regulatory documents.

*O – social and ethical competences*

O1 – desire for self-development, improvement of their skills and skills;

O2 – ability to analyze socially significant problems and processes;

O3 – the ability to perceive a variety of cultural traditions and customs, the ability to tolerance of views;

O4 – knowledge of social and ethical values based on public opinion, traditions, customs, social norms and the ability to navigate them in their professional activities;

O5 – knowledge of trends in social development of society, the ability to adequately navigate in various social situations;

O6 – understanding and practical use of healthy lifestyle norms, including prevention issues;

O7 – possession of the state, Russian and one of the foreign languages at the level that ensures human communication;

O8 – the ability to independently acquire with the help of information technology and use in practice new knowledge and skills, including new areas of knowledge not directly related to the field of activity.

*C – Special and managerial competencies*

C1 – knowledge of the culture of thinking, the ability to generalize, analyze, perception of information, setting goals and choosing ways to achieve it;

C2 – the ability to find and make management decisions in the field of labor organization and environmental protection measures; monitor the execution of tasks;

C3 – ability to analyze a technological process as an object of management and prepare technical and economic documentation;

C4 – possession of the fundamentals of project management and decision-making methods used in the development, design and operation of technological processes;

C5 – knowledge of the principles of management, control and correction of activities in the context of teamwork, improving managerial and executive professionalism;

C6 – ensuring technological discipline, sanitary and hygienic mode of operation of the enterprise, keeping process equipment in proper condition, organizing compliance with safety regulations at work and environmental protection rules.

### **2.5 Further education policy Minor**

When mastering at least 12 credits in the disciplines of the program in the direction of 6B052-Environment, including the following mandatory disciplines (if any):

- M1 - Environmental Monitoring
- M2 - Geoecology
- M3 - Fundamentals of industrial safety

### **2.6 ECTS Diploma Supplement**

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

The purpose of the Appendix 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 KI Kazakh National Technical Research University. Satbayev graduates of accredited educational programs only in strict accordance with the model developed by the Joint Working Group of representatives from 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 must contain information on all sections. In the absence of information in any of the sections of the European Supplement to the Diploma, it is necessary to indicate the reasons for the refusal to provide mandatory information.

4. The European Diploma Supplement must always accompany the original education certificate, since it is not legally binding. The presence of the European Diploma Supplement does not guarantee the status of the institution, its qualifications, as well as the fact that it is recognized as an integral part of the national system of higher education.

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 Appendix is to provide comprehensive independent data in order 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. The application does not allow making judgments, statements of equivalence or propositions of recognition. Data should be presented for all eight sections. In the absence of such data, the reason should be indicated. ”

6. In the European Diploma Supplement, the name and degree of qualification should always be given; the name and status of the institution that awarded the qualification / management, and the classification of qualifications. All these data must be submitted in the state and English languages, as a wrong translation is misleading for those who pass judgment on qualifications. In cases where an alphabet other than Latin is used, transliteration is allowed. You can link the titles of degrees and qualifications with the description of the higher education system in the eighth section.

7. Institutions should take appropriate measures to minimize the chances of fraud and distortion of the European Diploma Supplements.

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

9. In the European Diploma Supplement, the assessment of qualifications obtained in other countries should focus on acquired knowledge, skills and abilities, taking into account the fact that one should look not for exact equivalence, but “fair recognition”.



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

1. Information about the identity of the holder of qualifications
2. Qualification Details
3. Information about the level of qualification
4. Information on the content of education and the results obtained
5. Information about the qualification functions
6. Additional information
7. Application Testimonies
8. National Higher Education System

## 3 Major Curriculum and elective disciplines of the Educational program “Chemical and Biochemical Engineering”

Year of study	Code	Name of discipline	Cycle	Total Credits	lec/lab/pr/srs	Code	pre-requisites		Code	Name of discipline	Cycle	Credits	lec/lab/pr/srs	Code	pre-requisites	
<b>1</b>	<b>1 semester (fall 2020)</b>								<b>2 semester (spring 2021)</b>							
	LNG 1051	Beginner (A1)	G	6	0/0/3/3	S4	Diagnost ic test		LNG 1052	Elementary English (A1)	G	6	0/0/3/3	S4	LNG 1051	
	LNG 1052	Elementary English (A1)						LNG 1053	General English 1 (A2)	LNG 1052						
	LNG 1053	General English 1 (A2)						LNG 1054	General English 2 (A2)	LNG 1053						
	LNG 1054	General English 2 (A2)						LNG 1055	Academic English (B1)	LNG 1054						
	LNG 1055	Academic English (B1)						LNG1056	Business English (B2)	LNG 1055						
	LNG1056	Business English (B2)						LNG 1057	Professional English (B2+)	LNG1056						
	LNG1012	Kazakh/Russian (A2)	G	4	0/0/2/2	S1	Diagnost ic test		LNG1102.1	Academic Kazakh/Russian (B1)	G	6	0/0/3/3 /3	S1	LNG10121	
	LNG1012.1	Academic Kazakh/Russian (B1)						LNG1102.2	Business Kazakh/Russian (B2)	LNG1012.1						
	LNG1012.2	Business Kazakh/Russian (B2)						1101	Elective	LNG1012.2						
	AAP106	Physical education I	G	4	0/0/2/2				AAP118	Physical education I, II	G	4	0/0/2/2			
	MAT100	Algebra & Calculus Begin	B	6	1/0/2/3	S2	Diagnost ic test		MAT101	Calculus I	B	6	1/0/2/3	S2	MAT100	
	MAT101	Calculus I						MAT102	Calculus II	MAT101						
	PHY110	Physics Begin	B	6	1/1/1/3	S3	Diagnost ic test		PHY111	Physics I	B	6	1/1/1/3	S3	PHY110	
	PHY111	Physics I						PHY112	Physics II	PHY111						
	BIO127	General Biology	B	6	2/1/0/3		no		HUM113	Contemporary History of Kazakhstan	G	6	2/0/1/3	S6	no	
	CBI101	Fundamental bases of chemistry	B	6	1/0/2/3	Diagnost ic test		CBI101	Fundamental bases of chemistry	B	6	1/0/2/3 1/1/1/3 1/1/1/3	S6			
	CBI102	General Chemistry I			1/1/1/3		CBI102	General Chemistry I								
							CBI104	General Chemistry II								
		<b>Total:</b>		<b>38</b>	<b>19</b>				<b>Total:</b>		<b>40</b>	<b>20</b>				
<b>2</b>	<b>3 semester (fall 2021)</b>								<b>4 semester (spring 2022)</b>							
	LNG 1053	General English 1 (A2)	G	6	0/0/3/3		LNG 1052	S6	HUM126	Social & Political Knowledge	G	8	4/0/0/4	нет		
	LNG 1054	General English 2 (A2)				LNG 1053	LNG 1054									
	LNG 1055	Academic English (B1)				LNG 1054	LNG 1055									
	LNG1056	Business English (B2)				LNG 1055	LNG 1056									
	LNG 1057	Professional English (B2+)				LNG1056	LNG1056									
	MAT102	Calculus II				B	6		1/0/2/3	MAT101				2108	Elective	
	MAT103	Calculus III				MAT102	MAT103	Calculus III	B	6	1/0/2/3		MAT102			
	HUM124	Phylosophy	G	6	1/0/2/3	no	MAT126	Ordinary Differentiation Equations MatLab					MAT103			
	PHY112	Physics II	B	6	1/1/1/3	PHYS11 1		CSE174	Information & Communication Technologies	G	6	2/0/1/3	no			
	2201	Elective					CHE154	Organic Chemistry II	B	6	1/1/1/3	CHE153				
	CHE153	Organic Chemistry I					B	6	1/1/1/3		BIO181	Biochemistry	B	6	2/1/0/3	
	CHE585	Physical chemistry	B	8	2/1/1/4			CBI109	General chemical technology	B	6	2/1/0/3				

		<b>Total:</b>		<b>38</b>	<b>19</b>			
<b>3</b>	<b>5 semester (fall 2022)</b>							
	MAT126	Ordinary Differentiation Equations MatLab	B	6	1/0/2/3			MAT103
	MAT127	Partial Differentiation Equations MatLab						MAT126
	BIO131	Basics of Biotechnology	B	6	2/0/1/3			BIO127
	CBI112	Transport Phenomena I (Heat transfer & Equipment)	B	6	2/1/0/3			CBI109
	CBI115	CAD Chemical and Biological Engineering I	B	6	2/1/0/3			
	3301	Elective	S	6				
		<b>Total:</b>		<b>30</b>	<b>15</b>			
<b>4</b>	<b>7 semester (fall 2023)</b>							
	SAF 104	Industrial ecology and industrial safety	S	6	1/0/2/3	no		
	CHE587	Process Design	S	6	2/0/1/3	no		
	BIO410	Geoecology	S	6	1/0/2/3			
	4301	Elective	S	6		no		
	ECA101	Preparation & writing of thesis (project)	F A	4				
		<b>Total:</b>		<b>28</b>	<b>12</b>			
<b>Additional academic programes (AAP)</b>								
<b>Year of study</b>	<b>Code</b>	<b>Name of discipline</b>	<b>Credits</b>	<b>Semester</b>				
1	AAP107	Ssectional sports club	0	2				
2	AAP500	Military training	0	3-6				

		<b>Total:</b>		<b>44</b>	<b>22</b>			
<b>6 semester (spring 2023)</b>								
MAT106	Partial Differentiation Equations MatLab	B	6	1/0/2/3				MAT126
3302	Elective	B						
3303	Elective	S	6					
CBI113	Transport Phenomena II (Mass transfer & Equipment)	S	6	2/1/0/3	no			CBI112
AUT146	Basics of automation	S	6	2/1/0/3	P 1 - 3			PHYS111
CBI116	CAD Chemical and Biological Engineering II	S	6	2/1/0/3				CBI115
		<b>Total:</b>		<b>30</b>	<b>15</b>			
<b>8 semester (spring 2024)</b>								
BIO414	Environmental monitoring	S	6	1/0/2/3	no			
4302	Elective	S	6	2/0/1/3				
ECA101	Preparation & writing of thesis (project)	FA	4					
ECA102	Thesis (project) defence	FA	6					
		<b>Total:</b>		<b>22</b>	<b>6</b>			
<b>Total number of credits</b>								
<b>Cycle of disciplines</b>		<b>Credits</b>						
		compul-sary	elective	total				
Cycle of general disciplines (G)		50	12	62				
Cycle of basic disciplines (B)		110	12	122				
Cycle of special disciplines (S)		42	18	60				
<b>Total of theoretical study :</b>		202	42	<b>244</b>				
Final attestation (FA)		14	0	<b>14</b>				
<b>Total:</b>		216	42	<b>282</b>				
Extra education		8	0	<b>8</b>				
<b>OVERALL:</b>		224	42	<b>266</b>				

**ELECTIVE DISCIPLINES for recruitment for the 2020-2021 academic year**

CURRICULUM OF THE EDUCATIONAL PROGRAM for recruitment for the 2020-2021 academic year

"6B07110 - "Chemical and Biochemical Engineering"

Form of study: full-time

Study period: 4 years

Academic degree: Bachelor of Engineering and Technology

Year of study	Elective code	Discipline Code	Name of disciplines	Cycle	Credits	lec/lab/prac	Prerequisite
<b>2 semester (spring 2021)</b>							
1	1101	LNG102.1-2	The culture of business communication (C1)	G	6	0/0/3/3	LNG101
		LNG103.1-2	Rhetoric (The basics of elocution) (C1)				
	<b>Total:</b>					6	
<b>3 semester (autumn 2021)</b>							
2	2201	ChToOS	Fundamentals of quality control of organic compounds	B	6	2/0/1/3	
		CHE120	Technical analysis			2/1/0/3	
		BT				2/1/0/3	
		BIO269	Engineering ecology			2/0/1/3	
		LS	Organizational, legal and regulatory framework in Belarusian Railways			1/0/2/3	
<b>Total:</b>					6		
<b>4 semester (spring 2022)</b>							
3	2108	LNG109	IELTS Preparation	G	6	0/0/3/3	LNG 1056
		LNG110	Intercultural Communication				
		LNG117	Technical Writing				
		LNG118	Public speaking				
		LNG119	Productivity skills				
		LNG120	GRE preparation				
		LNG121	Academic Writing				
<b>Total:</b>					6		
<b>5 semester (autumn 2022)</b>							
3	3301	ChToOS		P	6		
		CHE196	Processing technology of hydrocarbon raws I			1/1/1/3	CHE586
		CHE 400	Chemistry of hydrocarbons			2/0/1/3	CHE586
		ChToIS					
		CHE406	Production of mineral acids and bases			2/1/0/3	CBI102
		BT					
		BIO421	General genetics			2/0/1/3	BIO127
		BIO126	Molecular genetics			2/0/1/3	BIO127
		Ecol					
		BIO149	Industrial ecology			2/0/1/3	no
		BIO420	Technogenic systems and environmental risk			2/0/1/3	no
		LS					
		ORB3302	Fundamentals of Radiation Safety			1/0/2/3	no
SAF121	Certification of production facilities for working conditions	1/0/2/3	no				
<b>Total:</b>					6		

6 semester (spring 2023)									
4	3302	MAT128	Theory of Probability and Mathematical Statistics	B	1/0/2/3	MAT102			
		<b>ChToOS</b>							
		CHE197	Processing technology of hydrocarbon raws II		2/0/1/3	CHE196			
		CHE401	Basics of Catalysis		2/0/1/3	CHE196			
		CBI122	Technology of organic and petrochemical industries		2/0/1/3	CHE196			
		CHE584	Electrochemical Science and Engineering		2/0/1/3	CHE585			
		CHE402	Quantum Chemistry		2/0/1/3	CHE585			
		<b>ChToIS</b>							
		CHE 538	Chemical technology of mineral fertilizers		2/1/0/3	CHE137			
		CHE110	Fundamentals of complex fertilizer technology		2/1/0/3	CHE137			
		CHE557	Technology of preparation of mineral and secondary raw materials for production		2/1/0/3	CHE106			
		CHE407	Mineral raw materials of Kazakhstan		2/1/0/3	CHE106			
		<b>BT</b>							
		BIO417	Morphology and physiology of microorganisms		2/0/1/3	BIO126, BIO421			
		BIO418	Morphology and physiology of plants		2/0/1/3	BIO126, BIO421			
		BIO419	Morphology and physiology of animals		1/1/1/1	BIO126, BIO421			
		BIO422	Cell culture biology		2/0/1/3	BIO421			
		BIO423	Cultivation techniques and technology		2/0/1/3	BIO421			
		<b>Ecol</b>							
		BIO159	Air-pollution control		2/0/1/3	BIO149			
		BIO160	Cleaning technology systems and use of exhaust gas		2/0/1/3	BIO149			
		BIO134	Ecology and economics of nature use		2/0/1/3	BIO149			
		<b>LS</b>							
		SAF135	Fire and explosion safety		1/0/2/3	no			
		SAF 102	Physiology and Psychology of Labor		1/0/2/3	no			
		5	3303		<b>ChToOS</b>		P		
					CHE 174	Theoretical bases of technology of organic substances		2/0/1/3	CBI112
					CHE403	Engineering in the construction of oil refining and petrochemical complexes		2/0/1/3	CBI112
<b>ChToIS</b>									
CHE503	The chemical technology glass and sitalls			2/1/0/3	CBI109				
CHE504	Chemical technology of alumina and silicate materials			2/1/0/3	CBI109				
CHE135	Chemical technology of soda and soda containing products			2/1/0/3	CBI109				
<b>BT</b>									
BIO108	Biotechnology of microorganisms			2/0/1/3	BIO417				
<b>Ecol</b>									
BIO145	The basic technology of purification of natural and waste waters			2/1/0/3	BIO131				
BIO411	Reagent production technology, wastewater treatment			2/0/1/3	BIO131				
<b>LS</b>									
SAF107	Social protection of employees			1/0/2/3	no				
SAF128	Ergonomics and technical aesthetics			1/0/2/3	no				
<b>Total:</b>					<b>12</b>				
6	7 semester (autumn 2023)								

4301	<b>ChToOS</b>		P	6						
	CHE180	Technology of aromatic hydrocarbons production			2/0/1/3	CHE154				
	CHE538	Technology of production of surfactants			2/1/0/3	CHE154				
	CHE146	Gaschemistry			2/0/1/3	CHE154				
	CBI125	Chemistry of high-molecular compounds			2/1/0/3	CHE154				
	CHE159	Chemistry and technology of film-forming materials			2/1/0/3	CHE154				
	<b>ChToIS</b>									
	CHE114	Production of phosphorus and its compounds			2/1/0/3	CBI109				
	CHE115	Production of chromic compounds			2/1/0/3	CBI109				
	CHE551	Chemistry and technology of uranium connections			2/0/1/3	CBI109				
	CHE104	Methods of corrosion protection of technological equipment			2/1/0/3	CHE585				
	CHE129	The Chemical and electrochemical corrosion of metals			2/1/0/3	CHE585				
	<b>BT</b>									
	BIO110	Plant biotechnology			2/0/1/3	BIO131				
	BIO425	Animal biotechnology			1/1/1/3	BIO131				
	<b>Ecol</b>									
	BIO161	Disposal, neutralization and burial of industrial wastes			2/0/1/3	BIO149				
	BIO426	Waste management technologies of the main production facilities			2/0/1/3	BIO149				
	BIO157	Ecological and normative documentation at the enterprise			2/0/1/3	BIO149				
	BIO158	Basics of environmental regulation and expertise			2/0/1/3	BIO149				
	<b>LS</b>									
	SAF127	Safety declaration of potentially dangerous objects			1/0/2/3	no				
	SAF130	Selection and professional training of personnel			1/0/2/3	no				
	<b>Total:</b>					6				
	<b>8 semester (spring 2022)</b>									
	7	4302			<b>ChToOS</b>		P	6		
					CHE 134	Chemical technolgy of rare metal compounds			2/0/1/3	CHE154
					CBI 127	Polymer materials in construction			2/0/1/3	CHE154
CHE 508			Technology of petroleum oils production	2/0/1/3	CHE154					
CHE 404			Physicochemical aspects of oil and oil products	2/0/1/3	CHE154					
CBI 128			Reagents for the mining industry	2/0/1/3	CHE154					
CHE188			Chemical technology of solid fossil fuels	2/0/1/3	CHE154					
CHE575			The basics of faine organic substances	2/1/10/3	CHE154					
<b>ChToIS</b>										
CHE124			Technology of electrochemical and electrothermal productions	2/0/1/3	CHE116					
CHE119			Technical thermodynamics and energotechnology of chemical and technological productions	2/0/1/3	CHE199					
CHE139			Power technological installations of chemical industry	2/0/1/3	CBI109					
CHE102			Nonwaste technology	2/0/1/3	CBI109					
CHE108			Bases of processing of the waste of chemical industry	2/1/0/3	CBI109					
CHE134			Chemical technolgy of rare metal compounds	2/1/0/3	CHE551					
CHE534			Technology of conversion of productive uranium solutions	2/0/1/3	CHE551					
<b>BT</b>										



	BIO216	Engineering biotechnology			2/0/1/3	BIO131
	BIO182	Industrial Biotechnology			2/0/1/3	BIO131
	BIO427	Environmental biotechnology			2/0/1/3	BIO131
	<b>Ecol</b>					
	BIO139	Fundamentals of Industrial Technologies			2/0/1/3	BIO410
	BIO428	Soil Science			2/0/1/3	BIO410
	BIO413	Ecology of soils			2/0/1/3	BIO410
	BIO141	Ecologic basis of industrial technologies			2/0/1/3	BIO410
	BIO150	Engineering systems, networks and facilities			2/0/1/3	
	<b>LS</b>					
	SAF115	Occupational safety management system			1/0/2	
	<b>Total:</b>				<b>6</b>	

	Credits
<b>The number of credits in elective disciplines for the entire period of study</b>	<b>0-42</b>
<b>Discipline cycles</b>	
<b>Cycle of general education disciplines (O)</b>	12
<b>Cycle of basic disciplines (B)</b>	12
<b>The cycle of profiling disciplines (P)</b>	18
<b>Total:</b>	<b>42</b>

#### 4 Discipline description

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

CODE -LNG1012.1-1102.2, 1107.1, 1102.2

CREDIT - 10 (0/0/5/5)

PREREQUISITE - diagnostic test

#### PURPOSE AND TASKS OF THE COURSE

- to teach students to perceives by hearing the statements on famous topics related to home, study, free time;
- to understand texts on personal and professional topics containing the most frequent words and phrases;
- to be able to have a conversation on everyday topics; to describe your experiences; to tell your opinion; to retell and to evaluate the content of the book read, the film seen;
- to be able to create simple texts on 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, mastering the lexical and grammatical minimum, has the opportunity to get acquainted with typical communicative situations and has turned out in such situations, be able to evaluate them correctly and to choose the appropriate model (strategy) of speech behavior.

The main focus of training is transferred from the process of knowledge transferring to the ability to use the target language in the implementation of various types of speech activity, such as reading (reading comprehension), listening (under the same condition) and producing texts of a certain complexity with a certain degree of grammatical and lexical correctness.

The material for the classes is selected in such a way that the students, learning Kazakh/Russian, acquire the skills of reading, writing and understanding the speech based on the simultaneous mastering of the grammar basics (phonetics, morphology and syntax) and word usage during continuous multiple repetitions with gradual complication of tasks.

#### KNOWLEDGE, SKILLS TO COMPLETE THE COURSE

The student, under the condition of active organization of work in the classroom and conscientious homework, by the end of the first semester acquires skills and abilities corresponding to the European level A2 (Threshold by ALTE classification), that is, he turns out to be on the threshold of independent language proficiency.

**ENGLISH**

CODE - LNG1051-1057

CREDIT - 24 (0/0/12/12)

PREREQUISITE- diagnostic test /LNG1051-1056, LNG1051

---

**PURPOSE AND TASKS OF THE COURSE**

Discipline on English language “Beginner English” is intended primarily for learning from the beginning. This course is also suitable for those who have only common elementary knowledge of the language. After passing this level, the student will be able to communicate confidently on basic topics in English, learn the basics of grammar and lay a certain foundation that will improve the skills at the next stage of learning English. Post requisites of the course: Elementary English.

LNG1052

**PURPOSE AND TASKS 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, using and memorizing the main grammatical rules and learning the pronunciation and elementary vocabulary, as well as the promotion of self-study and critical thinking.

Course Prerequisites: Beginner.

Post requisites of the course: General 1.

LNG1053

**PURPOSE AND TASKS OF THE COURSE**

The purpose of the “General English 1” course is to provide students with the opportunity to obtain sufficient knowledge in order to become more free in everyday social and academic conditions. Students work on improving pronunciation, vocabulary and grammar. At this level, the main task will be to consolidate the skills acquired earlier, learn how to make and correctly to apply complex syntactic constructions in English, and also to achieve really good pronunciation.

Course prerequisites: Elementary English.

Post requisites of the course: General 2.

LNG1054

**PURPOSE AND TASKS OF THE COURSE**

The “General English 2” course is designed for students who continue to study “General English 1”. The course is focused on the ability to use actively in practice most aspects of English language, conditional sentences, passive voice phrases, etc. At this stage, the student will be able to maintain a conversation with several interlocutors or to express his point of view. The student greatly expands

his vocabulary, which allows him freely to express his thoughts in any situation. At the same time, the speech will be replenished with various synonyms and antonyms of familiar words, phrasal verbs and stable expressions.

Course Prerequisites: General 1.

Post requisites of the course: Academic English.

LNG1055

**PURPOSE AND TASKS OF THE COURSE**

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

Course Prerequisites: General 2.

Post requisites of the course: Professional English.

LNG1056

**PURPOSE AND TASKS OF THE COURSE**

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

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

Course Prerequisites: IELTS score 5.0 and/or Academic English Post requisites of the course: Professional English, IELTS score 5.5-6.0

LNG1057

**PURPOSE AND TASKS OF THE COURSE**

The “Professional English” course is designed for B2+ students, the purpose of which is to enhance students' language competence in relevant professional areas. The main objective of the course is to teach students to work with texts, both audio and written, on their specialty. The curriculum is created on the necessary vocabulary (words and terms), often used in English for special purposes. Students will acquire professional English language skills through integrated learning based on content and language, learn vocabulary in order to read and understand original sources with a high degree of independence, and practice various communication patterns and vocabulary in specific professional situations.

Course prerequisites: Business English.

Post requisites of the course: any elective course.

**MODERN HISTORY OF KAZAKHSTAN**

CODE - HUM113

CREDIT - 6 (1/0/2/3)

PREREQUISITE - no

**PURPOSE AND TASKS OF THE COURSE**

The purpose of the course is to familiarize students of technical specialties with the main theoretical and practical achievements of national historical science on the problems of the history of modern Kazakhstan, a comprehensive and systematic study of the main stages of the formation and development of Kazakhstan society.

- to analyze the features and contradictions of the history of Kazakhstan in the Soviet period;
- to reveal the historical content of the foundations of the laws of political, socioeconomic, cultural processes at the stages of the formation of an independent state;
- to contribute to the formation of students' civic position;
- to educate students in the spirit of patriotism and tolerance, their participation in its nation, native land;

**BRIEF DESCRIPTION OF THE COURSE**

The course Modern history of Kazakhstan is an independent discipline and covers the period from the beginning of the twentieth century to the present day. The modern history of Kazakhstan is studying the national liberation movement of the Kazakh intelligentsia at the beginning of the 20th century, the creation of the Kazakh Autonomous Soviet Socialist Republic, as well as the process of the formation of a multi-ethnic society.

**KNOWLEDGE, 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 to predict their further development;
- the ability to work with all kinds of historical sources;
- the ability to write essays and scientific articles on the history of the native land;
- the ability to operate with historical concepts;
- the ability to lead a discussion;
- skills of independent analysis of historical facts, events and phenomena;
- public speaking skills.

## **PHILOSOPHY**

CODE - HUM 124

CREDIT - 6 (1/0/2/3)

PREREQUISITE - Modern history of Kazakhstan

---

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

The purpose of the course is the formation of cognitive, operational, communicative, self-educational competencies to-solve problems:

- to contribute to the development of adequate ideological orientations in the modern world;
- to form a creative and critical thinking among students;
- to distinguish between the ratio of spiritual and material values, their role in human life, society and civilization;
- to contribute to the definition of their attitude to life and the search for harmony with the outside world.

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

"Philosophy" is the formation of a holistic worldview, which is developed in the context of the socio-historical and cultural development of mankind. Familiarity with the main paradigms of the philosophy teaching methodology and education in the classical and post-classical traditions of philosophy. Philosophy is designed to develop sustainable life directions, finding the meaning of their being as a special form of spiritual production. Contributes to/the formation of the moral image of the individual with the ability of critical and creative thinking. The theoretical sources of this course are the concepts of Western, Russian, and Kazakhstan scholars on history and theory of philosophy.

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

- knowledge of basic terms, main concepts and problems of philosophy;
- knowledge of the basic 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 ideological issues in the history of human development;
- the ability to identify the main theoretical approaches in the relationship of man with society;
- the ability to own methods of performing independent work;
- the search skills of the material systematization;
- the skills to discuss freely and to make rational decisions;
- the skills of ethical principles in professional activities



## **INFORMATION AND COMMUNICATION TECHNOLOGY**

CODE - CSE174

CREDIT - 6 (2/1/0/3)

PREREQUISITE- no

---

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

Training in the use of modern information technology in the field of professional activity.

Course objectives include:

- Expand the basic concepts of computer systems architecture;
- To reveal the basic concepts of information and communication technologies and subject terminology;
- Teach to work with software interfaces of operating systems;
- Teach to work with data in a different presentation, both in tabular structured and unstructured form;
- Teach to apply the basic principles of information security;
- Expand the concepts of data formats and multimedia content.
- To teach how to work with typical applications of multimedia data processing, to use modern approaches to the presentation of the material;
- Expand the concept of modern social cloud and email platforms and ways to work with them;
- Teach to use the methods of algorithmization and programming for solving 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, a full range of topics, with a predominance of developing practical skills in working with data, algorithms and programming. The course is designed to teach students not only the basic concepts of architecture and modern infrastructure of information and communication technologies, but also to use these tools to solve applied problems, learn how to optimize processes, apply adequate models and methods for solving practical problems using modern methods and information technology tools, automate routine processes, be productive and efficient.

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

Students will know:

- Computer device;
- Architecture of computing systems;
- Information and communications technology infrastructure;
- Interfaces of modern operating systems;

- Modern tools for working with data of different nature and purpose;
  - Types of information security threats, principles, tools and methods for data protection;
  - Python programming language.
- Students will be able to:
- Work with the interfaces of modern operating systems;
  - Work with modern application software to work 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.

**ALGEBRA AND THE INTRODUCTION TO MATHEMATICAL ANALYSIS**

CODE-MAT00100

CREDIT - 6 (1/0/2/3)

PREREQUISITE – diagnostic test

---

**PURPOSE AND TASKS OF THE COURSE**

The purpose of the course is to familiarize students with the basic ideas and concepts of algebra and mathematical analysis and the formation of the basic knowledge necessary for studying the course "Mathematics 1".

Course objectives - the formation of skills for the study of mathematical disciplines and the effective use of mathematical methods for solving research and practical problems in the professional field.

**BRIEF DESCRIPTION OF THE COURSE**

The course "Algebra and Introduction to Analysis" gives the basic concepts of algebra, mathematical analysis, differential and integral calculations.

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

The student must know:

- basic concepts of algebra;
- basic concepts of mathematical analysis;
- basic elementary functions; should be able to:
  - find solutions of equations and inequalities, systems of equations and inequalities;
  - convert algebraic and trigonometric expressions;
  - solve text problems;
  - find the derivative of elementary functions;
  - investigate functions using a derivative;
  - find indefinite integral of elementary functions;
  - find a definite integral;
  - find the square of a curvilinear trapezoid.

**MATHEMATICS I**

CODE – MAT101

CREDIT-6 (1/0/2/3)

PREREQUISITE - Elementary School Mathematics / Diagnostic Test

---

**PURPOSE AND TASKS OF THE COURSE**

The main purpose of the course is to provide the future specialist with a certain amount of knowledge in the sections of the “Mathematics-I” course, which is necessary for studying related engineering disciplines. Introduce students with ideas and concepts of mathematical analysis. The main attention is paid to the formation of basic knowledge and skills with a high degree of their understanding of differential and integral calculation.

Course objectives: the acquisition of knowledge necessary for the effective use of rapidly developing mathematical methods; obtaining the skill of creation and studying 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**

In the course “Mathematics-I” the following sections are presented: introduction to analysis, differential and integral calculation

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

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

**MATHEMATICS II**

CODE -MAT102

CREDIT-6 (1/0/2/3)

PREREQUISITE - Mathematics 1

---

**PURPOSE AND TASKS OF THE COURSE**

The purpose of “Mathematics II” course teaching is to form the bachelor's ideas about modern mathematics as a whole as a coherent system of theoretical knowledge.

The objectives of the course is to instill in students solid skills for solving mathematical problems with bringing the solution to a practically acceptable result. Develop primary skills of mathematical research of applied questions and the ability to understand independently 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 exposition of the sections: elements of linear algebra and analytic geometry, differential calculus of many variables functions, multiple integrals. “Mathematics II” is a logical continuation of the “Mathematics I” course.

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

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

**MATHEMATICS III**

CODE-MAT103

CREDIT-6 (1/0/2/3)

PREREQUISITE - Mathematics II

---

**PURPOSE AND TASKS OF THE COURSE**

The purpose of the course teaching is the formation of basic knowledge and skills with a high degree of understanding of the course sections, which help to analyze and to solve theoretical and practical problems.

Course objectives: instilling in students the skills to study independently educational literature, to carry out probabilistic and statistical analysis of applied problems; the development of logical thinking and increasing the general level of mathematical culture.

**BRIEF DESCRIPTION OF THE COURSE**

The course "Mathematics III" includes sections: theory of series, elements of probability theory and mathematical statistics, and is a logical continuation of the discipline "Mathematics II".

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

Student must know:

- theory of numerical series;
- theory of functional series;
- Fourier series;
- elements of probability theory and mathematical statistics; should be able to:
- solve problems in all sections of the theory of series;
- find the probability of events;
- find the numerical characteristics of random variables;
- use statistical methods for experimental data processing.



**MATLAB ORDINARY DIFFERENTIAL EQUATIONS**

CODE -MAT126

CREDIT-6 (1/0/2/3)

PREREQUISITE - Mathematics I-III

---

**PURPOSE AND TASKS OF THE COURSE**

The purpose of “Ordinary Differential Equations. Matlab” course teaching is the formation of basic knowledge on course sections, which helps to analyze, to model and to solve theoretical and practical problems using both analytical and numerical methods using Matlab; instilling in students the ability to study independently educational literature.

Course objectives are teaching to recognize the types and forms of integrable equations and systems, to integrate them and to apply differential equations for the mathematical solution of applied problems.

**BRIEF DESCRIPTION OF THE COURSE**

Ordinary 1st order differential equations. Ordinary differential equations of higher orders. Systems of differential equations. Linear equations with variable coefficients. Numerical integration of differential equations and systems. Usage of Matlab in order to solve differential equations numerically.

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

- to master the methods of solving ordinary differential equations;
- to set mathematical problems;
- to be able to create mathematical models;
- to be able to solve problems modeled by differential equations using both analytical and numerical methods using Matlab.

**PHYSICS I, II**

CODE-PHYS111-112

CREDIT - 12 (2/2/2/6)

PREREQUISITE - diagnostic test

---

**PURPOSE AND TASKS OF THE COURSE**

The main purpose of teaching the course Physics I and Physics II is to form ideas about the modern physical picture of the world and the scientific worldview.

**BRIEF DESCRIPTION OF THE COURSE**

The disciplines Physics I and Physics II are the basis of theoretical training for engineering and technical activities of graduates of higher technical schools and represent the core of the physical knowledge necessary for an engineer operating in the world of physical laws. The course "Physics 1" includes the following sections: physical fundamentals of mechanics, the structure of matter and thermodynamics, electrostatics and electrodynamics. The discipline "Physics II" is a logical continuation of the discipline "Physics 1", and forms a holistic view of the course of general physics as one of the basic components of the general theoretical training for bachelors in engineering and technical area. The discipline "Physics II" includes the following sections: magnetism, optics, nanostructures, fundamentals of quantum physics, atomic and nuclear physics.

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

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

## GENERAL BIOLOGY

CODE - BIO127

CREDIT - 6 (2/0/1/3)

PREREQUISITE - no

---

### PURPOSE AND TASKS OF THE COURSE

**Purpose:** To give students a holistic view of the life and principles of the organization of living matter, the properties of living systems and the features of their evolutionary development.

**Tasks:**

- understand the interrelation and interdependence of natural science disciplines, their impact on the natural environment, economic and social spheres of human activity,
- understand the principles of sustainability and productivity of living matter, ways of its change in the process of evolution and rational use of natural resources,
- be able to justify the place and role of biological knowledge for solving professional problems in practice, in the development of modern technologies.

### BRIEF DESCRIPTION OF THE COURSE

**Biological diversity:** Biodiversity and the evolution of life. Speciation mechanisms. Biodiversity Formation, Biodiversity and Ecosystem Resistance; biodiversity of microorganisms, plants and animals. Biological systematics and nomenclature. Quantitative and economic assessment of biodiversity; loss and restoration of species; biodiversity and biological pollution.

**Biology and chemistry of cells, histology:** Cells, tissues and organs, their organization and functioning. Cell morphology and chemistry of prokaryotes and eukaryotes in a comparative aspect. Chemical components and properties of living: elements contained in cells. The concept of cell structure, cell compartment and division of labor, cell fractionation. Ultrastructure of cells. Cell membranes and structures. Histology of tissue and their structural and functional organization. Plant tissues consisting of single cells (parenchyma, collenchyma, sclerenchyma) and several (xylem, phloem) types. Animal tissues (epithelial, connective, muscular, nervous).

**Nutrition and energy use:** The classification of organisms according to sources of energy and carbon. Autotrophic nutrition. Biochemistry and the value of photosynthesis. Factors affecting photosynthesis. Mineral nutrition of plants and animals. Heterotrophic nutrition. Types of heterotrophic nutrition. Mechanisms of nutrition in animals. The fate of absorbed nutrients. Human nutrition: recommended nutrient intake rates and their standard values, unhealthy diet. Energy use: respiration, ATP, cellular respiration, gas exchange.

Environment and Organisms: Ecosystems and Energy Flow. Biochemical cycles - cycles of water and nutrients. Ecology of microorganisms, plants and animals. Ecology community. Human influence on ecosystems. Environmental protection. Quantitative ecology: methods for measuring environmental factors, biota analysis. Transport in plants and animals. Coordination and regulation in plants and animals. The movement of plants and animals. Homeostasis: a control system in biology. Water saving in plants. Continuity of life. Reproduction: asexual and sexual. Growth and development. Types of growth.

General genetics: Heredity and variability: classification and methods of study. The main stages of development of genetics, directions (classical genetics, private genetics, cytogenetics, molecular genetics, population and evolutionary genetics, mathematical genetics) and the tasks of genetics. Patterns of inheritance of characters, principles of heredity and variability. Mendelism - discreteness in the inheritance of characters. Morganism - the chromosomal theory of heredity. Genetics floor.

#### KNOWLEDGE, SKILLS, SKILLS TO COMPLETE COURSE

As a result of mastering the discipline, students should:

- know the basic methods, laws and concepts of the development of biological sciences,
- have the skills to analyze biological processes and systems,
- be able to conduct experimental studies in the biological and biotechnological sciences

**FUNDAMENTALS OF CHEMISTRY**

CODE - CBI101

CREDIT - 6 (1/0/2/3)

PREREQUISITE – high school chemistry course / diagnostic test

---

**PURPOSE AND OBJECTIVES OF THE COURSE:** Closing the gap of knowledge in the course of high school chemistry. A logical and accessible presentation of the fundamentals of chemistry.

Objective of the course: Good understanding of the course and the ability to creatively use knowledge of the fundamentals of chemistry in the future in understanding chemical and biological, chemical-technological, biomedical, metallurgical and other processes.

**BRIEF DESCRIPTION OF THE COURSE**

In his work "Fundamentals of Chemistry" D.I. Mendeleev wrote that "chemistry is the study of elements and their compounds."

Studying the course includes an understanding of concepts such as:

- Subject of the study of chemistry. Atomic-molecular teaching. Basic concepts and laws of chemistry.
- Periodic table of D.I. Mendeleev. Electronic structure of atoms of chemical elements, classification of families of elements, periods and groups. The periodic law of D.I. Mendeleev.
- Chemical bond and types of chemical bonds. Intramolecular and intermolecular chemical bonds.
- The main classes of inorganic compounds: oxides, acids and bases, salts. Their classification and nomenclature.
- Water. Water molecule structure. Solubility of compounds in water with the formation of aqueous solutions.
- The theory of electrolytic dissociation. Weak and strong electrolytes, non-electrolytes.
- Dissociation of water. Hydrogen index.
- The main types of chemical reactions in aqueous solutions: acid-base reactions, precipitation reactions, redox reactions.
- Solutions and their classification. Qualitative and quantitative characteristics of solutions. Solubility. Factors affecting solubility.
- Features of aqueous solutions of salts. Salt hydrolysis. Acidity of aqueous salt solutions.
- Redox reactions. The oxidation states of atoms of elements in compounds and their determination; oxidation states of simple and complex ions.

KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

As a result of mastering the Fundamentals of Chemistry, students should have the ability to set and solve problems, which contributes to the informal assimilation of the theoretical course of general chemistry.

NEED TO KNOW:

- the essence of the basic laws of chemistry;
- electronic structure of atoms and molecules, Periodic law of D.I. Mendeleev;
- foundations of the theory of chemical bonding in compounds of different types;
- main classes of chemical compounds and their nomenclature;
- basic laws of chemical transformations;
- properties of solutions;
- the main types of chemical reactions in aqueous solutions;
- oxidation states of atoms of elements in compounds and their determination;
- method of electronic balance for equalizing redox reactions.

BE ABLE TO:

- Predict the properties of chemical elements and their compounds based on the position of the element in the Periodic Table of the Elements;
- Write chemical formulas and make calculations on them;
- Find formulas of substances based on analysis results;
- Write chemical equations and carry out stoichiometric calculations on them;
- To be able to solve typical problems on all the main topics of the course;
- Balance redox reactions.

HAVE SKILLS of using the basic concepts and laws of chemistry, the fundamentals of chemistry to solve professional problems.



## GENERAL CHEMISTRY I

CODE – CBI102

CREDIT - 6 (1/1/1/3)

PREREQUISITE – diagnostic test

---

### 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 the 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 in using the laws of chemistry in describing and comparing specific professional tasks;
- acquisition of skills in performing laboratory work;
- acquisition of skills for solving typical problems and compiling equations of chemical reactions;
- formation of students' skills in chemical thinking.

### BRIEF DESCRIPTION OF THE COURSE

The study of 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. The 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 index. 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

NEED TO KNOW:

- the essence of the basic laws of chemistry;

- electronic structure of atoms and molecules, Periodic law of D.I. Mendeleev;
- foundations of the theory of chemical bonding in compounds of different types;
- basic laws of chemical transformations;
- properties of solutions;
- the 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.

**BE ABLE TO:**

- determine the chemical properties of elements and their compounds by their position in the Periodic Table of the Elements of D.I. Mendeleev;
- apply the basic laws of chemistry in solving practical problems;
- write the equations of chemical reactions;
- calculate the concentration of solutions and prepare solutions of a given concentration;
- balance redox reactions.

**HAVE SKILLS**

- the use of chemical laws to solve specific professional problems with quantitative calculations and the use of educational, reference and special literature;
- compiling equations of chemical reactions, methods of describing the properties of elements and their compounds by position in the periodic table of D.I. Mendeleev, to conduct chemical experiments and explain the phenomena taking place.

## GENERAL CHEMISTRY II

CODE – CBI104

CREDIT - 6 (1/1/1/3)

PREREQUISITE – diagnostic test

---

### PURPOSE AND TASKS OF THE COURSE

#### PURPOSE AND OBJECTIVES OF THE COURSE

Formation of basic knowledge, skills and abilities of independent work necessary in solving chemical problems for their application in professional activities.

Objective of the course:

- formation of knowledge of the basic laws of the course of chemical reactions, which will allow both to improve existing and create new technological processes;
- acquiring knowledge and skills to use the laws of chemistry processes in solving specific professional problems;
- acquisition of skills in performing laboratory work;
- acquisition of skills for solving typical problems;
- formation of students' skills in chemical thinking.

#### BRIEF DESCRIPTION OF THE COURSE

The study of the following main topics:

1. Intermolecular interaction.
2. Basic gas laws.
3. Thermodynamic characteristics of chemical processes.
4. Kinetics of a chemical reaction. The basic law of chemical kinetics. Factors affecting the reaction rate.
5. Fundamentals of Electrochemistry. Galvanic cell. Electrochemical series of metal activity. Electromotive force.
6. Electrolysis of melts and aqueous solutions. Electrode reactions. The sequence of the discharge of ions on the electrodes. Faraday's laws.
7. Chemistry of complex compounds. The structure and classification of complex compounds.
8. Fundamentals of Qualitative Analysis. Acid-base classification of cations.
9. Quantitative analysis. Quantitative analysis methods. Gravimetry. Titrimetry.

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

NEED TO KNOW:

- The nature of the forces of intermolecular interactions.

Developed by:	Reviewed: meeting of the Institute's AC	Approved by: EMC of KazNRTU	Page 47 of 75
---------------	---	-----------------------------	---------------

- Basic gas laws.
- Basic thermodynamic parameters and functions. Direction of chemical reactions.
- Fundamentals of Chemical Kinetics. The law of the acting masses.
- Chemical equilibrium. Chemical equilibrium shift. Le Chatelier's principle.
- Complex compounds. The structure and classification of complex compounds.
- Fundamentals of Qualitative and Quantitative Analysis.
- Rules for safe work in a chemical laboratory.

#### BE ABLE TO:

- make calculations for the application of gas laws;
- determine the type of intermolecular interactions;
- conduct thermodynamic calculations and determines the direction of chemical reactions;
- carry out calculations to determine the reaction rate and the shift in chemical equilibrium;
- solve problems on the application of the basic methods of separation and analysis of substances.

#### HAVE SKILLS

- application of chemical laws to solve specific professional problems with quantitative calculations and the use of educational, reference and special literature;
- explanations of the properties of elements and their compounds, conduct chemical experiments and explain the phenomena that occur.

## **GEOECOLOGY**

CODE - BIO410

CREDIT - 6 (1/0/2/3)

PREREQUISITE - no

---

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

The purpose of the course "Geoecology" is to study the experience of using the most reasonable effective ways of rational use of natural conditions and resources, and environmental protection in the process of interaction between nature and society.

The tasks of studying the discipline arise from the requirements for the knowledge and skills of future specialists in accordance with the state standard for basic higher education.

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

The concept of the environment, technogenesis, patterns of functioning of the technosphere. Ecological functions of the Earth's geospheres. The influence of anthropogenic activity on the atmosphere, hydrosphere, soil. Rational use of mineral resources. Modern landscapes of the Earth, as a result of the anthropogenic transformation of natural geosystems. Ecological consequences of anthropogenesis, anthropostability of geosystems. Landscape basics of environmental management and nature conservation. Geoecological mapping, forecasting, local and global zoning. Estimated environmental geo-ecological maps. Management of natural-anthropogenic geosystems.

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

After completing this course, students should know and be able to identify: anthropogenic pollution; the role of climatic factors in atmospheric pollution; danger of air pollution; determination of the maximum permissible impact; maximum permissible concentrations of harmful substances; assess the degree of soil contamination, groundwater and surface water; the impact of the oil and gas industry on the environment.

## ORGANIC CHEMISTRY I

CODE – CHE153

CREDIT – 6 (1/1/1/3)

PREREQUISITE - General Chemistry, Fundamentals of Chemistry

---

### COURSE GOALS AND OBJECTIVES

The aim of the course is to provide students with knowledge and skills about the classification of organic compounds, the nomenclature, the structure, the isomeria, the properties of different classes of organic compounds, the mechanisms of reactions and their application in professional activities.

Course task:

The formation of knowledge of the basic laws of chemistry and chemical properties of elements and their compounds, understanding and applying which will allow both to improve existing and create new technological processes;

Acquiring knowledge and skills to use the laws of chemistry to describe and compare specific professional tasks;

Acquiring laboratory skills

Acquiring the skills to solve typical problems and make chemical reaction equations;

The formation of chemical thinking skills in students.

### SUMMARY OF THE COURSE

Study:

Organic compounds of the aliphatic range – chemistry and hydrocarbons of the linear structure and their oxygen-, sulfur and nitrogen-containing derivatives; the physical and chemical properties of these compounds;

how to get organic matter in the lab and industry;

have used 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 organic compounds; the basics of the theory of organic compound structure and some of its modern aspects;

The common physical and chemical properties of the main classes of organic compounds and the methods of obtaining them;

Basic methods of qualitative elemental and functional analysis of organic matter.

Basic methods and techniques in the organic chemistry laboratory;

Methodology for the structure of organic compounds to assess the dependence of substances' properties on their structure;

2) be able to:

- make quantitative calculations in chemical reactions;

- use theoretical frameworks to explain organic compounds' transformations



- use the knowledge gained during the study of educational disciplines on the basis of organic chemistry, as well as in production, in the laboratory, in everyday life; to perform stoichiometric calculations on reaction equations for organic compounds;

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

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

- apply the knowledge, skills, skills and competencies to the production and technological challenges of obtaining organic compounds.

3) To master the skills:

- to use chemical law to solve specific professional tasks with quantitative computing and the use of educational, reference and special literature;

- to make up the composition of chemical reaction equations, to explain the properties of organic compounds, chemical experiments and explain the phenomena that are taking place.

## ORGANIC CHEMISTRY II

CODE – CHE154

CREDIT – 6 (1/1/1/3)

PREREQUISITE – Organic Chemistry 1

---

### COURSE AIMS AND OBJECTIVES

The aim of the course: Mastering the complex of knowledge and scientific ideas about the fundamental theoretical and experimental foundations of organic chemistry of cyclic compounds; mastering the skills to characterize the structure, physical and chemical properties of cyclic organic substances; mastering experimental teachings and skills.

#### OBJECTIVES:

- Acquisition of in-depth knowledge in the field of organic chemistry of the cyclic series;
- the formation of a logical connection between the structure and reactivity of organic cyclic compounds, to have information about the substances themselves and the methods of their preparation;
- the acquisition of skills for solving typical problems and drawing up equations of chemical reactions;
- the formation of practical skills in the synthesis and identification of compounds in laboratory work.

#### BRIEF DESCRIPTION OF THE COURSE

As a result of mastering the discipline, the student must

Study:

- general patterns linking the structure and properties of cyclic organic compounds;
- methods for obtaining the main classes of cyclic compounds, mechanisms of the main types of reactions;
- the basics of drawing up installations for organic synthesis and purification of organic compounds, safety rules when working with organic substances.

Be able to:

- solve problems related to the technology of organic substances, to synthesize and identify cyclic compounds;
- types of organic reactions and their mechanisms, factors influencing the reaction;
- write the necessary elements of a given chain of transformations of organic cyclic compounds;
- to carry out a simple synthesis of cyclic compounds.

Have skills:

- skills of working with various organic (liquid, solid, flammable, volatile, toxic) substances, with instruments, laboratory glassware and equipment of the organic synthesis laboratory;
- methods of separation, isolation, purification, identification and synthesis of organic cyclic compounds.

## **BIOCHEMISTRY**

CODE – BIO181

CREDIT - 3 (2/0/1)

PREREQUISITE - Organic Chemistry

---

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

The aim of the course is to form knowledge about the structure, properties, and functions of the most important biological compounds, as well as the molecular mechanisms of the main metabolic processes occurring in living organisms and use this knowledge to solve biotechnological problems.

Objective of the course:

- formation of knowledge about the features of the molecular organization and metabolism of the most important biological compounds of living organisms - objects of biotechnology;
- acquisition of knowledge and skills to use modern methods of biochemical research in practice;
- acquisition of skills in planning and conducting qualitative and quantitative analysis of biological material;
- acquisition of skills to interpret the results of biochemical experiments, assessing the relationship between the structure of biomolecules and their physiological functions at the molecular level;
- formation of skills to predict the possibility of using various biological molecules and biochemical processes for biotechnological purposes.

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

The course "Biochemistry" plays an important role in the system of training a specialist, in the formation of a scientific understanding of the essence of life, knowledge of the flow and management of the processes underlying metabolism and energy in living organisms. The course is designed as a course of static biochemistry, which reveals the main tasks of forming knowledge about the composition, structure of the main classes of compounds that make up living matter and dynamic biochemistry, which describes the metabolic processes in the body from the cellular level to the functioning of the body as a whole.

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

Know:

- Chemical composition of organisms.
- Sections of biological chemistry: static, dynamic.
- Modern methods of biochemical research.

Be able to:

- use methods of isolation, separation and research of the main classes of compounds that make up living matter-proteins, amino acids, enzymes, vitamins, polysaccharides, lipids, organic acids;

To own:

- skills and techniques of performing the experiment, the ability to analyze and compare experimental results and theoretical data, the ability to compile and design a report on the research work done.

## PHYSICAL CHEMISTRY

CODE - CHE585

CREDIT - 8 (2/1/1/4)

PREREQUISITE – General Chemistry, Mathematics, Physics

---

### PURPOSE AND TASKS OF THE COURSE

The main goal of the course is to form students:

- the ability to understand the physical-chemical nature of processes and using the basic laws of physical chemistry in integrated production and technological activities;

- the ability to perform calculations of the physical-chemical parameters of chemical processes based on the methods of physical chemistry;

- the ability to understand the physical-chemical nature of electrochemical processes and the theory of electrolytes and to use the basic laws of electrochemistry in integrated production and technological activities;

- the ability to understand the essence of the chemical kinetics of processes and using the basic laws of chemical kinetics in the integrated production and technological activities;

- the ability to understand and describe the patterns of complex reactions and suggest mechanisms for the occurrence of complex reactions based on kinetic patterns;

- the basis of ideas about the kinetics of catalytic processes and their applications in industrial practice.

Course objectives:

The main objectives of studying this discipline include the following items:

- the study of the main sections of physical chemistry - chemical thermodynamics, chemical kinetics, electrochemistry, photochemistry, the theory of gases, solutions, chemical and phase equilibria, catalysis;

- providing students with creative thinking, combining the fundamental knowledge of the basic laws and methods of conducting physical and chemical research, with subsequent processing and analysis of the results.

- finding the relationship between chemical and physical processes.

### BRIEF DESCRIPTION OF THE COURSE

The course will deal with the laws of thermodynamics and thermodynamic potentials, chemical and phase equilibrium in one- and two-component systems, state diagrams of one-component and two-component systems, thermal analysis, solid solutions, properties and thermodynamics of solutions, electrolytes, electrical conductivity and electrochemical potentials, thermodynamic description processes and equilibrium in electrochemical systems, features of electro-chemical systems, galvanic cells, electrolysis and its application, corrosion and protection of metals,

formal kinetics, reaction rate, reaction rate constant, half-transformation period, reaction order, temperature effect on reaction rate, theory of active collisions, transition theory, complex reaction kinetics: reversible, parallel and sequential reactions, method stationary concentrations, basic kinetics of catalytic processes, photochemical reactions.

#### KNOWLEDGE, SKILLS TO COMPLETE THE COURSE

After studying this discipline, the student

*should know:* the laws of thermodynamics; basic equations of chemical thermodynamics; methods of thermodynamic description of chemical and phase equilibria in multicomponent systems; properties of solutions; fundamentals of electrochemistry; basic concepts, theories and laws of chemical kinetics and catalysis.

After studying this discipline, the student

*should be able to:* calculate the thermodynamic parameters of the systems; determine the thermodynamic characteristics of chemical reactions and equilibrium concentrations of substances; determine the direction of the process in the given initial conditions; predict the influence of various factors on the balance in chemical reactions; establish the boundaries of the phase regions in single-component and binary systems; calculate thermal effects and equilibrium constants of chemical reactions; make the necessary physical and chemical calculations; calculate the rate and rate constant of chemical reactions, half-life, determine the order of the reaction, describe the kinetics of simple and complex reactions, determine the degree of conversion, suggest an reaction mechanism based on kinetic data.



## GENERAL CHEMICAL TECHNOLOGY

CODE - CBI109

CREDIT – 6 (2/1/0/3)

PREREQUISITE - General Chemistry, Physics, Mathematics

---

### PURPOSE AND TASKS OF THE COURSE

Studying purpose: studying of the general regularities of reactionary processes of chemical technology, bases of synthesis and analysis of chemical production as chemical and technological system, questions of complex rational use of raw material and energy resources and acquaintance with production of some major inorganic substances.

**BRIEF DESCRIPTION OF THE COURSE** Chemical production. The hierarchical organization of processes in chemical production, criterion for evaluation of production efficiency. General regularities of chemical processes, industrial catalysis, chemical reactors. The main mathematical models of processes in chemical reactors, isothermal and non-isothermal processes in chemical reactors, industrial chemical reactors. Chemical and Technological Systems (CTS): structure and description of CTS, synthesis and analysis of CTS, raw and power subsystems of CTS.

### KNOWLEDGE, SKILLS TO COMPLETE THE COURSE

After end of a course students have:

- to know composition and structure of chemical production, its key indicators and criteria for evaluation of its efficiency;
- to know physical and chemical bases of chemical processes and chemical transformations in the conditions of industrial production;
- to own methods of a research and calculation of a condition of a chemical and technological system;
- to know the main components of chemical production and the concept of rational use of raw material and energy resources of chemical technology.

## **BASICS OF BIOTECHNOLOGY**

CODE – BIO131

CREDIT – 6 (2/0/1/3)

PREREQUISITE - General Biology

---

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

**Purpose:** To acquaint students with the main directions and methods of biotechnology.

**Tasks:**

- to form competences in the field of methods for obtaining biotechnological products in controlled production processes using enzymes, monocultures and associations of microorganisms, plant and animal cell cultures,
- to study the basics of biotechnological processes and production,
- to master the techniques and methods of biological processing of natural raw materials, methods of biotransformation of secondary raw materials and their waste in various industries, methods of quality control and safety of biotechnological products,

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

**Objects of biotechnology:** The hierarchy of objects of biotechnology and biotechnological resources. Objects of bioproduction, bioconstructive, bioenergy and bioreconstruction technologies.

**Fundamental Biotechnology:** The Hierarchy of Biotechnological Sciences. Biotechnology as a science. **Molecular biotechnology:** subject, tasks and methods of science. **Hierarchy of bioengineering constructions based on recombinant DNA technology:** genetic engineering, bioengineering of metabolites, cell bioengineering, bioengineering systems. **Cell biotechnology.** Hierarchy of bioconstructive technologies. Basics of gene and cell therapy.

**Applied biotechnology:** Hierarchy of bio-production and bioreconstruction technologies. Biotechnology, as a sphere of production. Production potential of biological objects. Biotechnology of microorganisms. Plant biotechnology. Animal biotechnology. Medical and veterinary biotechnology. Biotechnology production of biologically active substances. Pharmaceutical biotechnology. Biotechnology in various industries. Biogeotechnology. Biotechnology, as a sphere of "green" environmental protection. Biotechnology and biosafety. Space biotechnology. Bionanotechnology.

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

As a result of mastering the discipline, students should:

- know modern methodological approaches and current problems of biotechnology,
- have an idea about the possibilities of using biological objects in bio-construction, bio-production, bio-energy and bioreconstruction technologies,

- be able to manage individual stages of the biological (biochemical) process in production and technological conditions.

**TRANSPORT PHENOMENA I (Heat transfer & Equipment )**

CODE - CBI112

CREDIT – 6 (2/1/0/3)

PREREQUISITE - Introduction to chemical and biochemical engineering, Physics, Mathematics

---

**PURPOSE AND TASKS OF THE COURSE**

Studying purpose: development of theoretical and practical justification of hydrodynamic and thermal processes, methods of their calculation, acquaintance with standard devices and the equipment in which these processes are carried out.

**BRIEF DESCRIPTION OF THE COURSE**

Basic concepts of a hydrostatics, equilibrium equation of liquids. Pacing factors and modes of the movement of liquids. Motion equation of Navier-Stokes. Bernoulli's equation. Hydrodynamic similarity. Resistance in pipelines. Hydrodynamics of granular materials. Movement of liquids (pumps volume, centrifugal, jet, air lifts, etc.). Division of gas and liquid heterogeneous systems. Thermal processes. Heat conductivity. Fourier's law and coefficient of heat conductivity. Heat radiation. Stefan-Boltzmann law, Kirchhoff's law. Heat emission, thermal similarity. A heat transfer at continuous and variable temperatures. Technological equipment of processes of heating, cooling and condensation.

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

After development of this discipline the students have:

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

**TRANSPORT PHENOMENA II (Mass transfer & Equipment)**

CODE - CBI113

CREDIT – 6 (2/1/0/3)

PREREQUISITE – Transport Phenomena I, General Chemical Technology

---

**PURPOSE AND TASKS OF THE COURSE**

Studying purpose: development of theoretical and practical justification of diffusive processes, methods of their calculation, acquaintance with standard devices and cars in which these processes are carried out.

**BRIEF DESCRIPTION OF THE COURSE**

Value of mass-exchanged processes in chemical technology and also at the solution of environmental problems. Classification and general characteristic of mass-exchanged processes. Laws of phase balance. Rule of phases. Henry's law, Raul's law. Molecular and convective diffusion. Driving force and speed of diffusive processes. Material balance and equation of the line of working concentration. Main equations of a mass transfer. Concentration change steps. Definition of theoretical number of steps of change of concentration by a graphic method. Similarity of diffusive processes. Coefficients of a mass transfer and return of weight. Sorption methods of division of gas mixes. Physical bases of absorption. Industrial methods of absorption. Superficial, film. Nozzle absorbers. Bubbling columns. Adsorption, basic concepts. Adsorbents, their properties. Adsorption isotherm. Calculation of adsorbers of periodic and continuous action. Desorption. Distillation of liquids. Phase balance of liquid mixes. Rectification, its principle. Types of rectification. Equipment of distillation installations. Extraction and its types. Equipment of extraction installations. Physical and chemical bases of process of crystallization, methods and equipment of process. Ways of removal of moisture and types of drying.

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

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

## **BASICS OF AUTOMATION**

CODE – AUT146

CREDIT – 6 (2/1/0/3)

PREREQUISITE - Physics I, II

---

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

- training future specialists who are able to actively and competently use modern means of automation and control for conducting technological processes;
- familiarity with the structures of modern automated process control systems, with the techniques for selecting and using emergency control, alarm, blocking and protection systems;
- study of the principles of construction of digital data processing facilities, features of the organization of work of microprocessor devices and issues of the use of microprocessors in control systems of technical objects and technological processes, as well as the development of design skills of control systems based on microcontrollers and the development of their application software.

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

The program of the course “Basics of Automation” is aimed at forming the fundamentals of knowledge in automating production processes, studying the basic methods of mathematical modeling, analyzing and synthesizing automatic control systems, acquainting with the main functions of an automated control system and the technical means used in building automatic and automated control systems, including microprocessor technique. Training graduates to be able and ready to carry out the process in accordance with the regulations and use technical means to measure the main parameters of the process, the properties of raw materials and products.

The application of the knowledge gained in the field of technological process control systems, using analytical and numerical methods for solving problems, using modern information technologies, processing information using business application programs; use network computer technologies and databases in their subject area, application packages for calculating the technological parameters of equipment.

Discipline is aimed at the formation of graduate professional competencies, deepens students 'natural-science and mathematical knowledge and relies on the technological and natural-science disciplines.

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

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

- classification, types, purpose and basic characteristics of typical instrumentation, automatic and signaling devices according to their place of

installation, device and principle of operation (electrical, electronic, pneumatic, hydraulic and combined sensors and actuators, interface, microprocessor and computer devices);

- general information about automated control systems (ACS) and systems of automatic control (SAC);

- principles of construction of automated process control systems, typical systems of automatic control of technological processes;

- a system of automatic emergency protection used in production;

- state and prospects of development of technological process automation;

- principles of measurement, regulation, control and automatic control of process parameters;

- the basic concepts of automated information processing;

- basics of measurement techniques.

As a result of mastering the discipline, the student should be able to:

- choose the type of instrumentation and automation equipment for production tasks and argue your choice;

- to regulate the parameters of the technological process according to the indications of instrumentation and equipment (instrumentation and automation) manually and remotely using automation equipment;

- take readings of instrumentation and automation equipment and evaluate the accuracy of the information.

To have skills:

- the use of computing technology in the management of technological processes.

To be competent:

- in matters of justification of the choice of adjustable, controlled, signaling parameters.



## **CAD CHEMICAL AND BIOLOGICAL ENGINEERING I**

CODE - CBI115

CREDIT - 6 (2/1/0/3)

PREREQUISITE- General Chemistry, Information and Communication  
Technology, Physical Chemistry

---

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

The main purpose of the course is to acquaint students with the basics of computer modeling of chemical-technological processes using ChemCad modeling program. ChemCad program allows you to create, analyze and optimize various variants of technological design of production processes, evaluate their effectiveness and choose the best one.

Course objectives are providing the students with the theoretical knowledge and practical skills for creation and optimization of complex technological flowsheets of various processes involving organic and inorganic substances, including recycled flow return using ChemCad modeling program and for conducting complex technological calculations.

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

The course will deal with the basics of computer modeling of chemical-technological processes using the ChemCad simulation program; the simulation of equilibrium (stationary) chemical-technological processes; methods for constructing a technological flowsheet; the choice of thermodynamic parameters and the method for determining the K-constant and enthalpy; characteristics of the technological flowsheet and streams; modeling of chemical-technological processes with the use of a periodic distilling column; calculation of a simple technological process with recycle; evaluation of the possibility of a pinch effect; calculation of material and heat balances of the processes; analysis of parametric sensitivity; process optimization.

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

The studying of this discipline gives the students an ability to correctly apply computer programs for modelling chemical-technological processes; to build chemical and technological flowsheets using ChemCad simulation program; to find optimal conditions of the chemical-technological processes; to calculate and analyze the heat and mass transfer in the process.

## CAD CHEMICAL AND BIOLOGICAL ENGINEERING II

CODE - CBI116

CREDIT - 6 (2/1/0/3)

PREREQUISITE- CAD Chemical and Biological Engineering I

---

### PURPOSE AND TASKS OF THE COURSE

The main purpose of the course is

- familiarizing students with the basics of computer modeling of chemical-technological processes using Aspen Hysys modeling program;
- training future professionals in the use of professional knowledge in the field of computer technology in their scientific research;
- forming an understanding of the basics of building information systems using computer technologies and the issues of modeling and optimization of complex chemical-technological processes for their subsequent practical use in science and education;
- the formation of professional skills for modeling chemical-technological processes using the Aspen Hysys modeling program, organizing and conducting an experiment, analyzing and processing data using modern information technologies.

Course objectives are to provide students with the theoretical knowledge and practical skills for creation and optimization of complex technological flowsheets of various processes involving organic and inorganic substances, including recycling flow using Aspen Hysys modeling program for carrying out complex technological calculations

### BRIEF DESCRIPTION OF THE COURSE

The course will deal with the basic concepts of the modeling method, computer modeling of chemical-technological processes using Aspen Hysys modeling program; modeling of equilibrium (stationary) chemical-technological processes; methods of the constructing a technological flowsheet; choice of thermodynamic parameters and method for determining the K-constant; characteristic technological flowsheet and streams; calculation of parameters of all streams and equipment; viewing of the modelling results; review of the results of the work of existing equipment and distillation apparatuses; plotting on the basis of obtained results, drawing up (creating) a report; calculation of a simple technological flowsheet with recycling; optimization of the heat exchange process in heat exchangers; calculation of the material and heat balances of the processes; analyzation of the parametric sensitivity; total mass and heat balance and process optimization.

### KNOWLEDGE, SKILLS TO COMPLETE THE COURSE

After studying this discipline, the students *should know*: the basics of the computer modeling, modern methods of modeling of chemical and technological

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

The students *should be able*: to apply computer modeling techniques to describe the laws of technological processes; to build chemical-technological flowsheets using the Aspen Hysys simulation program; to optimize chemical-technological flowsheets; calculate and analyze the processes of heat and mass transfer.

**Industrial ecology and industrial safety**

CODE – SAF104

CREDIT – 6 (1/0/2/3)

PREREQUISITES: no

---

**PURPOSE AND OBJECTIVES OF THE COURSE**

Purpose of the course: Formation of systematized knowledge on the environmental management system and industrial safety at enterprises depending on the industry

Course Objectives:

- to study the systems of concepts, main factors and problems, principles and methodological techniques of industrial ecology and industrial safety;
- to consider the problems of the influence of various industries on natural ecosystems and human labor conditions;
- to consider the main ways to optimize the relationship between industries and the environment;
- to increase the level of professional competence of students by establishing a system of interdisciplinary connections between the content of the course of the discipline and the content of the major disciplines

**SHORT DESCRIPTION OF THE COURSE**

When studying the course, it is supposed to consider the main sources of environmental pollution by industrial enterprises and study industrial safety issues, familiarize yourself with methods for reducing pollution of the technosphere and ensuring the safety of production equipment and processes, ways to prevent and restore harmful effects on OS components and workplaces.

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

As a result of mastering the discipline, students should

1) know:

- the basic principles of ensuring the norms and rules of environmental protection at industrial enterprises and methods of ensuring industrial safety;
- the basics of industrial sanitation and labor hygiene, accounting for accidents and occupational diseases;
- basics of electrical and fire safety;

2) be able to:

- apply the main provisions of environmental and labor legislation, sanitary and epidemiological and regulatory requirements for industrial ecology and industrial safety at work;

- to make the right choice of measures to reduce the negative impact of production processes on the environment;

3) own skills:

- calculation of environmental standards,

- calculation of the volumes and consequences of environmental pollution, the consequences of injuries,

- determination of indicators of working conditions.

## **PROCESS DESIGN**

CODE – CHE 587

CREDIT – 6 (2/0/1/3)

PREREQUISITE - General Chemical Technology, Transport Phenomena I

---

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

the main purpose of the course-the acquisition of students ' theoretical knowledge and skills of engineering calculations, in the development of methods and the main stages of design required in the implementation of the diploma project and independent professional activity. chemical engineer must know the basics of design and be able to perform all the work necessary for the development of cost - effective and environmentally safe technological part of the project, reconstruction or construction of a new enterprise.

Course objective:

- study of the basic principles of chemical production design;
- analysis of the existing equipment, the choice of ways to upgrade and improve the equipment, the ability to formulate technical proposals;
- familiarization with the purpose, principle of operation and device of chemical equipment of organic production;
- acquisition of skills of technological and structural calculation of equipment;
- ability to work with regulatory and technical documents and choose equipment in the appropriate directories, standards, directories.

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

This discipline considers issues related to the development of new designs of machines and devices with high performance and providing higher economic efficiency and improvement of product quality.

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

The study of this discipline will allow the student to acquire theoretical knowledge and skills of engineering calculations, to master the methods and the main stages of design necessary for the implementation of the pilot project and independent professional activity. chemical engineer must know the basics of design and be able to perform all the work necessary for the development of cost-effective and environmentally safe technological part of the project, reconstruction or construction of a new enterprise.

**ENVIRONMENTAL MONITORING**

CODE – BIO414

Credit – 6 (1/0/2/3)

PREREQUISITE – no

---

**PURPOSE AND TASKS OF THE COURSE**

The purpose of teaching the discipline "Environmental monitoring" is theoretical and practical training of students on monitoring the state of the environment and warning of critical situations, harmful or dangerous to human health, flora and fauna.

Objectives of the discipline:

As a result of studying the course the student should know:

- nature, specificity and properties of environmental monitoring;
- features of the organization of monitoring of different hierarchical levels;
- methods and tools for environmental data collection;
- methodology of organization of environmental information collection for integrated assessment of geosystems;
- theoretical basis of mathematical and cartographic data processing, automatic construction of cartographic images.

**BRIEF DESCRIPTION OF THE COURSE**

Discipline "Environmental monitoring" gives an idea of environmental monitoring programs, types and types of monitoring, the principles of organization, the main functions and structure of monitoring of Kazakhstan, methods of collection, storage and transmission of geo-environmental information.

**KNOWLEDGE, SKILLS TO COMPLETE THE COURSE**

As a result of studying the course the student must be able to:

- navigate in the range of tasks that require the organization of different types and types of monitoring and solved on the basis of geo-environmental information;
- use modern methods and means of environmental monitoring on the examples of training data on the quality of the surface layer of the atmosphere, soil and water environment for integrated geo-environmental assessment of the territory.



## **PROTECTION OF THE THESIS / DIPLOMA PROJECT**

CODE – ECA 102

Credit – 6

PREREQUISITE: professional training

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

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

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

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

The diploma project presents a summary of the results of self-study and research on a pressing problem in the field of chemical engineering, environmental protection and biotechnology.

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

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

**РЕЦЕНЗИЯ**

на образовательную программу  
«Химическая и биохимическая инженерия»  
в области инженерии и инженерного дела  
(Бакалавр техники и технологий)

Рецензируемая образовательная программа (ОП) «Химическая и биохимическая инженерия» квалификации «Инженерия и инженерное дело» (бакалавр) Национальной рамки квалификации представляет собой описание образовательной подготовки, разработанной на основе Государственного общеобязательного стандарта высшего образования Республики Казахстан (бакалавриат).

Содержание и структура ОП по направлению подготовки «6В071 – Инженерия и инженерное дело» отвечает основным требованиям стандарта и содержит следующую информацию: цели и задачи ОП, характеристику профессиональной деятельности выпускника, академические требования к поступающим, требования для завершения обучения и получение диплома, правила перезачета кредитов, дескрипторы уровня и объема знаний, умений, навыков и полный перечень общечеловеческих, социально-этических, базовых, профессиональных и специальных компетенций.

Структура Учебного плана ОП «Химическая и биохимическая инженерия» логична и последовательна. Дисциплины учебного плана раскрывают сущность актуальных на сегодняшний день проблем. Общая трудоемкость программы составляет 242 академических часа теоретического обучения (ECTS).

Сильными сторонами рецензируемой ОП являются:

- обеспечение фундаментальной подготовки студентов для успешного решения ими научных и инженерных задач в профессиональной области, о чем свидетельствует объем дисциплин базового цикла;

- развитие обучающихся через научно-исследовательскую деятельность, критическое мышление, приобретение профессионально-ориентированных навыков и умений;

- возможность выбора обучающимися различных видов профессиональной деятельности, что повышает их востребованность на рынке труда.

На основании вышесказанного считаю, что образовательная программа «Химическая и биохимическая инженерия» направления подготовки «6В071 – Инженерия и инженерное дело» может быть рекомендована для внедрения в учебный процесс.

**Первый заместитель ген. директора  
АО «Институт химических наук  
им. А.Б. Бектурова»,  
д.т.н., профессор, член-корр. НАН РК**



**Джусипбеков У.Ж.**

МУНАЙ ӨНІМДЕРІН СЫНАЙТЫН ТӘУЕЛСІЗ ОРТАЛЫҒЫ  
НЕЗАВИСИМЫЙ ЦЕНТР ЭКСПЕРТИЗЫ НЕФТЕПРОДУКТОВ

ЖШС «МӨСТО  
«ORGANIC»  
Қазақстан Республикасы  
050028, Алматы қ-сы,  
Первомайский бұр., 38  
Тел.: 8 727 246 65 42, 380 51 58  
E-mail: organic.oiltest@mail.ru



ТОО «НЦЭН  
«ORGANIC»  
Республика Казахстан  
050028, г. Алматы,  
пер. Первомайский, 38  
Тел.: 8 727 246 65 42, 380 51 58  
E-mail: organic.oiltest@mail.ru

Рецензия  
на образовательную программу бакалавриата  
«Химическая и биохимическая инженерия»

Образовательная программа «Химическая и биохимическая инженерия» бакалавриата предназначена для подготовки специалистов широкого профиля в области химической и биологической инженерии с фундаментальной подготовкой по базовым дисциплинам: химия, физика, математика, биология, английский язык. Вместе с тем предусмотренные в образовательной программе общетехнические и инженерные дисциплины, а также специальные дисциплины способствуют успешному формированию у студентов профессиональных компетенций таких, как организация и управление технологическими процессами химических производств; осуществление контроля качества исходного сырья, материалов и готовой продукции; оценка экономической эффективности технологических процессов и инновационных технологических рисков при внедрении новых технологий.

Программа направлена на подготовку специалистов через триединство: образовательный процесс – наука – производство. Выпускники программы наряду с профессиональными компетенциями приобретают социально-гуманитарную подготовку на основе законов социально-экономического развития общества, истории, современных информационных технологий, государственного языка, иностранного и русского языков.

Считаю, что образовательная программа «Химическая и биохимическая инженерия» уровня бакалавриата отвечает потребностям работодателей и рынка труда, задачам индустриально-инновационного развития страны и может быть рекомендована к внедрению в образовательный процесс

Директор  
ТОО «Независимый центр  
экспертизы нефтепродуктов  
«ORGANIC»



А. Калмуратова



**РЕЦЕНЗИЯ**  
**на образовательную программу**  
**«Химическая и биохимическая инженерия»**

Основной целью рецензируемой образовательной программы (далее-ОП) является формирование знаний, умений и навыков, необходимых для решения задач профессиональной деятельности, обеспечение контроля уровня освоения компетенций с предоставлением выпускникам возможности выбора области профессиональной деятельности и совершенствования личностных и профессиональных качеств.

Образовательная программа содержит информацию о квалификации выпускников, о профессиональных компетенциях, приведены описание программы и нормативные документы, перечень профессиональных навыков и умений, которыми должен обладать выпускник в результате освоения образовательной программы «Химическая и биохимическая инженерия»

Качество рассматриваемой образовательной программы не вызывает сомнений. Включенные в ОП базовые и фундаментальные дисциплины раскрывают сущность актуальных на сегодняшний день проблем в области химической и биотехнологической инженерии, охраны окружающей среды и экологии. Выпускники на базе фундаментально-прикладных знаний инженерно-технического, химического и биологического профилей будут обладать глубокими знаниями теоретических и практических основ инженерии, защиты окружающей среды, экологического прогнозирования и мониторинга, оценки воздействия экологических факторов на окружающую среду.

Необходимо отметить, что образовательная программа повышает конкурентоспособность выпускников этой программы на рынке труда, а объектами возможного трудоустройства выпускников являются промышленные предприятия различных отраслей промышленности, включая предприятия химического и нефтехимического профилей различных форм собственности, предприятия биотехнологических производств, а также сектор экологического мониторинга и эколого-нормативного проектирования предприятий.

**Главный специалист ТОО «КАПЭ»,**  
**ученый секретарь НТС,**  
**кандидат технических наук**  
**по специальности 25.00.36-Геоэкология**

**Ж. Дюсенова**

*Подлинность подписи заверено*  
  
*мен. по пер.*