Geology and Oil-gas Business Institute named after K. Turyssov
Department of Chemical and Biochemical Engineering

EDUCATION PROGRAM

6B07125 «CHEMICAL TECHNOLOGY OF ORGANIC SUBSTANCES»

Code and classification of the field of education: **6B07** «Engineering, manufacturing and construction industries»

Code and classification of areas of study: **6B071** «Engineering and Engineering»

Group of educational programs: **6B060** «Chemical engineering and processes»

Уровень по НРК: 6

Уровень по ОРК: 6

Year of study: 4

Credits: 240

Almaty 2025

The educational program 6B07125 «Chemical technology of organic substances» was approved at the meeting of the Scientific Council of KazNTU named after K.I.Satpayev

Protocol №10 from «06» 03 2025y

Reviewed and recommended for approval at a meeting of the Educational and Methodological Council of K.I.Satpayev KazNTU

Protocol №3 from «20» 12 2024y

The educational program 6B07125 «Chemical technology of organic substances» was developed by the academic committee in the direction 6B071 «Engineering and Engineering»

Name	**Academic degree/ academic**	**Post**	**Place of work**	
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List of abbreviations and designations

EP – Educational program
CC – Communicative competence
LO – Learning Outcomes
NJSC - Non-profit joint stock company

1. Description of educational program

The educational program is a set of documents developed by the academic committee of the Kazakh National Research Technical University named after K.I. Satpayev.

The EP considers the needs of the regional labor market, the requirements of government agencies and relevant industry requirements. The branch of organic and petrochemical synthesis, which uses oil, gas, coal as raw materials, is the leading one and determines the progress of the chemical industry - an important link in the economy of Kazakhstan. Products of organic and petrochemical synthesis, having valuable chemical and physico-chemical properties, are semi-products in the production of polymers, medicinal substances, plant protection products and other synthetic materials. And since the industry of organic and petrochemical synthesis provides raw materials for all other sub-sectors of the chemical industry that produce synthetic materials, it must develop at a faster pace.

The EP is based on the state educational standard for higher professional education in the relevant field.

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

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

2. Purpose and objectives of the educational program

The purpose of the EP: Training of specialists with key and professional competencies in the field of production of organic substances, processing of oil, gas, coal and polymers, elastomers, paints and varnishes.

The objectives of this EP are:

- social, humanitarian and professional training of bachelors in the field of chemical engineering in accordance with the development of science and production, as well as with the needs of oil and gas chemical clusters in Kazakhstan, national research centers, master's and doctoral studies of higher educational

institutions;

- training of bachelors - technologists who know the raw material base, methods of analytical quality control of raw materials and commercial products, production technologies and areas of consumption of organic substances and materials with fundamental training in physics, mathematics, chemistry, physical and chemical foundations of technologies for obtaining the most important classes of organic substances, production of chemical reagents (additives, surfactants, polymers) used in the production of fuels and petroleum oils, in the processes of extraction, preparation and transportation of hydrocarbon raw materials.

– providing knowledge, skills and abilities that allow analyzing problems in the field of chemical engineering and finding ways to solve them, solve engineering problems in the design of production of organic substances and materials, conduct research work in the field of synthesis and study of the properties of new chemical compounds and materials using information technologies and methods of mathematical planning of experiment.

- preparation of students for professional activities in the conditions of existing production, the formation of skills and abilities to maintain the required level of labor and production discipline; on conducting a technical and economic analysis of production; on the adoption and implementation of management decisions in the face of different opinions.

3. Requirements for evaluating the learning outcomes of an educational program

The educational program was developed by the academic committee in accordance with the State Mandatory Standards of Higher and Postgraduate Education of the Republic of Kazakhstan dated July 20, 2022 No. 2 and reflects the learning outcomes on the basis of which curricula (working curricula, individual curricula of students) and working curricula in disciplines (syllabuses) are developed. Formed learning outcomes: applies knowledge of natural science, socio-economic and profile disciplines of biotechnology to solve practical and professional tasks of the biotechnology industry.

Formed learning outcomes: applies knowledge of natural science, socio-economic and profile disciplines of chemical technology to solve practical and professional tasks of the technological industry.

Evaluation of learning outcomes is carried out according to the developed test tasks within the educational program in accordance with the requirements of the state mandatory standard of higher and postgraduate education.

When evaluating learning outcomes, uniform conditions and equal opportunities are created for students to demonstrate their knowledge, skills and abilities. To use modern information technologies for the collection, processing and dissemination of scientific information in the field of production of organic substances, processing of oil, gas, coal and polymers, elastomers, paints and varnishes.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	6B07 «Engineering, manufacturing and construction industries»
1	Code and classification of areas of study	6B071 «Engineering and Engineering» (0710)
3	Group of educational programs	6V060 Chemical Engineering and Processes"
4	Name of the educational program	6V07101 "Chemical technology of organic substances"
5	Brief description of the educational program	The educational program (hereinafter EP) is a set of documents developed by the Kazakh National Research Technical University named after K.I. Satpayev and approved by the Ministry of Education and Science of the Republic of Kazakhstan. The EP considers the needs of the regional labor market, the requirements of government agencies and relevant industry requirements.
6	Purpose of the OP	Training of specialists with key and professional competencies in the field of production of organic substances, processing of oil, gas, coal and polymers, elastomers, paints and varnishes.
7	OP type	new
8	NQF level	6
9	ORC level	6
10	Distinctive features of the OP	The EP was developed considering the Atlas of new professions and competencies of Kazakhstan in the field of chemical technology of organic substances.
11	List of competencies of the educational program:	KK1.Communication - Fluent monolingual oral, written and communication skills - The ability to use communicative communication in various situations KK 2. Basic literacy in natural science disciplines - basic understanding of the scientific picture of the world with an understanding of the essence of the basic laws of science KK3.General engineering competencies - basic general engineering skills and knowledge, the ability to solve general engineering tasks and problems KK4.Professional competencies - a wide range of theoretical and practical knowledge in the professional field; - the ability to carry out the technological process in accordance with the regulations and use technical means to measure the main parameters of the technological process, the composition and properties of raw materials and finished products; KK5. Engineering and computer competencies - basic skills of using computer programs and software systems to solve general engineering tasks KK6.Engineering and working competencies - skills and abilities of using technical means and experimental devices to solve general engineering tasks KK7. Socio-economic competencies - Critical understanding and cognitive ability to reason on contemporary social and economic issues KK8. Specially-professional competencies for the perception of information, setting goals and choosing ways to achieve it; – the ability to independently organize the work of performers, find and make

		management decisions in the field of labor organization and implementation of environmental measures; – knowledge of the principles of management, control and correction of activities in the context of teamwork, improving managerial and executive professionalism.
12	Learning outcomes of the educational program:	PO1 Develop design and estimate documentation for the production of organic substances, analysing alternative technology options of varying levels of complexity; PO2 Understand the impact of engineering decisions in global, economic, environmental, and social contexts, taking into account the principles of sustainable development, the values of inclusion, and modern trends in societal development; PO3 Apply methods of mathematical analysis and modelling in the design and optimisation of technological processes, demonstrating skills in the calculation of typical equipment of the main types of industries; PO4 Demonstrate the ability to ensure the safe operation of technological equipment in compliance with occupational safety and environmental regulations; RO5 Describe systems and methods of design of technological processes and production modes; prospects of technical development of the enterprise; RO6 Solve technical problems related to the production of organic substances, combining the theory and practice of engineering problem solving and the ability to independently identify and formulate practical problems; RO7 Carry out the technological process in accordance with the regulations and application of technical means to measure the main parameters of the technological process, composition and properties of raw materials and finished products RO8 Understand the fundamental laws of natural science and special technical disciplines, using them in professional activities RO9 Apply professional knowledge in the field of organic substance technology and the principles of operation of technological equipment for the justified selection and effective management of technological processes, in compliance with industrial safety requirements, environmental standards, and the principles of sustainable development.
13	Form of study	Full-time
14	Training period	4 years
15	Volume of loans	240
16	Languages of instruction	Kaz, Russian and English
17	Awarded Academic Degree	Bachelor of Engineering and Technology
18	Developer(s) and authors:	Selenova B.S., Mangazbaeva R.A., Aitkalieva G.S.

4.2. The relationship between the achievability of the formed learning outcomes in the educational program and academic disciplines

№	Name of discipline	Brief description of discipline	Number of credits		Formed learning outcomes (codes)							
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
	Cycle of basic disciplines University component											
1	English language	English is a compulsary subject. According to the results of placement test or IELTS score, students are placed into groups and disciplines. The name of the discipline corresponds to the level of English. When passing from level to level, prerequisites and postrequisites are respected.	**10**	**v**								
2	Kazakh (russian) language	In this course author considers socio-political, socio-cultural spheres of communication and functional styles of the modern kazakh (russian) language. The course covers the specifics of the scientific style to develop and activate professional communication skills and abilities of students. Also it allows students to leavn the basics of scientific style practically and develop the ability of production structural and semantic text analysis.	**10**	**v**								
3	Physical culture	The purpose of the discipline is to master the forms and methods of forming a healthy lifestyle within the framework of the professional education system. Familiarization with the natural-scientific basics of physical education, knowledge of modern health-improving technologies, basic methods of independent physical education and sports. As part of the course, the student will master the rules of judging in all sports.	**2**									
4	Information and communication technologies	Required component. The aim of the course is to gain theoretical knowledge in information processing, the latest information technologies, local and global networks, the methods of information protection; Getting the right use of text editor editors and tabulators; creation of base and different categories of applications.	**5**					**v**				

5	Modern history of Kazakhstan	Required component. The task of studying the discipline is to acquire theoretical knowledge about information processes, new information technologies, local and global computer networks, methods of information protection; obtaining skills in the use of text editors and spreadsheet processors; creation of databases and various categories of application programs.	**5**		**v**							
6	Philosophy	Philosophy forms and develops critical and creative thinking, worldview and culture, provides knowledge about the most general and fundamental problems of being and endows them with a methodology for solving various theoretical practical issues. Philosophy expands the horizon of vision of the modern world, forms citizenship and patriotism, contributes to the education of self-esteem, awareness of the value of human existence. It teaches to think and act correctly, develops the skills of practical and cognitive activity, helps to seek and find ways and means of life in harmony with oneself, society, and the world around.	**5**									
7	Module of socio-political knowledge (sociology, political science)	Studying the course contributes to the formation of students' theoretical knowledge about society as an integral system, provides the political aspect of training a highly qualified specialist on the basis of modern world and domestic political thought. The discipline is designed to improve the quality of both general humanitarian and professional training of students. Knowledge in the field of sociology and political science is necessary for understanding political processes, for forming a political culture, developing a personal position and a clearer understanding of the measure of one's responsibility.	**3**	**v**								
8	Module of socio-political knowledge (culturology, psychology)	The module of socio-political knowledge (culturology, psychology) is designed to acquaint students with the cultural achievements of mankind, for their understanding and assimilation of the main forms and universal patterns of the formation and development of culture. During the course of cultural studies, general problems of the theory of culture, leading cultural concepts, universal patterns and mechanisms for the formation and development of culture, the main historical stages of the formation and development of Kazakhstani culture are considered.	**3**		**v**							

	Cycle of general education disciplines Optional component											
9	Basics of Financial Literacy	Purpose: formation of financial literacy of students on the basis of building a direct link between the acquired knowledge and their practical application. Contents: using in practice all kinds of tools in the field of financial management, saving and increasing savings, competent budget planning, obtaining practical skills in calculating, paying taxes and correctly filling out tax reports, analyzing financial information, orienting in financial products to choose adequate investment strategies.	**5**				v	v				Purpose: formation of financial literacy of students on the basis of building using in practice all kinds of tools in the field of financial management, sav calculating, paying taxes and correctly filling out tax reports, analyzing fin strategies.
10	Fundamentals of Entrepreneurship and Leadership	Purpose: To develop basic knowledge of economic processes and skills in entrepreneurial activities. Content: The course aims to develop skills in analyzing economic concepts such as supply and demand, and market equilibrium. It includes the basics of creating and managing a business, developing business plans, risk assessment, and strategic decision-making.	**5**				**v**	**v**				
11	Law basics	The purpose of the study: To attain knowledge in legal sphere in order to use them effectively in engineering activity; To make students know about efficient management of a work collective basing on legal mechanisms. Short content: the course allows students to get knowledge about specified directions of law, to organize information about subject and object of legal relations, about the main institutes and functions of legal directions. Expected results: After the course studying students should know, how to use legal norms in particular situations, how to make necessary documents and how to use special legal measures to restore broken rights.	**5**				**v**					
	Cycle of basic disciplines University component											
12	Mathematics I	Purpose: to introduce students to the fundamental concepts of linear algebra, analytical geometry and mathematical analysis. To form the ability to solve typical and applied problems of the discipline. Contents_ Elements of linear algebra, vector algebra and analytical geometry. Introduction to the analysis. Differential calculus of a function of one variable. The study of functions using derivatives. Functions of several variables.	**5**								**v**	

		Partial derivatives. The extremum of a function of two variables.											
13	Physics	Purpose:To form ideas about the modern physical picture of the world and scientific worldview, the ability to use knowledge of fundamental laws, theories of classical and modern physics. Contents_ physical fundamentals of mechanics, fundamentals of molecular physics and thermodynamics, electricity and magnetism, vibrations and waves, optics and fundamentals of quantum physics.	**5**								**v**	
14	Mathematics II	Purpose: To teach students integration methods. To teach you how to choose the right method for finding the primitive. To teach how to apply a certain integral to solve practical problems. Contents_ integral calculus of the function of one and two variables, series theory. Indefinite integrals, methods of their calculation. Certain integrals and applications of certain integrals. Improper integrals. Theory of numerical and functional series, Taylor and Maclaurin series, application of series to approximate calculations_	**5**								**v**	
15	Engineering and computer graphics	Purpose: To develop students' knowledge of drawing construction and skills in developing graphical and textual design documentation in accordance with standards. Content: Students will study ESKD standards, graphic primitives, geometric constructions, methods and properties of orthogonal projection, Monge's projection, axonometric projections, metric tasks, types and features of connections, creating part sketches and assembly drawings, detailing, and creating complex 3D solid objects in AutoCAD.	5			**v**						
16	Introduction to the specialty	The purpose of the discipline is to acquaint students who have begun their studies at the university with the basic and basic provisions of the specialty and study program; development of interest in the chosen profession, the formation of students' competence and understanding of the chosen direction of study, initial professional knowledge about the physical and chemical foundations of the technology of organic substances; formation of technological and ecological thinking among students. The main initial concepts of chemical technology are considered: kinetic laws of chemical transformations, types of reactors and	4		**v**							**v**

		mole balance equations, technological indicators of processes, drawing up technological schemes of chemical processes.											
17	general chemistry	Purpose: formation of knowledge on fundamental issues of general chemistry and skills of their application in professional activity. Summary Laws, theoretical propositions and conclusions that underlie chemical disciplines; properties and relationships of chemical elements based on the periodic law of D.I.Mendeleev and on modern ideas about the structure of matter; fundamentals of chemical thermodynamics and kinetics; processes in solutions; structure of complex compounds.	5								**v**	
18	Organic Chemistry I	The purpose of the discipline is the development of a complex of knowledge and scientific ideas about the fundamental theoretical and experimental foundations of organic chemistry of aliphatic compounds; in students gaining knowledge of the basic concepts of theoretical organic chemistry, mastering the ability to characterize the structure, physico-chemical properties of organic substances, as well as modern methods for the synthesis of organic substances. The course forms the basis of chemical reactions and methods for the synthesis of organic compounds for the most important branches of the chemical and biochemical industries	6								**v**	
19	Organic Chemistry II	The purpose of the discipline is to study the general patterns of the flow of organic reactions of cyclic compounds, such as cycloalkanes, aromatic hydrocarbons, and heterocyclic compounds. Each class of compounds is considered in terms of their chemical structure, isomerism and nomenclature, method of preparation, physical and chemical properties, and scope of their application. In the process of mastering this discipline, the student forms and demonstrates competencies that allow applying the obtained basic scientific and theoretical knowledge to solve scientific and practical problems.	5								**v**	
20	Chemical thermodynamics	The purpose of the discipline: the study of the theoretical foundations of classical and statistical thermodynamics, the general principles of thermodynamics as applied to multicomponent systems, ways of using thermodynamic methods to solve chemical problems, as well as the formation of students' knowledge and skills that allow	5						v		**v**	

		them to model and carry out numerical calculations when describing various types of chemical and phase equilibria and properties of substances in solutions. The content of the discipline covers a range of issues related to the general laws of the course of chemical processes. The directions of the spontaneous course of chemical processes are investigated, methods for determining the qualitative and quantitative composition of an equilibrium reaction mixture, the basics of thermodynamics of isolated and open systems, the theory of binary and multicomponent solutions, analysis of phase diagrams, and the development of the thermodynamic theory of chemical reactions are considered. In the process of mastering this discipline, students develop knowledge on the basic laws of chemical thermodynamics and methods for calculating the thermodynamic parameters of chemical technological processes, skills in theoretical calculations of thermodynamic constants of substances and potentials.										
21	Theoretical foundations of organic substances technology	The purpose of the discipline is for students to study modern trends in the creation of theoretical foundations of technology for processing oil, gas, coal, hydrocarbon raw materials, monomers for the synthesis of polymers and synthetic rubbers, synthetic detergents. The theoretical foundations of preparation and physical methods of separation of oil, gas, coal and products of their processing, various processes (thermodestructive, thermooxidative, catalytic) transformations of combustible minerals and products of their processing are considered, the theoretical foundations of polymer production, which are one of the main directions of application of organic substances, are touched upon.	5						v			v
22	Hardware design of the production of organic substances I	Formation of students' understanding of the laws of hydromechanical and heat exchange processes occurring in systems with several phases and several components and development of methods for calculating equipment, choosing a rational design and determining the size of devices. As a result, the student forms competencies that allow calculations of processes and apparatuses of hydromechanical and heat exchange processes, perform constructive calculations of apparatuses.	5				v	**v**				

23	CAD Chemical engineering I	The purpose of studying the discipline is to develop the ability to create effective and optimal technologies for various chemical processes using the modeling computer program CemKad. The issues considered in the course are the study of the laws of hydromechanical and heat exchange processes occurring in various systems, and the development of various calculation methods. The method of calculating chemical technology devices using a modeling program. The course-forms the student's ability to perform engineering and technological calculations using a computer modeling program, encourages the creation of various projects.	5		v					v		
24	Economic aspects of the technology of organic substances	The purpose of the discipline is to form a set of students' knowledge about the methods of conducting production processes, scientific thinking about understanding the logical connection between the chemical structure and reactivity of organic compounds, the processes of their processing, leading to a radical change in their properties. Creation of the basics of theoretical training for students to solve practical problems in the field of basic organic and petrochemical production.	5	v	v							
25	Processing technology of hydrocarbon raw materials I	To form the ability to use knowledge of the physico-chemical features of the technology of processing heavy oil raw materials in order to increase the depth of oil refining. Preparation of graduates for production and technological activities, search and acquisition of new information, integration of knowledge in relation to professional activity.To form basic knowledge and basic concepts of technology, ideas about its fundamental laws and basic methods, the ability to acquire new knowledge in the field of natural sciences.	5						v			v
26	CAD Chemical Engineering II	The purpose of the discipline is the study of modeling chemical-technological processes using the AspenHysys modeling software package. The course studies the basic concepts of the modeling method, methods for constructing a technological scheme, characteristics of a technological scheme and flows, calculation of the parameters of all flows and equipment. The course forms the ability to develop the optimal technology of a chemical process with a high-quality yield of the target product.	5		v					v		

27	Hardware design of production of organic substances II	The aim of the course is to study the regularities and mathematical description of mass transfer processes occurring in systems with several phases and several components. The essence and theoretical foundations of the main processes of chemical technology. Mass transfer processes, calculation and selection of devices and structures. Comparative analysis of the operation of devices, finding optimal conditions for technological processes. Methods of calculation of the main processes and devices.	4				v	v				
28	Processing technology of hydrocarbon raw materials II	The purpose of the discipline is to provide students with the necessary professional competencies in the field of chemical technology for the secondary processing of hydrocarbon raw materials. As a result of studying the discipline, the student must: - know the basics of managing chemical and technological processes for processing products of primary oil and gas processing; - have the skills to study the physical and chemical properties and composition of raw materials and the quality of hydrocarbon raw materials processing products; - be able to make specific technical decisions in the development of technological processes.	5						v			v
29	Chemical kinetics and catalysis	The purpose of the discipline is to consider the basics of chemical kinetics and catalysis, to give an idea of the mechanisms of chemical reactions. basic laws and regularities that determine the direction and result of processes in homogeneous and heterogeneous systems, methods of analytical representation of these regularities. The educational material contributes to the expansion of students' knowledge about the catalysis of chemical reactions, the difference and the basic principles of homogeneous, enzymatic and heterogeneous catalysis. During the study of the discipline, the skills of experimental determination and calculation of the rates of chemical transformations, the study of the nature of the catalytic action and intermediate compounds of reagents with a catalyst are instilled.	5						v		v	
30	Chemistry and Physics of Polymers	The purpose of the discipline is to study by students the main directions of modern development of chemistry and physics of polymers, their use and various sectors of the economy. General concepts and terminology in the field of polymers.	5						v		v	

		Regularities of the chain and step mechanism of polymer synthesis. Chemical modification of polymers. Molecular and supramolecular structure of polymers. Deformation properties of polymers. Thermomechanical method of polymer research. Features of polymer dissolution. In the process of mastering this discipline, students develop knowledge on the classification and terminology of polymers.											
31	Educational practice	Passing an instruction on familiarization with the requirements of labor protection, safety, fire safety, and the rules of the internal labor regulations of the enterprise. Conducting a general tour of the enterprise, studying the structure. The stage of collecting, processing and analyzing technical or technological information on the technology being implemented.	2				v	v				
		Cycle of basic disciplines Optional component											
32	General chemical technology	The purpose of the course: the study of the general patterns of the flow of chemical-technological processes (CTP) of the most important chemical industries. The course examines the patterns of chemical transformations in industrial production; basic chemical equipment. Calculation of technical and economic indicators of the process, material and energy balances. industrial catalysis. Basic mathematical models of chemical reactors. Methods for the development of effective chemical-technological processes and systems, methods of energy and resource saving, environmental protection.	5									v
33	Analytical chemistry and physico-chemical methods of analysis	The purpose of the course is to master the methods of analysis of organic substances and their application to solve problems in professional activity. The course discusses the principles and methods of determining the chemical composition of substances and their structure, including using physico-chemical research methods. Application of analytical methods for product quality control in various industries.	5						v	v		
34	Legal regulation of intellectual property	Purpose: the goal is to form a holistic understanding of the system of legal regulation of intellectual property, including basic principles, mechanisms for protecting intellectual	5				v					

		property rights and features of their implementation. Content: The discipline covers the basics of IP law, including copyright, patents, trademarks, and industrial designs. Students learn how to protect and manage intellectual property rights, and consider legal disputes and methods for resolving the										
35	Automation of control systems in chemical-technological processes	Automation of control systems in chemical and technological processes. The purpose of studying the discipline is to acquire the knowledge necessary for effective use in the development of modern automatic control systems. Gaining skills in building and researching mathematical models. Possession of TAR sections necessary for solving research and applied problems. The course "APCS" provides a presentation of the sections of the basics of TAP, measuring elements, actuators, functional diagrams. The study of this discipline will allow the student to acquire the skills to choose the types of switching devices and regulators depending on the law of regulation, to develop a functional and mathematical model of the control system, to analyze the operation of the system based on quality indicators of regulation.	6						v	v		
36	Automation of control systems	Purpose: - to form the ability to develop, research and operate modern automated process control systems. As a result of training: understand the theory and practice of automated process control systems, learn the principles of building a technical base, mathematical and information support for automated process control systems, be able to apply the basic principles of preparing technological processes and industries for automation.	6						v	v		
37	General principles of chemical and technological principles	The course is designed to get acquainted with the general laws of chemical technology, the most typical chemical and technological processes, reactors and chemical and technological systems. As a result, the course develops competencies that allow the technological process to be carried out in accordance with the regulations and use technical means to control its main process parameters, properties of raw materials and products.	5	v								
38	Fundamentals of sustainable development and	Objective: students to master the theoretical foundations and practical skills in the field of sustainable development and ESG, as well as to form an understanding of the role of these	5		v							

	ESG projects in Kazakhstan	aspects in the modern economic and social development of Kazakhstan. Content: introduces the principles of sustainable development and the implementation of ESG practices in Kazakhstan, includes the study of national and international standards, the analysis of successful ESG projects and strategies for their implementation in enterprises and organizations.										
39	The basics of artistic intelligence	Purpose: to familiarize students with the basic concepts, methods and technologies in the field of artificial intelligence: machine learning, computer vision, natural language processing, etc. Contents: general definition of artificial intelligence, intelligent agents, information retrieval and state space exploration, logical agents, architecture of artificial intelligence systems, expert systems, observational learning, statistical learning methods, probabilistic processing of linguistic information, semantic models, natural language processing systems.	5		**v**	v						
40	Ecology and life safety	The discipline studies the main approaches to solving environmental problems; sources and types of environmental pollution by transport enterprises; methods of reducing harmful effects on the environment. Natural and man-made emergencies, their causes, methods of prevention and protection. Conducting rescue and other emergency operations, rules of human behavior in emergency situations.	5		**v**							
41	ESG Principles in an inclusive culture	Purpose of the course: It focuses on studying ESG (Environmental, Social, Governance) principles and their interaction with the creation of an inclusive culture within an organization. Content: Students will gain knowledge on how implementing ESG principles contributes to corporate social responsibility, sustainable development, and equal opportunities for all employees, including those who may face various forms of discrimination. The course will help students understand the importance of an inclusive culture in achieving long-term business goals and ensuring sustainable organizational development.	5		**v**							**v**
42	The foundations of an anti-	The course introduces students to the improvement of socio-economic relations of Kazakh society, the psychological features of corrupt behavior. Special attention is paid to the	5				**v**					

	corruption culture	formation of an anti-corruption culture and legal responsibility for acts of corruption in various fields. The purpose of studying the discipline "Fundamentals of anti-corruption culture" is to increase public and individual legal awareness and legal culture of students, as well as to form a knowledge system and a civic position on combating corruption as an antisocial phenomenon. Expected results: to implement the values of moral consciousness and follow moral norms in daily practice; to work on improving the level of moral and legal culture; to use spiritual and moral mechanisms to prevent corruption.											
43	Fundamentals of scientific research	Purpose: to form students' research skills, to develop an interest in scientific activity. Content: based on the course, students will consider: - the formation of practical skills in planning and performing scientific research; - the development of skills in independent search, analysis and use of scientific information using software and hardware; - mastering the concepts of sustainable development and ESG principles, with an emphasis on their application in the oil and gas sector of Kazakhstan.	5						v		v		
	Cycle of major disciplines University component												
44	Technology of production and processing of polymers	The discipline "Technology of production and processing of polymers" includes the study of methods for implementing technological processes for obtaining the main types of polymerization, polycondensation and chemically modified polymers and polymeric materials based on them. As a result of studying this discipline, students should have: an idea of: modern technologies for the production and processing of polymers know: the physical and chemical bases of polymer processing.	4					v	v				
45	Enterprise Design Fundamentals	The purpose of the discipline is to study the structures, the principle of operation of the main and special equipment for chemical production, familiarization with its main components and details. At the end of the course, the student should know the basic principles of designing and developing a feasibility study for production; parameters and modes of operation of typical equipment; typical processes of chemical technology, corresponding apparatuses and methods of their calculation; requirements for the technical condition of the equipment;	5	v				v	v				v

		methods of technological calculations of individual components and parts of chemical equipment.											
46	Technology of organic and petrochemical industries	To form students' knowledge about the ways of conducting production processes, scientific thinking about understanding the logical relationship between the chemical structure and reactivity of organic compounds, and the processes of their processing, leading to a fundamental change in their properties. Creating the foundations of theoretical training for students to solve practical problems in the field of basic organic and petrochemical production.	5						v			v
47	Environmental management in the production of organic products	The purpose of the course is to study the fundamentals of rational and environmentally sound environmental management, which is an urgent problem for the oil production, processing industry and for subsurface use in general. The course also examines environmental monitoring and technological solutions for reducing pollution in chemical and petrochemical enterprises. In the process of mastering this discipline, the student forms and demonstrates competencies that allow him to apply the acquired basic scientific and theoretical knowledge on the use of natural resources and the development of conservation measures.	4					v				v
48	Equipment for organic synthesis enterprises	The course provides students with a holistic perception of the complex of technological knowledge in the field of equipment and technological production of organic synthesis. The course develops the following skills for students: drawing up the composition of the project (working draft), design estimates, the grounds for its development, the organizational foundations for designing enterprises of organic synthesis and polymers, mastering the methods and features of calculating the strength of elements of apparatus and machines. In the course of studying the discipline, students also gain skills in using scientific, technical and reference literature, determining the technical characteristics of apparatus and equipment and evaluating their technical and economic efficiency.	6	v				v	v			v
49	Production practice I	The production practice I is of an introductory nature. During the internship, students will get acquainted with the work of the production enterprise, they will observe the production process.	2				v			v		

50	Industrial practice II	Goals and objectives of the practice: 1. To ensure the formation of professional knowledge, skills and abilities in the information and communication field. 2. To acquaint students with the methods of work and the specifics of the activities of specialists in the production process. 3. To demonstrate the relationship between theoretical courses taught in the learning process and practical activities. 4. Consolidate students' knowledge	3				v			v		
	Cycle of major disciplines Selectable Component											
51	Chemical technology of solid fossil fuels	The purpose of the discipline is to form students' technological thinking in the field of solid fuel processing technology as an alternative to petroleum fuel, to provide information about the main methods and stages of fuel processing and the prospects for the development of the industry, and to teach students to creatively use general scientific and general engineering disciplines for management, understanding and explanation complex phenomena occurring in the processes of chemical processing of solid fuels	5					v	v			v
52	Thermal decomposition of coal	The purpose of studying the course "Thermal decomposition of coal" is to train highly qualified specialists, chemical engineers and technologists for the processing of solid fossil fuels, who know the methods of calculation and design of operational installations and equipment, the formation of a scientific and technical worldview among future specialists. The technology of thermal decomposition of coal for the purpose of production of various types of fuels is considered; state and prospects of the raw material base of the coke industry.	5					v		v		v
53	Gas chemistry	The purpose of the discipline is to form the competence of the student in the field of natural and associated gas processing technology. In the course of studying the discipline, the student must: -know the importance of natural gases in the economy and energy, the composition of hydrocarbon gases, their physical and chemical properties, the current state and prospects for the development of the gas processing industry in Kazakhstan and the world; - be able to assess the technical and economic efficiency of technology and have the skills to	5					v	v			v

		determine the technical characteristics of apparatus and equipment;											
54	Production of hydrocarbon raw materials for the petrochemical industry	The purpose of studying the discipline: The formation of students' systemic knowledge on the theoretical foundations and technology for the production of hydrocarbon raw materials for the petrochemical industry. In the course of studying the discipline, the student must: -know the chemistry and mechanism of thermal and catalytic transformations of oil and gas components; - to know the physical and chemical properties of hydrocarbons and other components of oil and their influence on the properties of petroleum products, - to know the principles of constructing technological schemes and designing technological processes in the petrochemical industry.	5	**v**				**v**				**v**
55	Technology for the production of aromatic hydrocarbons	The purpose of the discipline: The formation of students' systemic knowledge on the theoretical foundations and industrial technologies for the production of aromatic hydrocarbons from petroleum feedstocks. In the course of studying the discipline, the student must: -know the structure, physicochemical and thermodynamic properties of aromatic hydrocarbons; - to know the industrial methods of separation and isolation of individual aromatic compounds from the concentrate of aromatic hydrocarbons; -know industrial technologies for increasing the resources of individual aromatic hydrocarbons and their isomers;	5						**v**	**v**			**v**
56	Modern petrochemical production	The discipline is intended for professional training of specialists in the field of petrochemical production. As a result of studying the discipline, the student will master: chemistry and production technologies of basic petroleum products – raw materials for the production and processing of polymers (plastics, chemical fibers, films, rubbers, lacquers, coatings, etc.); develop economically feasible and environmentally safe technologies for processing raw materials and intermediates of petrochemical synthesis; have engineering calculation skills.	5					**v**	**v**			**v**
57	Petroleum oils production technology	The purpose of studying the discipline "Technology for the production of petroleum oils" is to study the technological and physico-chemical foundations of the production, separation and purification of distillate and residual petroleum fractions;	5					v		v		v

		parameters, hardware design and technological schemes of processes; properties and uses of petroleum oils. As a result of studying the discipline, the student must: - know the main products of petrochemical synthesis, in particular petroleum oils, their classification and specific unique properties; know the chemistry and technology of petroleum oils production; - to know about the main scientific achievements in the field of petroleum oils technology; to be able to describe the basic technological schemes of the main industries;											
58	Coal hydrogenation	Purpose: - to form the ability to understand the origin, composition and properties of coals, coal hydrogenation processes, as well as technologies for obtaining motor fuels and organic substances from coal hydrogenation products. As a result of training: know the molecular structure and petrographic composition of coals, carry out a macroscopic description of coals, have an idea about the microcomponents of coals, organic and inorganic constituents of coal, the influence of various factors on the process of coal hydrogenation	5					v	v			v
59	Organic Wastewater Treatment	To form the student's competencies in the field of theory and technology of purification of water flows of various origins, focused on the use of modern technological solutions in the field of protection of water bodies. To instill skills in the calculation of the main processes, which will allow students to be most professionally guided in the justification of technological solutions in the implementation of integrated approaches in the development of measures for the protection of water bodies and systems for the rational water use of industrial facilities;	5					v				v
60	Engineering design of chemical-technological processes	Purpose: -to form the ability to understand the issues of calculating chemical reactions occurring in reactors typical of chemical technology processes. As a result of training: know the basics of the kinetics of homogeneous and heterogeneous processes, draw up the material and energy balances of reactors, understand the issues of hydrodynamics. thermodynamics of chemical reactions, schemes and principles of operation of absorber apparatuses, distinctive features of bubbling and spraying absorbers	5	v				v				v

61	International standardization and certification	Purpose: To become familiar with the formation and development of international certification and standardization, including the history, organizational structure of ISO and its divisions, as well as certification at the international and regional levels. Contents: History of the development of international standardization, organizational structure of ISO and its divisions (STAKO, PLAKO, CASCO, etc.), ISO activities in the field of certification, IEC international certification systems, participation of international organizations in standardization, national certification systems of various countries.	5							**v**		**v**
62	Regulatory framework for the quality of chemical products	The main provisions for the creation of new schemes for the synthesis of large-scale production of samples of a new material using technological equipment and processes that meet all requirements with inexpensive starting materials, easy isolation of pure products and the absence of environmental problems are considered. This course is designed to introduce the basic concepts of chemical engineering for bachelors. instilling in students the ability to independently study educational literature.	5	**v**						**v**		**v**
63	Preparation and use of reservoir and fresh waters for injection into the reservoir	The course presents measures to maintain reservoir pressure, which is a complex of technological equipment that is necessary for the preparation, transportation and injection of water into the oil reservoir. The student must know: the theory of oil treatment in the fields; theory of the theoretical basis of the requirements for formation waters; use of statistical methods for processing experimental data.	6					**v**				**v**
64	Corrosion and equipment protection of organic substances	The purpose of the course is to study the fundamentals of the theory of corrosion of various types of materials, methods of protecting equipment from corrosion from the standpoint of minimizing the impact on the environment, as well as the use of inhibitor protection and modern methods for studying technological processes and natural environments. Knowledge of the basics of this course will allow you to make the right choice of structural materials when creating chemical equipment in a corrosion-resistant design.	6							v		**v**

5. Curriculum of the educational program

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 06.03.2025 Minutes № 10

WORKING CURRICULUM

Academic year	**2025-2026 (Autumn, Spring)**
Group of educational programs	**B050 - "Biological and related sciences"**
Educational program	**6B05105 - "Biotechnology"**
The awarded academic degree	**Bachelor of natural sciences**
Form and duration of study	**full time - 4 years**

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters								Prerequisites
									1 course		2 course		3 course		4 course		
									1 sem	2 sem	3 sem	4 sem	5 sem	6 sem	7 sem	8 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)																	
M-1. Module of language training																	
LNG108	Foreign language		GED, RC	5	150	0/0/45	105	E	5								
LNG104	Kazakh (russian) language		GED, RC	5	150	0/0/45	105	E	5								
LNG108	Foreign language		GED, RC	5	150	0/0/45	105	E		5							
LNG104	Kazakh (russian) language		GED, RC	5	150	0/0/45	105	E		5							
M-2. Дене шынықтыру пәні бойынша дайындық модулі																	
KFK101	Physical culture I		GED, RC	2	60	0/0/30	30	E	2								
KFK102	Physical culture II		GED, RC	2	60	0/0/30	30	E		2							
KFK103	Physical culture III		GED, RC	2	60	0/0/30	30	E			2						
KFK104	Physical culture IV		GED, RC	2	60	0/0/30	30	E				2					
M-3. Module of information technology																	
CSE677	Information and communication technology		GED, RC	5	150	30/15/0	105	E			5						
M-4. Socio-cultural development module																	
HUM137	History of Kazakhstan		GED, RC	5	150	15/0/30	105	GE		5							
HUM134	Module of socio-political knowledge (cultural studies, psychology)		GED, RC	5	150	30/0/15	105	E			5						
HUM132	Philosophy		GED, RC	5	150	15/0/30	105	E				5					
HUM120	Module of socio-political knowledge (sociology, political science)		GED, RC	3	90	15/0/15	60	E				3					
M-5. Module on the basis of anti-corruption culture, ecology and life safety																	
MNG489	Fundamentals of economics and entrepreneurship	1	GED, CCH	5	150	30/0/15	105	E				5					
MNG564	Basics of Financial Literacy	1	GED, CCH	5	150	30/0/15	105	E				5					
HUM159	Law basics	1	GED, CCH	5	150	30/0/15	105	E				5					
CYCLE OF BASIC DISCIPLINES (BD)																	
M-6. Module of physical and mathematical training																	
MAT101	Mathematics I		BD, UC	5	150	15/0/30	105	E	5								
PHY468	Physics		BD, UC	5	150	15/15/15	105	E	5								
MAT102	Mathematics II		BD, UC	5	150	15/0/30	105	E		5							MAT101
M-7. Module of basic training																	
CHE894	Introduction to biotechnology and professional activities		BD, UC	4	120	30/0/15	75	E	4								

GEN429	Engineering and computer graphics		BD, UC	5	150	15/0/30	105	E	5								
BIO128	Objects of biotechnology		BD, UC	5	150	30/0/15	105	E		5							SAF104
AAP173	Practical training		BD, UC	2				R		2							
CHE665	Organic Chemistry I		BD, UC	6	180	30/15/15	120	E			6						
CHE495	Chemistry		BD, UC	5	150	15/30/0	105	E			5						
CHE615	General Biology	1	BD, CCH	5	150	30/0/15	105	E			5						
CHE895	General genetics	1	BD, CCH	5	150	30/0/15	105	E			5						
MNG562	Legal regulation of intellectual property	1	BD, CCH	5	150	30/0/15	105	E			5						
HBI100	Cellular biology		BD, UC	5	150	30/15/0	105	E				5					
BIO124	Molecular biology		BD, UC	5	150	30/0/15	105	E				5					BIO128, BIO106
CHE639	Organic chemistry II		BD, UC	5	150	15/15/15	105	E				5					
CHE499	Biochemistry		BD, UC	5	150	30/15/0	105	E					5				
CHE941	Microbiology and virology		BD, UC	5	150	15/15/15	105	E					5				
CHE896	Botany and plant physiology		BD, UC	5	150	30/0/15	105	E					5				
CHE897	bioinformatics		BD, UC	5	150	30/0/15	105	E					5				
CHE898	Sanitation and hygiene of biotechnological productions		BD, UC	5	150	30/0/15	105	E					5				
CHE899	Physical and chemical research methods in biotechnology		BD, UC	5	150	30/0/15	105	E					5				
AUT424	Basics of automation		BD, UC	5	150	30/15/0	105	E						5			
CHE900	Agricultural biotechnology	1	BD, CCH	4	120	30/0/15	75	E						4			
CHE901	Food biotechnology	1	BD, CCH	4	120	30/0/15	75	E						4			
CHE902	Plant Biotechnology	2	BD, CCH	5	150	30/0/15	105	E						5			
CHE903	Pharmaceutical biotechnology	2	BD, CCH	5	150	30/0/15	105	E						5			
MNG563	Fundamentals of sustainable development and ESG projects in Kazakhstan	2	BD, CCH	5	150	30/0/15	105	E						5			
CSE880	Fundamentals of Artificial Intelligence	2	BD, CCH	5	150	30/0/15	105	E						5			
IDD427	Ecology and life safety	2	BD, CCH	5	150	30/0/15	105	E						5			
CHE950	ESG principles in inclusive culture	2	BD, CCH	5	150	30/0/15	105	E						5			
HUM158	The basics of anti-corruption culture	2	BD, CCH	5	150	30/0/15	105	E						5			
PET525	Fundamentals of scientific research	2	BD, CCH	5	150	30/0/15	105	E						5			
CHE904	Technique and technology of cultivation	1	BD, CCH	6	180	30/15/15	120	E							6		
CHE905	Methods of cell selection for resistance	1	BD, CCH	6	180	30/0/30	120	E							6		
CYCLE OF PROFILE DISCIPLINES (PD)																	
M-8. Module of professional activity																	
AAP102	Production practice I		PD, UC	2				R				2					
CHE906	Processes, devices and equipment in biotechnology		PD, UC	4	120	30/15/0	75	E						4			
CHE907	Engineering enzymology		PD, UC	4	120	30/0/15	75	E						4			
BIO429	Biotechnology of microorganisms		PD, UC	5	150	15/15/15	105	E						5			
AAP183	Production practice II		PD, UC	3				R						3			
CHE668	Process Design		PD, UC	6	180	30/0/30	120	E							6		
HPP123	Engineering ecology	1	PD, CCH	5	150	30/0/15	105	E							5		
CHE908	GMOs and biosecurity	1	PD, CCH	5	150	30/0/15	105	E							5		
CHE919	Biosecurity	2	PD, CCH	5	150	30/0/15	105	E							5		
CHE909	Quality management in biotech industries	2	PD, CCH	5	150	30/0/15	105	E							5		
CHE910	Fundamentals of technological regulation of the quality of finished products	3	PD, CCH	6	180	30/0/30	120	E							6		
CHE911	Biotechnology for the processing of production and consumption waste	3	PD, CCH	6	180	30/0/30	120	E							6		

CHE912	Biotechnology in the energy industry	4	PD, CCH	5	150	30/0/15	105	E							5		
CHE913	DNA Technology	4	PD, CCH	5	150	30/0/15	105	E							5		
HBI105	Bionanotechnology		PD, UC	4	120	30/0/15	75	E								4	
CHE914	Biotechnological methods for obtaining organic products	1	PD, CCH	5	150	15/0/30	105	E								5	
CHE915	Biotechnology in the metallurgical industry	1	PD, CCH	5	150	15/0/30	105	E								5	
CHE920	Biotechnology in the petrochemical industry	2	PD, CCH	5	150	30/0/15	105	E								5	
CHE916	Biotechnological methods for obtaining probiotics	2	PD, CCH	5	150	30/0/15	105	E								5	
CHE917	Biotechnology for deep processing of industrial waste	3	PD, CCH	5	150	15/0/30	105	E								5	
CHE918	Medical biotechnical systems, biotechnology and bioethics	3	PD, CCH	5	150	15/0/30	105	E								5	
M-9. Final certification module																	
ECA103	Final examination		FA	8												8	
Additional type of training (ATT)																	
AAP500	Military training																
Total based on UNIVERSITY:									31	29	28	32	30	30	33	27	
									60		**60**		**60**		**60**		

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	51	0	5	56
BD	Cycle of basic disciplines	0	92	20	112
PD	Cycle of profile disciplines	0	28	36	64
Total for theoretical training:		**51**	**120**	**61**	**232**
FA	Final attestation				8
TOTAL:					**240**

ecision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

ecision of the Academic Council of the Institute. Minutes № 3 dated 28.11.2024

Signed:

Governing Board member - Vice-Rector for Academic Affairs — Uskenbayeva R. K.

Approved:

Vice Provost on academic development — Kalpeyeva Z. Б.

Head of Department - Department of Educational Program Management and Academic-Methodological Work — Zhumagaliyeva A. S.

Director - Geology and Oil-gas Business Institute named after K. Turyssov — Auyelkhan Y. .

Department Chair - Chemical and biochemical engineering — Mangazbayeva R. A.

Representative of the Academic Committee from Employers ___Acknowledged___ — Dzhamalova G. A.