Geology and Oil-gas Business Institute named after K. Turyssov

Department of Chemical and Biochemical Engineering

EDUCATIONAL PROGRAM
6B05105 – «Biotechnology»

Code and classification of the field of education: **6B05** «Natural Sciences, Mathematics and Statistics»

Code and classification of training areas: **6B051** «Biological and related sciences»

Group of educational programs: **B050** «Biological and related sciences»

Level according to the NQF: 6

Level according to the IQF: 6

Duration of study: 4

Volume of loans: 240

Almaty 2025

The educational program 6B05105 «Biotechnology» 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 6B05105 «Biotechnology» was developed by the academic committee in the direction: 6B051 «Biological and related Sciences»

Name	Academic degree/ academic	Post	Place of work	Signature
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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 the 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 takes into account the needs of the regional labor market, the requirements of government agencies and relevant industry requirements.

The EP includes both theoretical knowledge and practical application from fundamental science through experimental design to production, product analysis and life cycle analysis of the manufactured object. The curriculum provides a cross-platform approach allowing students to have a unique and personalized experience that will appeal to a wide range of employers. Students practice problem solving, project management, and professional communication skills.

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

The EP defines the program educational goals, the results of bachelor's studies, the necessary conditions, content and technologies for the implementation of the educational process, assessment and analysis of the quality of students during and after graduation.

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

2. The purpose and objectives of the educational program

The purpose of the educational program "Biotechnology" is training of qualified, competitive specialists capable of applying modern experimental methods of working with biological objects and modern equipment in the conditions of modernization of biotechnological industries.

The task of the educational program is focused on the implementation of the following principles: within the framework of the program, different directions are offered: The direction is intended to provide specialization in a specific field of industrial biotechnology. Students have the opportunity to adapt their education by choosing one direction and supplementing it with courses in other areas or other courses in biotechnology. You can also choose courses from any field to create your unique professional profile.

Areas of professional activity:

- scientific and experimental research in industrial areas of biotechnology, breeding and breeding of new breeds of animals, plant varieties and strains of microorganisms;
- production of biotechnological products for various purposes and development of new biotechnological processes.

3. Requirements for the evaluation of learning outcomes of the 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.

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 biotechnology and related industries.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	6B05 «Natural Sciences, Mathematics and Statistics»
2	Code and classification of training areas	6B051 «Biological and related sciences»
3	Group of educational programs	B050 «Biological and related sciences»
4	Name of the educational program	6B05105 «Biotechnology»
5	Brief description of the educational program	The educational program 6B05105 "Biotechnology" provides a deep understanding of how to design and use modern life science-based manufacturing processes, considering product quality, sustainability and finance. Graduates have the competencies and skills to use cells, cellular components and biomolecules to produce goods such as chemicals, food, biofuels and biomaterials to develop a sustainable society. The educational program includes advanced training courses on biotechnological tools used for the development of industrial processes, the sustainable production of goods and the impact of such processes on the environment and society.
6	The purpose of the EP	Training of qualified, competitive specialists capable of applying modern experimental methods of working with biological objects and modern equipment in the conditions of modernization of biotechnological industries.
7	Type of EP	New
8	Level according to the NQF	6
9	Level according to the IQF	6
10	Distinctive features of the EP	no
11	List of competencies of the educational program:	CC1. Communication skills - fluent mono-lingual oral, written and communication skills;

		- ability of non-fluent communication with a second language; - the ability to use communicative communication in various situations; CC2. Basic literacy in natural sciences - a basic understanding of the scientific picture of the world with an understanding of the essence of the basic laws of science; - understanding of basic hypotheses, laws, methods, formulation of conclusions and estimation of errors CC3. General Engineering competencies - basic general engineering skills and knowledge, the ability to solve general engineering tasks and problems; - be able to use application software packages for processing experimental data, solving systems of algebraic and differential equations CC4. Professional competencies - critical perception and deep understanding of professional competencies at level 5 or 6; - the ability to discuss and polemize on professional issues within the framework of the mastered program CC5. Engineering and computer competencies - basic skills of using computer programs and software systems to solve general engineering tasks CC6. Engineering and working competencies - skills and abilities of using technical means and experimental devices to solve general engineering tasks CC7. Socio-economic competencies - critical understanding and cognitive abilities to reason on modern social and economic issues - basic understanding of the economic assessment of the objects of study and the profitability of industry projects
12	Learning outcomes of the educational program:	PO1. Acquire fundamental knowledge of biology, chemistry, genetics and microbiology, and understand the basic principles and patterns of biotechnological methods, including fermentation, biosynthesis, biocatalysis, genetic engineering and bioprocessing; PO2. Perform a variety and complex laboratory experiments and analyses, using modern physico-chemical and technological methods, to assess the compliance of biological objects and products with the standards of biotechnological and technochemical production, which is necessary to ensure a high level of quality, safety and efficiency of biotechnological products and processes; PO3. Apply the knowledge of natural science disciplines in a range of research studies, enhancing experimental protocols and statistical techniques for analyzing data, and presenting results in the form of scientific reports and publications, thus contributing to the development of new biotechnological solutions, innovation and advancing the frontiers of scientific knowledge in biotechnology; PO4. Assess the efficacy and compliance with international quality standards of various biologics, including innovative and synthetic biologics, is crucial for improving product competitiveness in the global market and meeting the growing

		needs of the biotechnology industry; PO5. Select optimal conditions and methods for isolation, cultivation and identification of microorganisms producing biomass, organic acids, ethanol, amino acids, antibiotics and other valuable biotechnological products; PO6. Adapt resource-efficient and waste-free technologies into production, optimising biotechnological processes to improve their productivity and environmental safety, thus contributing to sustainable development and innovation in the biotechnology industry; PO7. Control biotechnological processes to ensure compliance with quality, environmental and Good Manufacturing Practice (GMP) standards, including the production of innovative biologics and synthetic biosystems, which is important for efficient production management and high performance and quality; PO8. Assess the environmental risks and social aspects of biotechnological processes, anticipating potential hazards associated with the use of genetically modified organisms and developing measures to prevent them, thereby contributing to sustainable development, biosafety and social responsibility of biotechnological activities; PO9. Integrate knowledge and methods from biological sciences, chemistry, physics and mathematics to solve problems in biotechnology, possessing modern information technology of interdisciplinary analysis to collect and process scientific information, which includes interaction with professionals from related fields to achieve complex and innovative solutions important for interdisciplinary projects and research;
13	Form of training	full-time education
14	Duration of training	4 years
15	Volume of loans	240
16	Languages of instruction	Kazakh, Russian, English
17	Academic degree awarded	Bachelor of Science
18	Developer(s) and authors:	Belkozhaev A.M., Narmuratova Zh.B., Mangazbaeva R.A., Sandybaeva S.K.

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

№	Name of the discipline	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)								
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Cycle of general education disciplines Required 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.	8				v					
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	The course studies historical events, phenomena, facts, processes that took place on the territory of Kazakhstan	5				v					

		from ancient times to the present day. The sections of the discipline include: the steppe empire of the Turks; early feudal states on the territory of Kazakhstan; Kazakhstan in the period of the Mongol conquest (XIII century), medieval states in the XIV-XV centuries. The era of the Kazakh Khanate XV-XVIII centuries. Kazakhstan as part of the Russian Empire, Kazakhstan during the Great Patriotic War, in the period of independence and at the present stage.										
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				**v**					
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.	5				**v**					

		It also studies the regularities of the emergence, development and functioning of mental processes, states, properties of a person involved in that or other activity, patterns of development and functioning of the psyche as a special life forms.										
		Cycle of general education disciplines University component										
9	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**	**v**
10	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**	
11	Fundamentals of economics and entrepreneurship	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**	
		Cycle of basic disciplines University component										
12	Mathematics I	Purpose: to introduce students to the fundamental concepts of linear algebra, analytical geometry and mathematical	5	**v**								

		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. Partial derivatives. The extremum of a function of two variables.										
13	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**								
14	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**								
15	Bioinformatics	Develops an understanding of programming languages and software tools in bioinformatics, the main methods of machine processing of the information flow obtained as a result of studying fundamental and applied research of biological and biotechnological processes. Also, special attention will be paid to the methods of using various computer programs for modeling biological processes and statistical processing of the data obtained, analysis of data obtained as a result of studying the chemical structure of biologically active substances and its biological activity.	5					**v**				**v**
16	Cell biology	Cell biology deals with the smallest unit of life.The main goal of the course is to form an idea of the structural and functional unity of the cell and the patterns of organization of the main cellular processes	5	**v**								
	Molecular biology	The purpose of teaching the discipline is to study modern methods and methodology used in the field of molecular	5	**v**								

17		biology. In the process of studying the course, students will master modern methods for studying DNA, RNA and the mechanisms of protein synthesis. The course studies the structure and functions of nucleic acids, the principles and mechanisms for the implementation of hereditary information, as well as the molecular basis of the structure and functions of cells, and growth processes. After completing the course, students must acquire knowledge that allows them to apply fundamental and applied knowledge in the field of molecular biology and knowledge about the genetic apparatus to solve actual problems of biotechnology										
18	Organic Chemistry I	The purpose of the discipline is to master the complex of knowledge and scientific ideas about the fundamental theoretical and experimental foundations of organic chemistry of aliphatic compounds; in obtaining students' knowledge of the basic concepts of theoretical organic chemistry, mastering the skills to characterize the structure, physico-chemical properties of organic substances, as well as modern methods of synthesis of organic substances. The course forms the basis of chemical reactions and methods of synthesis of organic compounds for the most important branches of the chemical and biochemical industry	6	**v**								
19	Organic Chemistry II	The aim of the course is to study the general patterns 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 acquired basic scientific and theoretical knowledge to solve scientific and practical problems.	5	**v**								
20	Introduction to biotechnology and professional activities	The purpose of teaching the discipline is to familiarize students with modern directions in the development of biotechnology and breakthrough projects for solving a variety of problems, including medicine, pharmacology, agriculture, ecology, nanobiotechnology, space biotechnology. In the process of studying the course,	4								**v**	**v**

		students will master the main areas and industries, DNA technology, the creation of a gene bank based on cellular technology and cryopreservation, methods of PCR diagnostics of dangerous diseases and the use of molecular markers to identify genes and valuable traits associated with productivity and resistance to biotic and abiotic environmental factors.										
21	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**			**v**
22	Biotechnology objects	The course considers microorganisms, plants and animals as objects of biotechnology, as well as the basic principles and approaches used to create new biological objects. The discipline forms knowledge about the peculiarities of the structural and functional organization of organisms - biological objects that produce the main practically significant cellular metabolites; introduces the biology of in vitro cultured plant and animal cells, methods of their cultivation and application to solve theoretical and practical problems; introduces the principles of selection of biological objects for their use in industrial production and with the techniques for obtaining modified biological objects in order to give them new properties and / or the ability to produce new substances.	5	**v**			**v**	**v**				
23	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**								

24	Biochemistry	The purpose of mastering the discipline is to acquire knowledge about the structure and properties of chemical compounds that make up living organisms, about the basic laws of biochemical processes and mechanisms for regulating metabolism. Master the methods and skills of working on instruments and equipment used in biochemical laboratories of both research and production profiles.	5	**v**								
25	Botany and plant physiology	The purpose of teaching the discipline is the formation of basic knowledge among students, the development of modern methods and methodology used in the field of botany and plant physiology. The course examines the external and internal structure of plants, as well as the relationship of plants and the environment. In the process of studying the course, students will master the methodologies of theoretical and practical application of fundamental physiological knowledge about plant life, both to discover new patterns in the existence of living organisms, and to solve urgent problems of crop production and conservation of biological diversity based on the results of fundamental and applied research.	5	**v**	**v**							
26	Sanitation and hygiene of biotechnological productions	The aim of the course is to develop students' knowledge about sanitation and hygiene of biotechnological production. The course studies the basic methods of sanitary and hygienic control of biotechnological production, methods for creating and controlling aseptic conditions for biotechnological production. As a result of studying the course, students will master the methods of conducting microbiological studies and assessing the results obtained, compliance with sanitary and hygienic requirements, sanitizing equipment and machinery in the conditions of biotechnological production, consider information about the main groups of microorganisms, main food infections, potential sources of microbiological contamination of raw materials, products in biotechnological production.	5				v	**v**	**v**			
27	Physical and chemical research methods in biotechnology	The main goal of the course is the development by students of the theoretical and methodological foundations of modern physical and chemical research methods that are used in biotechnology. The course will cover the basic techniques and methods of physical and chemical analysis,	5		**v**							

		widely used in the modern biotechnological laboratory and biochemical laboratory practice; rules for organizing a workplace, working with biological material, methods for isolating biologically active substances, enzymes, proteins, DNA, RNA genetic materials, spectrophotometric and chromatographic methods for studying biotechnological objects, analyzing and interpreting the data obtained.										
28	Fundamentals of Automation	The discipline studies the main measuring instruments, primary converters (sensors) of technological parameters, actuators, microcontrollers and automatic control systems for machine tools and technological equipment. Describes the elements of automation systems, time and frequency characteristics of typical links, criteria for studying linear systems for stability and methods for assessing the quality of the process.	5						**v**			
29	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 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 them.	5			v					v	
30	Microbiology and Virology	The purpose of studying the discipline is the development by students of modern methods and methodology used in the field of microbiology and virology. The discipline is aimed at mastering by students the theoretical foundations and patterns of interaction between micro- and microorganism, practical skills in methods of prevention, microbiological, molecular biological diagnostics. The course is aimed at developing students' general ideas about the structure and functioning of microorganisms as living systems, their role in ecology and methods of decontamination, including the basics of disinfectology and sterilization techniques.	5	**v**	**v**			v				
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	2				**v**	**v**				

		analyzing technical or technological information on the technology being implemented.										
Cycle of basic disciplines Selectable Component												
32	Plant biotechnology	The purpose of the discipline is the formation of the ability to cultivate plant cells in vitro to solve the set biotechnological problems. The course includes the study of modern methods and methodology of plant biotechnology, including biotechnological methods in practical plant breeding and genetic engineering. As a result of studying the course, students form ideas about modern biotechnological methods of in vitro fertilization, methods of cloning and cryopreservation of plant material to preserve biological diversity.	5				v	v			v	
33	Agricultural biotechnology	The purpose of the discipline is to form students' knowledge about modern trends in the development of agricultural biotechnology and the main methods and methodologies that are used to speed up the breeding process. The course summarizes the results of fundamental and applied research in the field of agricultural biotechnology. The course forms the basis of effective biotechnologies for the creation and selection of highly productive forms and lines of plants resistant to biotic and abiotic adverse factors.	4				v			v	v	
34	Technique and technology of cultivation	The purpose of the discipline is to develop students' knowledge about modern technologies and techniques for cultivating isolated cells under in vitro conditions. As a result of studying the course, students will master modern biotechnological methods for cultivating biotechnological objects in aseptic conditions in order to achieve goals and objectives aimed at solving urgent problems of industrial biotechnology.	6				v			v		
35	General biology	The purpose of the discipline is the formation of students' abilities to analyze and apply the acquired fundamental knowledge in general biology to solve the problems of modern biotechnology. The study of the subject deals with data on the evolution of the development of organisms and their adaptation to changing living conditions. As a result of studying the course, students will master modern ideas about the work of genes, mutational changes and the	5	v								

		mechanisms of repair and restoration of damaged sections of DNA molecules.										
36	General genetics	The purpose of the discipline is the formation of knowledge about genes and factors that affect gene expression and the patterns of inheritance of traits. The course focuses on the study of modern data on genetic variability and biotechnological methods for expanding the genetic basis of breeding and genetics. As a result of studying the course, students will master the patterns of inheritance of dominant and recessive genes.	5	v								
37	Food biotechnology	This course forms theoretical knowledge and practical skills in the field of food biotechnology, biotechnological organization of production, quality control of raw materials and food products obtained on the basis of biotechnological processes. The course describes the parameters of control of biotechnological processes that determine the directions of biochemical reactions and provide the formation of high-quality target products and modern methods for isolating and purifying products formed as a result of biotechnological processes, as well as the basics for obtaining and producing organic products	4					v	v	v		
38	Methods of cell selection for resistance	The purpose of the discipline is the formation of the ability to conduct experiments on cell selection for use in biotechnological production. The course summarizes the results of fundamental and applied research on the biology of the body's resistance to adverse environmental factors. As a result of studying the course, students will master the methods and methodologies of cell selection, where special attention was paid to the creation of lines and forms of plants resistant to drought.	6				v			v		
39	Pharmaceutical biotechnology	The purpose of the discipline is to form students' knowledge about modern bitechnological methods and methodologies that are used to create new highly effective drugs. The course summarizes the results of fundamental and applied research in the field of pharmaceutical biotechnology, methods and methodology of in vitro cultivation of producers of valuable biologically active substances and drugs, antibiotics, essential amino acids, phenolic compounds, alkaloids, vitamins, enzymes, insulin, interferon and vaccines.	5						v	v		

40	Fundamentals of sustainable development and ESG projects in Kazakhstan	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 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.	5	v							**v**	
41	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**
42	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**	
43	ESG Principles in an inclusive culture	Course objective: This course focuses on the study of the principles of ESG (Environmental, Social, Governance) and their interaction with the creation of an inclusive culture in the organization. Content: Students will gain knowledge about how the implementation of ESG principles promotes business social responsibility, sustainable development and equal opportunities for all employees, including those	5								**v**	**v**

		who may face various types of discrimination. The course will help students understand the importance of an inclusive culture for achieving long-term business goals and the sustainable development of an organization.										
44	The foundations of an anti-corruption culture	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 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.	5							v	v	
45	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						
Cycle of major disciplines University component												
46	Biotechnology of microorganisms	The purpose of the discipline is to develop students' knowledge about modern bitechnological methods and methodologies for cultivating microorganisms - producers to obtain target products for use in various industries. The course includes the following sections: Fundamentals of	5			v				v		

		microbiological biotechnology; Biotechnology as a scientific discipline; The course forms the basis of effective biotechnologies carried out using microorganisms to obtain target products.										
47	Engineering enzymology	The purpose of the discipline is to form students' knowledge in the field of engineering enzymology and the use of enzymatic processes in various areas of biotechnological production. The course summarizes the data obtained as a result of fundamental and applied research in the field of enzymology, presents modern methods for isolating and studying the activity of enzymes, the mechanisms of enzyme operation and factors that determine the activity of enzymes and the efficiency of biotechnological processes.	4						v			
48	Enterprise Design Fundamentals	The course is designed to form competencies in the field of theoretical and practical aspects of enterprise design and preparation of a feasibility study of production. As part of the course, the student will master the practical use of design for chemical processes and units of chemical technology; their application for certain processes and structural hierarchy. At the end of this course, students must demonstrate the ability to design a chemical process that combines physical and chemical units, while at the same time ensuring the achievement of technical and economic goals, environmental goals and safety of an industrial enterprise in the form of a final course project.	6			v						v
49	Processes, devices and equipment in biotechnology	The purpose of the course: to prepare specialists for professional activities in accordance with the optimization of biotechnological processes using modern equipment and apparatus to ensure the volume and quality of production of target products. Methods for cultivating producers, isolated cells, tissues and organs in laboratory conditions, in semi- and industrial volumes will be studied in detail. Particular attention is paid to the study of the design and methods of using modern equipment and apparatus, parameters for optimizing biotechnological processes and cultivation conditions for producers to obtain target products that meet high market requirements and quality standards.	4			**v**						
50	Bionanotechnology	The aim of the course is to study the latest achievements of fundamental and applied research in the field of	4			**v**		**v**				

		bionanotechnology. The course also studies the creation of bionanomachines and bionanorobots, the processes and mechanisms of self-organization in biological systems, the specifics of relationships in bionostructures, the structural features of biogenic macromolecules and bionanomachines, the basic materials and methods of bionanotechnology, the biological effect of nanomaterials, the mechanisms of penetration of bionanotechnology into cells, the positive and toxic effects of nanomaterials and other important areas of research of bionanomaterials.										
51	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**		
52	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												
53	Biosecurity	The purpose of the discipline is to form students' basic knowledge in the field of biosafety. The course summarizes the data obtained as a result of fundamental and applied research in the field of biosafety. The course forms the basis for building effective biosecurity systems. The course separately considers pathogens of especially dangerous infectious diseases, their structure, classification and ways of their spread, the main vectors and methods of spread, methods for ensuring biosafety.	5					**v**				
54	Biotechnological methods for obtaining organic products	The purpose of the discipline is to form students' basic knowledge in the field of creation and production of organic products using biotechnological methods. The course summarizes the results of fundamental and applied	5					**v**		**v**		

		research in the field of production of ecologically pure organic products. The course forms the basis of effective biotechnology for the production of organic products and focuses on the requirements and standards for the production of organic products.										
55	Biotechnological methods for obtaining probiotics	The purpose of the discipline is the development by students of modern knowledge in the field of study, production and application of probiotics. The course summarizes modern data obtained as a result of fundamental and applied research of microorganisms that can be used as probiotics. The course forms the basis for the creation of effective biotechnologies for the selection of strains, the selection of microorganisms - probiotics, the creation of consortiums of probiotics and use in various branches of the food industry and in medicine.	5						v			
56	Biotechnology in the metallurgical industry	The purpose of the discipline is to form students' basic knowledge in the field of using biotechnological methods in the metallurgical industry. The role of bacteria in the circulation of substances is very huge, and as a result of the activity of microorganisms, all biogeochemical processes in nature occur, including the destruction and transformation of various organic and inorganic compounds. The course forms the basis for creating effective biotechnologies to increase mining through the use of microorganisms.	5								v	
57	Biotechnology in the petrochemical industry	The purpose of the course is to form students' basic knowledge in the use of biotechnological methods in the oil and gas industry to increase efficiency and production volume. The course summarizes the data of fundamental and applied research in the field of the use of biotechnological methods in the oil industry. The course forms the basis for creating effective biotechnologies for use in the oil industry. This is due to the fact that modern methods of biotechnology can be successfully used at various stages of oil field development: search for new deposits, microbiological enhanced oil recovery (MEOR)	5								v	
58	Biotechnology in the energy industry	The purpose of the discipline is to form students' basic knowledge in the field of production of alternative energy sources from renewable raw materials. The course summarizes the data of fundamental and applied research in the field of bioenergy. Particular attention was paid to	5							v	v	

		biotechnological methods for the production of alternative energy sources from renewable raw materials. The course forms the basis for the creation of efficient biotechnological methods for the production of alternative energy sources.										
59	Biotechnology for deep processing of industrial waste	The purpose of the course is to form students' basic knowledge in the field of deep processing of industrial waste. The course summarizes modern data obtained as a result of fundamental and applied scientific research in the field of industrial waste disposal and disposal, the volumes of which are increasing every year and create certain environmental problems of a local and global nature. The course forms the basis for the creation of effective biotechnologies for the deep processing of industrial waste to obtain target products.	5								v	
60	Biotechnology for the processing of production and consumption waste	The purpose of the discipline is the development by students of basic knowledge in the field of modern biotechnological methods for processing production and consumption waste. The course summarizes the data of fundamental and applied research in the field of disposal and disposal of production and consumption waste. The course forms the basis for the creation of effective biotechnologies for the processing of production and consumption waste. In the course studies, special attention is paid to modern biotechnological methods of processing industrial waste, sewage treatment and processing of solid domestic waste to obtain alternative energy sources such as biogas and biofertilizers.	6								v	
61	GMOs and biosecurity	The purpose of the discipline is the formation of students' knowledge in the field of creation and biosafety of the use of genetically modified organisms. The course examines the current state of genetic engineering and research results obtained as a result of fundamental and applied research in the field of creating genetically modified organisms and the problems of ensuring biosafety. Separately, genetic engineering tools are considered - enzymes that are used to create recombinant DNA and RNA molecules.	5								v	
62	DNA Technologies	The purpose of the discipline is to form students' knowledge in the field of using DNA technology in various fields. The course summarizes data from fundamental and applied research in the field of DNA technology. The	5			v						

		course forms the basis for the creation and use of DNA technology based on the study of the principles underlying the matrix principle of storing genetic information for solving fundamental and applied problems; - study of types of DNA structural sequences (unique and various types of repeating sequences) and their role in the formation of functional and structural elements of the genome;										
63	Engineering ecology	The purpose of the course: to prepare specialists for professional activities in accordance with the concepts of environmental safety and sustainable development, capable of implementing environmental, energy and resource-saving technical policies in the design, development and operation of industries. The course examines the legal framework of the environmental policy of the Republic of Kazakhstan, the main sources of environmental pollution, methods to reduce the harmful effects on environmental components and jobs, as well as environmental risk and economic aspects of environmental protection.	5						**v**	v	**v**	
64	Medical biotechnical systems, biotechnology and bioethics	The purpose of the discipline is to form students' knowledge in the field of using biotechnological methods in medicine and bioethics. The course summarizes the results of fundamental and applied research in the field of using biotechnological methods in medical biotechnology. Particular attention was paid to the use of IVF methods to solve human reproductive problems. The course forms the basis for the use of effective biotechnological methods in medicine and the principles and ways of solving issues that arise in the field of bioethics.	5							**v**		
65	Fundamentals of technological regulation of the quality of finished products	The purpose of the discipline is to form students' knowledge in the field of technological regulation of the quality of finished products, international systems of standardization and certification of biotechnological products. The course includes theoretical knowledge and practical skills in working with regulatory documents on the issues of standardization and technical regulation of the quality of finished products of biotechnological production. The course forms the basis for the creation of effective quality control systems, standardization and certification of biotechnological products.	6									**v**

66	Quality management in biotech industries	The purpose of the discipline is to develop students' knowledge and skills in the field of quality management in biotechnological industries. The course summarizes data from fundamental and applied research in the field of industrial biotechnology and quality assurance of biotechnological products. The course forms the basis for the creation of effective quality management systems in biotechnological industries that meet the high requirements of the market. Particular attention is paid to the standardization of the biotechnological process and the resulting target products to improve product quality; legal bases of standardization;	5									**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**

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

Decision 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.