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

Department of Chemical and Biochemical Engineering

EDUCATIONAL PROGRAM

6B05105 – Biotechnology

the cipher and the name of the educational program

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 years

Volume of loans: 240

Almaty, 2022

Educational program 6B05105 – Biotechnology

Approved by the meeting of the Academic Council of KazNRTU named after K.I.Satpayev.

Protocol № 13 from «28» 04 2022 y.

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

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Educational program 6B05105 – Biotechnology developed by the academic committee in the direction of 6B051 Biological and related sciences, design and improvement of educational programs: B050 Biological and related sciences

Name	Academic degree/ academic title	Post	Place of work	Signature
Chairman of the Academic Committee:				
Amitova Aigul Amantaevna	Doctor PhD	Head of the Department	KazNRTU 87012042408	
Teaching staff:				
Anapiyaev Bakhytzhan Beisenbekovich	Doctor of Biology Sciences	Associate Professor	KazNRTU 87772623067	
Tastambek Kuanysh Talgatovich	Doctor PhD	Associate Professor	KazNRTU 87026400428	
Usmanova Zaira Usmanovna	Doctor of Biological Sciences, Professor	Head of the Department of Biotechnology	Tashkent Pharmaceutical Institute +998 94 685 78 57	
Employers:				
Ilyin Alexander Ivanovich		Chairman of the Management Board	JSC "Scientific Center of Anti-infectious Drugs"	
Students:				
Madina Musalimova		3 course 6B05101		

F KazNRTU 703-05 Educational program

Table of contents

List of abbreviations and designations

1. 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. Satpaev and approved by the Ministry of Science and Higher Education of the Republic of Kazakhstan. 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 learning outcomes of undergraduates, the necessary conditions, content and technologies for the implementation of the educational process, the assessment and analysis of the quality of students during training and after graduation.

The EP includes the curriculum, the content of 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 to train qualified, competitive specialists capable of applying modern experimental methods of working with biological objects and modern equipment in the conditions of modernization of biotechnological production.

The main professional 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

Formed learning outcomes:

PO1. Applies knowledge of specialized natural science basic disciplines in the field of biotechnology;

PO2. Applies knowledge of the natural sciences, socio-economic and major disciplines of biotechnology to solve practical and professional problems of the biotechnology industry;

PO3. Participates in the improvement of biotechnological processes at the level of modern methods of studying biological systems to solve practical problems in applied biotechnology;

PO4. Uses knowledge bases and methodologies to identify problems and evidence-based conclusions, applies his knowledge to solve professional problems;

PO5. Applies knowledge of the basic laws and modern achievements of genetics, genomics, and proteomics;

PO6. Demonstrates knowledge of the essence of biotechnological processes and the theoretical basis of the operation of production equipment, possesses the skills of a typical calculation of product yield;

PO7. Demonstrates knowledge of the activities necessary to ensure the quality management system of the enterprise, and methods of product quality control;

PO8. Applies knowledge of the organization of workplaces, taking into account the requirements for labor protection, and sanitary safety;

PO9. Applies knowledge of enzymology, methods of immobilization of enzymes, and the use of enzymes in food production;

PO10. Able to determine the possible ways of biosynthesis of protein substances, to select the optimal conditions for the biotechnological process;

PO11. Able to apply resource-saving and waste-free technologies in certain stages of biotechnological production;

PO12. Able to select conditions and carry out identification, isolation, and cultivation of microorganisms producing biomass, organic acids, ethanol, amino acids, and antibiotics;

PO13. Possesses the skills of colonial micropropagation of plants, somatic hybridization of cells, and obtaining new plant species;

PO14. Use modern information technologies to collect, process, and disseminate 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	Biotechnology

	program	
5	Brief description of the educational program	The biotechnology degree program 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	The purpose of the development of the EP "Biotechnology" is to train qualified, competitive specialists capable of applying modern experimental methods of working with biological objects and modern equipment in the conditions of modernization of biotechnological production.
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:	KK1. Communicativeness KK2. Basic literacy in natural sciences KK3. General engineering competencies KK4. Professional competencies KK5. Engineering and computer competencies KK6. Engineering and working competencies KK7. Socially-economic competencies
12	Learning outcomes of the educational program:	PO1. Applies knowledge of specialized natural science basic disciplines in the field of biotechnology; PO2. Applies knowledge of the natural sciences, socio-economic and major disciplines of biotechnology to solve practical and professional problems of the biotechnology industry; PO3. Participates in the improvement of biotechnological processes at the level of modern methods of studying biological systems to solve practical problems in applied biotechnology; PO4. Uses knowledge bases and methodologies to identify problems and evidence-based conclusions, applies his knowledge to solve professional problems; PO5. Applies knowledge of the basic laws and modern achievements of genetics, genomics, and proteomics; PO6. Demonstrates knowledge of the essence of biotechnological processes and the theoretical basis of the operation of production equipment, possesses the skills of a typical calculation of product yield; PO7. Demonstrates knowledge of the activities necessary to ensure the quality management system of the enterprise, and methods of product quality control; PO8. Applies knowledge of the organization of workplaces, taking into account the requirements for labor protection, and

		sanitary safety; PO9. Applies knowledge of enzymology, methods of immobilization of enzymes, and the use of enzymes in food production; PO10. Able to determine the possible ways of biosynthesis of protein substances, to select the optimal conditions for the biotechnological process; PO11. Able to apply resource-saving and waste-free technologies in certain stages of biotechnological production; PO12. Able to select conditions and carry out identification, isolation, and cultivation of microorganisms producing biomass, organic acids, ethanol, amino acids, and antibiotics; PO13. Possesses the skills of colonial micropropagation of plants, somatic hybridization of cells, and obtaining new plant species; PO14. Use modern information technologies to collect, process, and disseminate scientific information in the field of biotechnology and related industries.
13	Form of training	Daytime
14	Duration of training	4 years
15	Volume of loans	240
16	Languages of instruction	Kazakh, Russian, English
17	Academic degree awarded	Bachelor of Engineering and Technology in Pharmaceutical Manufacturing Technology
18	Developer(s) and authors:	1. Head of the PhD department Amitova A.A. 2. Assoc. Professor, Doctor PhD, Kosalbaev B.D. 3. Assoc. Professor, Doctor of Biological Sciences, Anapiyaev B.B. 4. Assoc. Professor, Doctor PhD, Tastambek K.T. 5. Assistant, master Narmuratova Zh.B.

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	PO10	PO11	PO12	PO13	PO14
Cycle of general education disciplines Required Component																	
	Modern history of Kazakhstan	The course studies historical events, phenomena, facts, processes that took place on the territory of Kazakhstan 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.	5				**v**										
	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	5				**v**										

		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.															
	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**										
	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	3				**v**										

		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. 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																	
	Fundamentals of anti-corruption culture	The discipline studies the essence, causes, causes of sustainable development of corruption from both historical and modern points of view. Considers the prerequisites and impacts for the development of an anti-corruption culture. Studies the development of countering corruption on the basis of social, economic, legal, cultural, moral and ethical norms. She studies the problems of forming an anti-corruption culture based on the relationship with various types of social relations and various manifestations. Situations of conflict of interest and moral	5		**v**												

		choice are analyzed; improving the anti-corruption culture; actions in situations of conflict of interest.															
	Fundamentals of Entrepreneurship and Leadership	The discipline studies the foundations of entrepreneurial activity and leadership from the point of view of science and law; features, problematic aspects and development prospects; theory and practice of entrepreneurship as a system of economic, organizational and legal relations of business structures; readiness of entrepreneurs for innovative susceptibility. The discipline reveals the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of an entrepreneur, theoretical and practical business planning and economic expertise of business ideas, as well as risk analysis of innovative development, introduction of new technologies and technological solutions.	5			**v**											
	Ecology and life safety	The discipline studies the tasks of ecology as a science, environmental terms, the laws of the functioning of natural systems and aspects of environmental safety in the conditions of labor activity. Monitoring of the environment and management in the field of its safety. Sources of pollution of atmospheric air, surface, groundwater, soil and ways to solve environmental problems;	5		**v**												

		life safety in the technosphere; natural and man-made emergencies															
	Cycle of basic disciplines University component																
	Mathematics I	The course is based on the study of mathematical analysis in a volume that allows you to explore elementary functions and solve the simplest geometric, physical and other applied problems. The main attention is paid to differential and integral calculus. The sections of the course include differential calculus of functions of one variable, derivative and differentials, study of the behavior of functions, complex numbers, polynomials. Indefinite integrals, their properties and methods of calculation. Definite integrals and their applications. Improper integrals.	5	**v**	**v**												
	Mathematics II	The discipline is a continuation of Mathematics 1. The sections of the course include elements of linear algebra and analytic geometry. The main questions of linear algebra are considered: linear and self-adjoint operators, quadratic forms, linear programming. Differential calculus of a function of several variables and its applications. Multiple integrals. The theory of determinants and matrices, linear systems of equations, as well as elements of vector algebra. Includes elements of analytical	5	**v**	**v**												

		geometry in the plane and in space.															
	Physics	The course studies the basic physical phenomena and laws of classical and modern physics; methods of physical research; the influence of physics as a science on the development of technology; connection of physics with other sciences and its role in solving scientific and technical problems of the specialty. The course covers the following sections: mechanics, mechanical harmonic waves, fundamentals of molecular kinetic theory and thermodynamics, electrostatics, direct current, electromagnetism, geometric optics, wave properties of light, laws of thermal radiation, photoelectric effect.	5	**v**	**v**												
	Cycle of basic disciplines Selectable Component																
	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	5		**v**												**v**

		the chemical structure of biologically active substances and its biological activity.															
	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	v												
	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	5		v	v											

		research.															
	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, 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.	4		v	v											
	Engineering and computer graphics	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												v
	Cell biology	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	v												
	Molecular biology	The purpose of teaching the discipline is to study modern methods and methodology used in the field of molecular biology. In the process of studying the	5	v	v												

		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															
	General chemistry	The purpose of the discipline is to study the basic concepts and laws of chemistry; fundamental regularities of chemical thermodynamics and kinetics; quantum mechanical theory of atomic structure and chemical bonding. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. Structure of matter and chemistry of elements.	5	v	v												
	Biotechnology objects	The purpose of the course is to form students' understanding of the main objects of biotechnology. The course examines microorganisms, plants and animal cells as objects of	5			v	v										

		biotechnology, as well as the basic principles and approaches used to create new biological objects. As a result of studying the course, students develop knowledge about the peculiarities of the structural and functional organization of organisms - biological objects that produce the main practically significant cellular metabolites; introduces the principles of selecting 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 the ability to produce new substances.															
	Organic Chemistry I	Organic chemistry I studies the chemistry of linear hydrocarbons and their oxygen- and nitrogen-containing derivatives, the structure and nomenclature, the physical and chemical properties of these compounds, methods of preparation in the laboratory and industry, as well as their use in various sectors of the national economy. Considered are saturated and unsaturated hydrocarbons, their various derivatives - aldehydes and ketones, alcohols, carboxylic acids, ethers and esters, etc.	6	**v**	**v**												
	Organic Chemistry II	The study of the general patterns of the flow of organic reactions of cyclic compounds, such as cycloalkanes, aromatic hydrocarbons, and heterocyclic	5	**v**	**v**												

		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.														
	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		v								
	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,	5								v						

		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.															
	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 macroorganism, 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 decantomination, including the basics of disinfectology and sterilization techniques.	5	v	v												
	Physical and chemical research methods in	The main goal of the course is the development by students of the theoretical and	5			v	v										

	biotechnology	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, 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.															
	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	
	Methods of cell selection for	The purpose of the discipline is the formation of the ability to	6					v							v	v	

	resistance	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.															
	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 mechanisms of repair and restoration of damaged sections of DNA molecules.	5	v	v												
	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	5	v				v									

		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.															
	Cycle of major disciplines University component																
	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**		**v**		
	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	4					**v**						**v**	**v**	**v**	

		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.															
	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**	
	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**		
	Cycle of major disciplines Selectable Component																

	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 microbiological biotechnology; Biotechnology as a scientific discipline; The course forms the basis of effective biotechnologies carried out using microorganisms to obtain target products.	5						v						v		
	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					
	Enterprise Design Fundamentals	The course was developed with the aim of developing competencies in the field of theoretical and practical aspects of enterprise design and	6						v	v	v						

		preparation of a feasibility study for production. As part of the course, the student will master the practical use of design for chemical processes and chemical technology units; their application to certain processes and structural hierarchy. At the end of this course, students are expected to demonstrate the ability to design a chemical process that combines physical and chemical units while achieving technical, economic, environmental, and industrial plant safety goals in the form of a final course project.															
	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	4				**v**		**v**								

		standards.															
	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							v				
	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 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.	5										v		v		
	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	5			v						v					

		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.															
	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**								**v**			
	Biotechnology in the petrochemical industry	The purpose of the course is to develop students' basic knowledge in the field of using biotechnological methods in the oil and gas industry to increase efficiency and production volume. The course summarizes data from fundamental and applied research in the field of	5			**v**								**v**			

		using 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: the search for new fields, microbiological enhanced oil recovery (MEOR)															
	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 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.	5											**v**	**v**		
	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 disposal and disposal of industrial waste, the volume of	5			**v**	**v**							**v**			

		which is increasing every year and creating 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.															
	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	v							v			
	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	5					v							v			

		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.															
	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 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;	5				v	v	v								
	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,	5				v				v						

		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.															
	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**										**v**		
	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	6			**v**	**v**			**v**								

		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.														
	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	v			v						

4.4. Information about disciplines

№	Name of the discipline	Brief description of the discipline (30-50 words)	Number of credits	Formed competencies (codes)
	Cycle of general education disciplines Required Component			
	Modern history of Kazakhstan	The course studies historical events, phenomena, facts, processes that took place on the territory of Kazakhstan 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.	5	**КК2**
	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	**КК2**
	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	**КК1, КК7**
	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. It also studies the regularities of the emergence, development and functioning of mental processes, states, properties of a person involved in that	3	**КК7**

		or other activity, patterns of development and functioning of the psyche as a special life forms.		
Cycle of basic disciplines University component				
	Fundamentals of anti-corruption culture	The discipline studies the essence, causes, causes of sustainable development of corruption from both historical and modern points of view. Considers the prerequisites and impacts for the development of an anti-corruption culture. Studies the development of countering corruption on the basis of social, economic, legal, cultural, moral and ethical norms. She studies the problems of forming an anti-corruption culture based on the relationship with various types of social relations and various manifestations. Situations of conflict of interest and moral choice are analyzed; improving the anti-corruption culture; actions in situations of conflict of interest.	5	**КК1, КК4, КК7**
	Fundamentals of Entrepreneurship and Leadership	The discipline studies the foundations of entrepreneurial activity and leadership from the point of view of science and law; features, problematic aspects and development prospects; theory and practice of entrepreneurship as a system of economic, organizational and legal relations of business structures; readiness of entrepreneurs for innovative susceptibility. The discipline reveals the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of an entrepreneur, theoretical and practical business planning and economic expertise of business ideas, as well as risk analysis of innovative development, introduction of new technologies and technological solutions.	**5**	**КК1, КК2, КК7**
	Ecology and life safety	The discipline studies the tasks of ecology as a science, environmental terms, the laws of the functioning of natural systems and aspects of environmental safety in the conditions of labor activity. Monitoring of the environment and management in the field of its safety. Sources of pollution of atmospheric air, surface, groundwater, soil and ways to solve environmental problems; life safety in the technosphere; natural and man-made emergencies	**5**	**КК2, КК7**
Cycle of basic disciplines University component				
	Mathematics I	The course is based on the study of mathematical analysis in a volume that allows you to explore elementary functions and solve the simplest geometric, physical and other applied problems. The main attention is paid to differential and integral calculus. The sections of the course include differential calculus of functions of one variable, derivative and differentials, study of the behavior of functions, complex numbers, polynomials. Indefinite integrals, their properties and methods of calculation. Definite integrals and their applications. Improper integrals.	**5**	**КК2, КК5**
	Mathematics II	The discipline is a continuation of	**5**	**КК2, КК5,**

		Mathematics 1. The sections of the course include elements of linear algebra and analytic geometry. The main questions of linear algebra are considered: linear and self-adjoint operators, quadratic forms, linear programming. Differential calculus of a function of several variables and its applications. Multiple integrals. The theory of determinants and matrices, linear systems of equations, as well as elements of vector algebra. Includes elements of analytical geometry in the plane and in space.		**КК6**
	Physics	The course studies the basic physical phenomena and laws of classical and modern physics; methods of physical research; the influence of physics as a science on the development of technology; connection of physics with other sciences and its role in solving scientific and technical problems of the specialty. The course covers the following sections: mechanics, mechanical harmonic waves, fundamentals of molecular kinetic theory and thermodynamics, electrostatics, direct current, electromagnetism, geometric optics, wave properties of light, laws of thermal radiation, photoelectric effect.	**5**	**КК2**
Cycle of basic disciplines Selectable Component				
	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	**КК3, КК4**
	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	**КК2, КК3**
	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	5	**КК2, КК4**

		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.		
	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, 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.	4	**КК4**
	Engineering and computer graphics	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	**КК5, КК6**
	Cell biology	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	**КК2, КК4, КК6**
	Molecular biology	The purpose of teaching the discipline is to study modern methods and methodology used in the field of molecular 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	5	**КК3, КК4**
	General chemistry	The purpose of the discipline is to study the basic concepts and laws of chemistry; fundamental regularities of chemical thermodynamics and kinetics; quantum	5	**КК2, КК3**

		mechanical theory of atomic structure and chemical bonding. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. Structure of matter and chemistry of elements.		
	Biotechnology objects	The purpose of the course is to form students' understanding of the main objects of biotechnology. The course examines microorganisms, plants and animal cells as objects of biotechnology, as well as the basic principles and approaches used to create new biological objects. As a result of studying the course, students develop knowledge about the peculiarities of the structural and functional organization of organisms - biological objects that produce the main practically significant cellular metabolites; introduces the principles of selecting 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 the ability to produce new substances.	5	**КК2, КК4, КК6**
	Organic Chemistry I	Organic chemistry I studies the chemistry of linear hydrocarbons and their oxygen- and nitrogen-containing derivatives, the structure and nomenclature, the physical and chemical properties of these compounds, methods of preparation in the laboratory and industry, as well as their use in various sectors of the national economy. Considered are saturated and unsaturated hydrocarbons, their various derivatives - aldehydes and ketones, alcohols, carboxylic acids, ethers and esters, etc.	6	**КК2**
	Organic Chemistry II	The study of 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	**КК2, КК4**
	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	5	**КК2, КК5**

		process.		
	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	**КК1, КК7**
	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 macroorganism, 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 decantomination, including the basics of disinfectology and sterilization techniques.	5	**КК3, КК4**
	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, 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.	5	**КК2, КК4, КК6**
	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	5	**КК4**

		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.		
	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	**КК2, КК4**
	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 mechanisms of repair and restoration of damaged sections of DNA molecules.	5	**КК1, КК2**
	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	**КК1, КК2, КК6**
Cycle of major disciplines University component				
	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	4	**КК3, КК4**

		products		
	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	**КК2, КК4, КК6**
	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	**КК4, КК7**
	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	**КК2, КК4**
Cycle of major disciplines Selectable Component				
	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 microbiological biotechnology; Biotechnology as a scientific discipline; The course forms the basis of effective biotechnologies carried out using microorganisms to obtain target products.	5	**КК2**
	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	4	**КК4, КК5, КК6**

		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.		
	Enterprise Design Fundamentals	The course was developed with the aim of developing competencies in the field of theoretical and practical aspects of enterprise design and preparation of a feasibility study for production. As part of the course, the student will master the practical use of design for chemical processes and chemical technology units; their application to certain processes and structural hierarchy. At the end of this course, students are expected to demonstrate the ability to design a chemical process that combines physical and chemical units while achieving technical, economic, environmental, and industrial plant safety goals in the form of a final course project.	6	**КК5, КК6, КК7**
	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	**КК4, КК6, КК7**
	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	**КК2, КК6, КК7**
	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 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	5	**КК3, КК6, КК7**

		standards for the production of organic products.		
	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	**КК3, КК4, КК6**
	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	**КК4, КК5**
	Biotechnology in the petrochemical industry	The purpose of the course is to develop students' basic knowledge in the field of using biotechnological methods in the oil and gas industry to increase efficiency and production volume. The course summarizes data from fundamental and applied research in the field of using 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: the search for new fields, microbiological enhanced oil recovery (MEOR)	5	**КК4, КК6**
	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 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.	5	**КК4, КК6, КК7**
	Biotechnology for deep processing of industrial	The purpose of the course is to form students' basic knowledge in the field of deep	5	**КК3, КК4**

	waste	processing of industrial waste. The course summarizes modern data obtained as a result of fundamental and applied scientific research in the field of disposal and disposal of industrial waste, the volume of which is increasing every year and creating 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.		
	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	**КК3, КК4**
	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	**КК4, КК7**
	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 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;	5	**КК3, КК4, КК5**
	Engineering ecology	The purpose of the course: to prepare	5	**КК4, КК5,**

		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.		**КК6**
	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	**КК4, КК7**
	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	**КК5, КК6, КК7**
	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	**КК5, КК6, КК7**

5. Curriculum of the educational program

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATBAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Kazakh NRTU named after K.Satpayev
M.M. Begentaev
_____ 2022 y.

CURRICULUM
of Educational Program on enrollment for 2022-2023 academic year

Educational program 6B05105 - "Biotechnology"
Group of educational programs 6B051 – "Biological and related sciences"

Form of study: full-time | Duration of study: 4 years | Academic degree: Bachelor of Science

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters							
								I course		II course		III course		IV course	
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
M-1. Module of language training															
LNG 108	English language	GED, RC	10	300	0/0/6	210	E	5	5						
LNG 104	Kazakh (Russian) language	GED, RC	10	300	0/0/6	210	E	5	5						
M-2. Module of physical training															
KFK 101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Difcredit	2	2	2	2				
M-3. Module of information technology															
CSE 677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E			5					
M-4. Module of socio-cultural development															
HUM 100	Modern History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE	5							
HUM 132	Philosophy	GED, RC	5	150	1/0/2	105	E			5					
HUM 120	Socio-political knowledge module (sociology, politology)	GED, RC	3	90	1/0/1	60	E			3					
HUM 134	Socio-political knowledge module (culturology, psychology)	GED, RC	5	150	2/0/1	105	E				5				
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM 133	Fundamentals of anti-corruption culture	GED, CCH	5	150	2/0/1	105	E				5				
MNG 488	Fundamentals of Entrepreneurship and Leadership	GED, CCH													
CHE 656	Ecology and life safety	GED, CCH													
CYCLE OF BASIC DISCIPLINES (BD)															
M-6. Module of physical and mathematical training															
MAT 101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5							
PHY 468	Physics	BD, UC	5	150	1/1/1	105	E	5							
MAT 102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5						
M-7. Module of basic general technical training															
GEN 429	Engineering and computer graphics	BD, UC	5	150	1/0/2	105	E		5						
CHE894	Introduction to biotechnology and professional activities	BD, UC	4	120	2/0/1	75	E	4							
BIO128	Objects of biotechnology	BD, UC	5	150	1/1/1	105	E		5						
CHE665	Organic Chemistry I	BD, UC	6	180	2/1/1	120	E			6					
BIO277	Cellular Biology	BD, UC	5	150	2/1/0	105	E				5				
CHE495	Chemistry	BD, UC	5	150	1/1/1*	105	E			5					
2201	Elective	BD, COC	5	150	2/0/1	105	E			5					
BIO124	Molecular biology	BD, UC	5	150	2/0/1	105	E				5				
CHE499	Biochemistry	BD, UC	5	150	2/1/0	105	E					5			
CHE639	Organic Chemistry II	BD, UC	5	150	2/1/1	105	E				5				
CHE941	Microbiology and virology	BD, UC	5	150	1/1/1*	105	E					5			
CHE896	Botany and plant physiology	BD, UC	5	150	2/0/1	105	E					5			
CHE897	Bioinformatics	BD, UC	5	150	2/0/1	105	E					5			
CHE898	Sanitation and hygiene of biotechnological productions	BD, UC	5	150	2/0/1	105	E					5			
CHE899	Physical and chemical research methods in biotechnology	BD, UC	5	150	2/0/1	105	E					5			
AUT424	Basics of automation	BD, UC	5	150	2/1/0	105	E						5		
3201	Elective	BD, COC	4	120	2/0/1	75	E						4		
3202	Elective	BD, COC	5	150	2/0/1	105	E						5		
4201	Elective	BD, COC	6	180	2/1/1 2/0/2	120	E							6	
AAP101	Training Practice	BD, UC	2						2						

CYCLE OF PROFILE DISCIPLINES (PD) (chemical technological disciplines)															
M-8. Module of professional chemical and technological activity															
CHE906	Processes, devices and equipment in biotechnology	PD, UC	4	120	2/1/0*	75	E						4		
CHE429	Biotechnology of microorganisms	PD, UC	5	150	1/1/1	105	E						5		
CHE907	Engineering enzymology	PD, UC	4	120	2/0/1	75	E						4		
CHE668	Process Design	PD, UC	6	180	2/0/2	120	E							6	
4301	Elective	PD, COC	5	150	2/0/1	105	E							5	
4302	Elective	PD, COC	5	150	2/0/1*	105	E							5	
4303	Elective	PD, COC	6	180	2/0/2	120	E							6	
4304	Elective	PD, COC	5	150	2/0/1*	105	E							5	
4305	Elective	PD, COC	5	150	1/0/2	105	E								5
4306	Elective	PD, COC	5	150	2/0/1	105	E								5
4307	Elective	PD, COC	5	150	1/0/2	105	E								5
AAP143	Industrial internship I	PD, UC	2								2				
CIV786	Industrial internship II	PD, UC	3										3		
M-9. Module of final attestation															
ECA003	Preparation and writing of a	FA	6												6
ECA103	Defense of the thesis (project)	FA	6												6
M-10. Module of additional types of training															
AAP500	Military affairs	ATT	0												
Total based on UNIVERSITY:								31	29	31	29	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		5	56
BD	Cycle of basic disciplines		92	20	112
PD	Cycle of profile disciplines		24	36	60
	Total for theoretical training:	*51*	*116*	*61*	*228*
FA	final attestation	12			12
	TOTAL:	63	116	61	240

Decision of the Academic Council of Kaznu named after K.Satpayev. Protocol № 12 от "28" 04 2022 г.

Decision of the Educational and Methodological Council of Kaznu named after K.Satpayev. Protocol № 7 от "26" 04 2022 г.

Decision of the Academic Council of the Institute Protocol № 1 от "30" 12 2021 г.

Vice-Rector for Academic Affairs Zhautikov B.A.

Director of IGaOGB Syzdykov A.H.

Head of the Department of Chemical and Biochemical Engineering Amitova A.A.

Specialty Council representative from employers Anapiyaev B.B.

SATBAYEV UNIVERSITY

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY after K. SATBAYEV

APPROVED
Director of the Institute GaOGB
A. Syzdykov
2022y.

MAJOR ELECTIVE DISCIPLINES educational program for the 2022-2023 academic year admission
Educational program 6B05305 "Biotechnology"
Group of Educational programs 6B051 "Biological and related sciences"

Full-time study Study duration : 4 years Academic degree: Bachelor of Science

Year of study	Code of elective	Code of discipline	Name of discipline	Semestr	Cycle	Credits	Total hours	lec/lab/pr	SIW (including SIWT) in	Prerequisites
			M-7. Module of basic general technical training							
2	3201	CHE615	General Biology	3	B	5	150	2/0/1	105	
		CHE895	General genetics					2/0/1		
3	3201	CHE900	Agricultural biotechnology	6	B	4	150	2/0/1	105	
		CHE901	Food biotechnology					2/0/1		
3	3202	CHE902	Plant Biotechnology	6	B	5	150	2/0/1	105	
		CHE903	Pharmaceutical biotechnology					2/0/1		
4	4201	CHE904	Technique and technology of cultivation	7	B	6	180	2/1/1	120	
		CHE905	Methods of cell selection for resistance					2/0/2		
			M-8. Module of professional chemical and technological activity							
4	4301	HPP123	Engineering ecology	7	S	5	150	2/0/1	105	
		CHE908	GMOs and biosecurity					2/0/1		
	4302	CHE919	Biosecurity	7	S	5	150	2/0/1	105	
		CHE909	Quality management in biotech industries					2/0/1		
	4303	CHE910	Fundamentals of technological regulation of the quality of finished products	7	S	6	180	2/0/2	120	
		CHE911	Biotechnology for the processing of production and consumption waste					2/0/2		
	4304	CHE912	Biotechnology in the energy industry	7	S	5	150	2/0/1	105	
		CHE913	DNA Technology					2/0/1		
	4305	CHE914	Biotechnological methods for obtaining organic products	8	S	5	150	1/0/2	105	
		CHE915	Biotechnology in the metallurgical industry					1/0/2		
	4306	CHE920	Biotechnology in the petrochemical industry	8	S	5	150	2/0/1	105	
		CHE916	Biotechnological methods for obtaining probiotics					2/0/1		
	4307	CHE917	Biotechnology for deep processing of industrial waste	8	S	5	150	1/0/2	105	
		CHE918	Medical biotechnical systems, biotechnology and bioethics					1/0/2		

Credits numbers of elective disciplines over the entire period of study	
Cycle of disciplines	Credits
Cycle of basic disciplines (B)	20
Cycle of special disciplines (S)	36
Overall:	56

Head of the Department of Chemical and Biochemical Engineering Amitova A.A.

Representative of Specialty council Anapiyaev B.B.

6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of the development of additional educational programs (Minor)