



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

Department of Chemical and Biochemical Engineering

EDUCATIONAL PROGRAM

7M05105 – Biotechnology

the cipher and the name of the educational program

Code and classification of the field of education:

7M05 Natural Sciences, Mathematics and Statistics

Code and classification of training areas:

7M051 Biological and related sciences

Group of educational programs:

M082 Biotechnology

Level according to the NQF: 7

Level according to the IQF: 7

Duration of study: 2 years

Volume of loans: 120

Almaty, 2022

Educational program 7M05105 – 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.

Protocol №7 from «26» 04 2022 r.

Educational program 7M05105 – Biotechnology developed by the academic committee in the direction of 7M051 Biological and related sciences, design and improvement of educational programs: M082 Biotechnology

Name	Academic degree/ academic title	Post	Place of work	Signature
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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. Interprets the latest theories and concepts as confirmation of the laws and trends in the development of biological science and comprehends the realities of modern theory and practice based on the history and philosophy of science, methodology of natural science, socio-humanitarian and technical knowledge;

PO2. Uses the latest techniques, concepts and theories, technologies to solve fundamental problems in the field of biology, genetics, biotechnology, plans and organizes stages of scientific research, analyzes the results of scientific research and applies them to solving specific research tasks;

PO3. Solves professional tasks corresponding to his qualifications, has an idea of alternative, technical, technologically safe solutions in the field under study;

PO4. He is fluent in a foreign language at a professional level, which allows him to conduct scientific research and teach special disciplines in universities;

PO5. Solves strategic and managerial tasks to improve enterprise management methods;

PO6. Conducts laboratory and field research in order to expand scientific knowledge about modern methods of biotechnology and to test hypotheses for solving problems of biotechnological ecology, agrobiotechnology in order to develop new products and methods for use in pharmacology, agriculture and environmental protection;

PO7. Applies the knowledge of pedagogy and psychology of higher education for the implementation of educational and pedagogical activities on the credit technology of education;

PO8. Uses regulatory documents regulating the organization of research and production and technological work in the field of biotechnology.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	7M05 Natural Sciences, Mathematics and Statistics
2	Code and classification of training areas	7M051 Biological and related sciences
3	Group of educational programs	M082 Biological and related sciences
4	Name of the educational program	Biotechnology
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	Training of highly qualified scientific and pedagogical personnel in the field of biotechnology, capable of solving practical problems in the field of biotechnological production, organizing and managing biotechnological production
7	Type of EP	New
8	Level according to the NQF	7
9	Level according to the IQF	7
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. Interprets the latest theories and concepts as confirmation of the laws and trends in the development of biological science and comprehends the realities of modern theory and practice based on the history and philosophy of science, methodology of natural science, socio-humanitarian and technical knowledge; PO2. Uses the latest techniques, concepts and theories, technologies to solve fundamental problems in the field of biology, genetics, biotechnology, plans and organizes stages of scientific research, analyzes the results of scientific research and applies them to solving specific research tasks; PO3. Solves professional tasks corresponding to his qualifications, has an idea of alternative, technical, technologically safe solutions in the field under study; PO4. He is fluent in a foreign language at a professional level, which allows him to conduct scientific research and teach special disciplines in universities; PO5. Solves strategic and managerial tasks to improve enterprise management methods; PO6. Conducts laboratory and field research in order to expand scientific knowledge about modern methods of biotechnology and to test hypotheses for solving problems of biotechnological ecology, agrobiotechnology in order to develop new products and methods for use in pharmacology, agriculture and environmental protection; PO7. Applies the knowledge of pedagogy and psychology of higher education for the implementation of educational and pedagogical activities on the credit technology of education; PO8. Uses regulatory documents regulating the organization of research and production and technological work in the field of biotechnology.
13	Form of training	Day time

14	Duration of training	2 years
15	Volume of loans	120
16	Languages of instruction	Kazakh, Russian, English
17	Academic degree awarded	Master of Engineering
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
Cycle of general education disciplines Required Component											
	English language (professional)	The course is designed for undergraduates of technical specialties to improve and develop foreign language communication skills in professional and academic fields. The course introduces students to the general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies. The course ends with a final exam. Undergraduates also need to study independently (MIS).	5				v				
	History and philosophy of science	The subject of philosophy of science, dynamics of science, specifics of science, science and pre-science, antiquity and the formation of theoretical science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.	3	v							
	Higher school pedagogy	The course is intended for undergraduates of the scientific and pedagogical magistracy of all specialties. Undergraduates will master the methodological and theoretical foundations of higher school pedagogy, plan and organize the processes of teaching and upbringing, master the communicative technologies of subject-subject interaction between a teacher and a master in the educational process of a university.	3							v	
	Psychology of management	The discipline studies the modern role and content of psychological aspects in managerial activity. The improvement of the psychological literacy of the student in the process of implementing professional activities is considered. Self-improvement in the field of psychology and studying the composition and structure of management activities, both at the local level and abroad. The psychological feature of modern managers is considered.	3					v			
Cycle of general education disciplines University component											
	Biotechnology in environmental protection	The course will consider modern biotechnological methods for solving environmental problems and methods for restoring disturbed ecosystems. Particular attention is paid to biotechnological methods for processing production and consumption waste. Biotechnological methods for cleaning soils from oil spills and oil refinery products are also considered separately. Modern methods of selecting oil	5		v	v					

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		decomposer microorganisms and principles of creating biological preparations based on the use of consortia of microorganisms to clean up oil spills. Biotechnological methods of soil purification from heavy metals based on phytoremediation using hyperaccumulators will also be considered.									
	Food biotechnical systems, biotechnology and biosafety	The course summarizes modern data from fundamental and applied research in the field of food biotechnology and biosafety. Raw materials for the development of food biotechnology and methods for separating and increasing the productivity and technological qualities of the raw materials and the resulting products are considered separately. Also, special attention is paid to microorganisms that are used in food biotechnology, methods for their cultivation and optimization of conditions and factors for obtaining target products for food biotechnology. The issues of biosafety of food products, biotechnology, methods and methodologies for obtaining organic pure products will also be considered.	5		v	v					
	Principles and methods of molecular biology	The course of this discipline presents the main range of issues related to the principles and modern methods of molecular biology - the most rapidly developing area of biotechnology. The logic of the presentation of the material includes a consistent coverage of modern data from fundamental and applied research on the study of the structural organization and functions of DNA, RNA, mechanisms and main stages of protein synthesis. Much attention is paid to the processes of signal transmission in living systems and the main areas of application of molecular biology methods in biotechnology.	5	v	v						
Cycle of basic disciplines University component											
	Modern methods of biochemistry	The course summarizes modern methods and basic processes in the field of biochemistry, details the main stages of plant photosynthesis and its effect on growth, development and productivity, pays attention to the processes of respiration, glycolysis and the cycle of di- and tricarboxylic acids. Special attention is paid to modern methods of isolation, purification and study of enzymes, proteins and peptides.	5		v						
	Pharmaceutical biotechnical systems, biotechnology and biosafety	The course examines modern achievements and promising directions in the development of pharmaceutical biotechnology. Particular attention is paid to the features of the creation and development of medicines, methods, stages, problems, and regulatory support for the safety of pharmaceutical biotechnological industries.	5		v	v					
	Chemistry and biotechnology of biologically active substances	This course will summarize the current data obtained as a result of fundamental and applied research in the field of chemistry and biotechnology of biologically active substances. Separately, the chemical structure of biologically active substances and methods for their classification based on their biological activity and chemical structure will be considered. The course separately studies the producers of	5		v						

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		biologically active substances and biotechnological methods of their cultivation to obtain target products.									
Cycle of basic disciplines Selectable Component											
	Biodiversity of biotechnology objects and their genetic resources	The course examines modern achievements and methods of stem cell cultivation, cloning and cryopreservation of valuable collections of genotypes and germplasm of microorganisms, plants and animals.	5		v						
	Integrated technologies for industrial waste processing	The course presents fundamental and applied research data in the field of industrial waste disposal and disposal. Special attention is paid to modern biotechnological methods of processing industrial waste. The course provides modern biotechnological methods and practices of industrial waste disposal, which are used in the Republic of Kazakhstan and the world's best methods for the disposal and disposal of industrial waste.	5						v		
	Methods of scientific research in biotechnology	In this course, all modern biotechnological methods and methodologies are considered in detail, which make it possible to identify and isolate genes that are associated with resistance to extreme climatic environmental factors to create new plant varieties and crops that are resistant to severe climatic conditions.	5		v	v		v			
	Scientific foundations of biogeotechnology	The course discusses the main modern methods of biogeotechnology to increase the complexity of the use of raw materials and ensure effective environmental protection. Particular attention is paid to the use of biotechnological processes based on the use of microorganisms to increase the efficiency and processing of minerals.	5		v	v					
	Scientific Foundations of Petroleum Biotechnology	The course summarizes the data of applied research in the field of using biotechnological methods in the oil industry. Modern methods of biotechnology can be successfully used at various stages of oil field development: microbiological enhancement of oil recovery, the creation of biological products, and the cleanup of oil spills.	5		v	v					
	Production of biotechnological products in various industries	Currently, the volume of production of biotechnological products is increasing every year and occupying all leading positions in various industries. In the course of this discipline, all key areas of development of the biotechnological industry, raw materials, promising producers, methods for creating and selecting new highly productive producers based on genetic engineering, cellular and mutational selection based on the use of molecular markers of detection and selection of genes associated with productivity and the formation of high-quality products are studied.	5			v					v
	Theory and technology of biohydrometallurgical processing of refractory raw materials	The current state of hydrometallurgical processes and equipment. Theoretical foundations and technologies for the use of microorganisms in the leaching of metals, schemes for the processing of concentrates. The use of microorganisms for wastewater treatment. Economic and environmental aspects of the use of biohydrometallurgical processing of difficult-to-enrich raw materials.	5		v	v		v			

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	Quality management in biotechnology	The course summarizes the data of fundamental and applied research in the field of industrial biotechnology and quality assurance of biotechnological products. Special attention is paid to the standardization of the biotechnological process and the obtained target products to improve the quality of products based on the legal and international bases of standardization, taking into account state control and supervision of compliance with the requirements of state standards. Special attention is paid to the placement and disposal of biotechnological production waste to protect the environment, and to reduce its negative impact on the environment in order to create a waste-free biotechnological production.	5					v			v
	Fundamentals of bioenergy	Bioenergy is a fundamental and applied direction that has emerged on the border of modern biotechnologies, chemical technology and energy, studying and developing ways of biological conversion of solar energy into fuel and biomass and biological and thermochemical transformation of the latter into fuel and energy. The course will study all modern biotechnological methods of production of alternative energy sources such as the production of biodiesel, biomethane, bioethanol and biohydrogen from renewable raw materials.	5		v	v					

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



APPROVED
Chairman of the Management Board
of KazNRTU named after K.Satbayev
M. Begentaev
2022 y.

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

Educational program 7M05105 "Biotechnology"
Group of educational programs M082 Biotechnology

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	Academic degree: Master of Natural Sciences			
								Allocation of face-to-face training based on courses and semesters			
								1 course		2 course	
1 semester	2 semester	3 semester	4 semester								
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Module of basic training (university component)											
LNG210	English (professional)	BD UC	5	150	0/0/3	105	E	5			
HUM214	Management Psychology	BD UC	3	90	1/0/1	60	E		3		
HUM212	History and philosophy of science	BD UC	3	90	1/0/1	60	E		3		
HUM213	Higher school pedagogy	BD UC	3	90	1/0/1	60	E	3			
component of choice											
HB1201	Principles and methods of molecular biology	BD COC	5	150	2/0/1	105	E	5			
HB1202	Modern methods of biochemistry	BD COC									
HB1203	Biotechnology in environmental protection	BD COC	5	150	2/0/1	105	E	5			
HB1204	Chemistry and biotechnology of biologically active substances	BD COC									
HB1205	Food biotechnical systems, biotechnology and biosafety	BD COC	5	150	2/0/1	105	E		5		
HB1206	Pharmaceutical biotechnical systems, biotechnology and biosafety	BD COC									
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Module of professional activity (university component, component of choice)											
HB1207	Biodiversity of biotechnology objects and their genetic resources	PD UC	5	150	2/0/1	105	E	5			
HB1208	Fundamentals of bioenergy	PD UC	5	150	2/0/1	105	E	5			
HB1209	Methods of scientific research in biotechnology	PD UC	5	150	2/0/1	105	E		5		
HB1210	Scientific Foundations of Petroleum Biotechnology	PD UC	5	150	2/0/1	105	E			5	
HB1211	Scientific foundations of biogeotechnology	PD UC	5	150	2/0/1	105	E			5	
MET318	Theory and technology of bihydrometallurgical processing	PD UC	5	150	2/0/1	105	E		5		
HB1212	Production of biotechnological products in various industries	PD UC	5	150	2/0/1	105	E		5		
HB1213	Integrated technologies for industrial waste processing	PD UC	5	150	2/0/1	105	E			5	
HB1214	Quality management in biotechnology	PD UC	5	150	2/0/1	105	E			5	
M-3. Practice-oriented module											
AAP229	Pedagogical practice	BD UC	6						6		
AAP256	Research practice	PD, CCH	4							4	
M-4. Experimental research module											
AAP251	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	2					2			
AAP241	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	3						3		
AAP254	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	5							5	

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)