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

Department of Chemical and Biochemical Engineering

EDUCATIONAL PROGRAM
7M05105 – Biotechnology

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 2025

The educational program 7M05105 «Biotechnology» was approved at the meeting of the Scientific Council of KazNTU named after K.I.Satpayev

Protocol №10 from «06» 03 2025y

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

Protocol №3 from «20» 12 2024y

The educational program 7M05105 «Biotechnology» was developed by the academic committee in the direction: 7M051 «Biological and related Sciences»

Name	Academic degree/ academic	Post	Place of work	Signature
Chairman of the Academic Committee:				
Belkozhaev Ayaz Maratovich	Doctor PhD	Associate Professor	Kazakh National Research Technical University named after K.I.Satpayev	
Teaching staff:				
Narmuratova Zhanar Bakhytovna	Doctor PhD	Associate Professor	Kazakh National Research Technical University named after K.I.Satpayev	
Mangazbaeva Rauash Amantaevna	Candidate of Chemical Sciences, Associate Professor	Associate Professor	Kazakh National Research Technical University named after K.I.Satpayev	
Sandybayeva Sandugash Kalzhankyzy	-	Lecturer	Kazakh National Research Technical University named after K.I.Satpayev	
Employers				
Jamalova Gulya Abaevna	Candidate of Agricultural Sciences	Associate Professor	General Director of Scientific Diagnostic Center "Animal expert group" LLP	
Students:				
Amantai Indira	-	Student	Kazakh National Research Technical University named after K.I.Satpayev	

Content

List of abbreviations and designations

EP – Educational program

CC – Communicative competence

LO – Learning Outcomes

NJSC - Non-profit joint stock company

1. Description of the educational program

The educational program (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 crossplatform 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 sciencebased 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 in biological sciences, comprehending their relevance and applicability in modern biotechnological research and development, which allows for a deeper understanding of the regularities and trends in the development of biological science and assesses their applicability in solving practical problems of biotechnology. PO2. Uses the latest techniques, concepts and theories of technology to solve fundamental problems in biology and biotechnology, which includes planning and organising research stages, analysing results and applying them to specific research problems, contributing to the development of new approaches and innovations in science; PO3. Solves professional problems appropriate to his/her qualification, developing alternative technical and technologically safe solutions in the field of study and contributing to the efficiency and safety of biotechnological processes; PO4. Uses a foreign language (English) at a professional level to conduct scientific research, publish results in international journals and teach special disciplines in higher education institutions, contributing to the internationalisation of scientific activity and increasing academic mobility; PO5. Applies regulatory documents governing the organisation and conduct of research and development and production and technological works in the field of biotechnology, which ensures compliance of activities with

		modern standards and requirements; PO6. Develops management solutions to improve the management practices of a biotechnology enterprise, which includes analysing current management practices and developing new strategies to improve the competitiveness and innovation of the enterprise; PO7. Conducts complex laboratory research aimed at expanding scientific knowledge of modern biotechnology methods, testing hypotheses and developing new products and techniques for application in pharmacology, agriculture and environmental protection, which provides a comprehensive approach to solving scientific and practical problems; PO8. Applies methods and means of teaching disciplines in the field of biotechnology, developing teaching materials and courses, adapting modern pedagogical technologies in the educational process, which contributes to the improvement of the quality of learning and development of professional competences in students.
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:	Belkozhayev A.M,Mangazbayeva R.M,Narmuratova Z.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 University component											
1	Foreign language (professional)	Mastering professional English at an advanced level (for non-linguistic areas). The study of grammatical characteristics of scientific style in its oral and written forms. Professional oral communication in monological and dialogical form according to the educational program. Ability to demonstrate the results of research in the form of reports, abstracts, publications and public discussions; interpret and present the results of scientific research in a foreign language.	3				v				
2	History and philosophy of science	Purpose: to explore the history and philosophy of science as a system of concepts of global and Kazakh science. Content: the subject of philosophy of science, dynamics of science, the main stages of the historical development of science, features of classical science, nonclassical 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						

3	Higher school pedagogy	The course is aimed at mastering the methodological and theoretical foundations of higher education pedagogy. The discipline will help to master the skills of modern pedagogical technologies, technologies of pedagogical design, organization and control in higher education, skills of communicative competence. At the end of the course, undergraduates learn how to organize and conduct various forms of organizing training, apply active teaching methods, and select the content of training sessions. Organize the educational process on the basis of credit technology of education.	3								**v**
4	Psychology of management	The course is aimed at mastering the tools for effective employee management, based on knowledge of the psychological mechanisms of	3						**v**		
		the manager's activity. Discipline will help you master the skills of making decisions, creating a favorable psychological climate, motivating employees, setting goals, building a team and communicating with employees. At the end of the course, undergraduates will learn how to resolve managerial conflicts, create their own image, analyze situations in the field of managerial activity, as well as negotiate, be stress-resistant and effective leaders.									
Cycle of basic disciplines University component											

5	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 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.	5	v		v					
6	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					
7	Principles and methods of	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	5	v	v						

	molecular biology	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.									
8	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**							
9	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**					
10	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 biologically active substances and biotechnological methods of their cultivation to obtain target products.	5	**v**							

11	Sustainable development strategies	Purpose: To train graduate students in sustainable development strategies to achieve a balance between economic growth, social responsibility, and environmental protection. Content: Graduate students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the evaluation of their effectiveness, and international standards and best practices. Cases and examples of successful sustainable development strategies are included.	5	v		v					

12	Intellectual property and research	The purpose of this course is to provide undergraduates with the knowledge and skills necessary to understand, protect and manage intellectual property (IP) in the context of scientific research and innovation. The course is aimed at training specialists who can effectively work with IP, protect the results of scientific research and apply them in practice.	5				v				
13	Pedagogical practice	In the course of teaching practice, undergraduates are involved in undergraduate studies at the discretion of the university. At the same time, undergraduates apply the knowledge of pedagogy and psychology of students' cognitive activity in the learning process, undergraduates form an idea of the professional competence of a teacher of higher education.	6			v	v				
	CYCLE OF PROFILE DISCIPLINES University component										
14	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						

15	Integrated technologies for industrial waste processing	The course presents fendamental 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		
16	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		
17	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					
18	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					

19	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			
20	Theory and technology of biohydrometallurgical processing of refractory raw materials	The purpose of this discipline is to develop and improve effective technologies for processing raw materials with a low metal content, which makes it possible to optimize the processes of mining and processing of minerals. Content: Thanks to the use of modern methods of biohydrometallurgy, scientists and engineers can effectively extract valuable metals, while reducing the negative impact on the environment.	5	v		v			v		
21	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	5					v	v		

		reduce its negative impact on the environment in order to create a waste-free biotechnological production.									

22	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					
23	Fundamentals of plant bioengineering	The course summarizes the current data of fundamental and applied research in the field of plant bioengineering. Plant bioengineering is a fundamental and applied direction that emerged on the borderline of modern research into biotechnologies of cultivation of plant organs, tissues, cells and protoplasts under in vitro conditions and its application in various directions to solve pressing global problems such as adaptation of important food crops to climate change and study of genes associated with resistance to biotic and abiotic environmental stress factors. To ensure food security, genes are being studied and modern methods of genetic engineering are being introduced, molecular labeling (MAS) is being carried out to speed up the breeding process and expand the genetic basis of important crops. This course will study in detail all modern methods and methodologies that are used to solve these urgent problems using advances in the field of plant bioengineering.	4	v							

24	Research practice	During the research practice, undergraduates get acquainted with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data. At the same time, undergraduates, performing experimental research on the topic of a master's thesis using modern instrumental methods and computing tools, learn to be responsible for the quality of research and the scientific reliability of the results obtained, professionally draw up, present and report the results of research work.	4					5			

5. Curriculum of the educational program

SATBAYEV UNIVERSITY

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

WORKING CURRICULUM

Academic year: 2025-2026 (Autumn, Spring)

Group of educational programs: M082 - "Biotechnology"

Educational program: 7M05105 - "Biotechnology"

The awarded academic degree: Master of science in Natural Sciences

Form and duration of study: full time (scientific and pedagogical track) - 2 years

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters				Prerequisites
									1 course		2 course		
									1 sem	2 sem	3 sem	4 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)													
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Module of basic training (university component)													
LNG213	Foreign language (professional)		BD, UC	3	90	0/0/30	60	E	3				
HUM214	Psychology of management		BD, UC	3	90	15/0/15	60	E	3				
HBI201	Principles and methods of molecular biology	1	BD, CCH	5	150	30/0/15	105	E	5				
HBI202	Modern methods of biochemistry	1	BD, CCH	5	150	30/0/15	105	E	5				
HBI203	Biotechnology in environmental protection	2	BD, CCH	5	150	30/0/15	105	E	5				
MNG782	Sustainable development strategies	2	BD, CCH	5	150	30/0/15	105	E	5				
HBI204	Chemistry and biotechnology of biologically active substances	2	BD, CCH	5	150	30/0/15	105	E	5				
HUM212	History and philosophy of science		BD, UC	3	90	15/0/15	60	E		3			
HUM213	Higher school pedagogy		BD, UC	3	90	15/0/15	60	E		3			
HBI205	Food biotechnical systems, biotechnology and biosafety	1	BD, CCH	5	150	30/0/15	105	E			5		
MNG781	Intellectual property and research	1	BD, CCH	5	150	30/0/15	105	E			5		
HBI206	Pharmaceutical biotechnical systems, biotechnology and biosafety	1	BD, CCH	5	150	30/0/15	105	E			5		
M-3. Practice-oriented module													
AAP273	Pedagogical practice		BD, UC	8				R			8		
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of professional activity (university component, component of choice)													
HBI207	Biodiversity of biotechnology objects and their genetic resources		PD, UC	5	150	30/0/15	105	E	5				
HBI208	Fundamentals of bioenergy		PD, UC	5	150	30/0/15	105	E	5				
HBI209	Methods of scientific research in biotechnology		PD, UC	5	150	30/0/15	105	E		5			
HBI210	Scientific Foundations of Petroleum Biotechnology		PD, UC	5	150	30/0/15	105	E		5			
HBI212	Production of biotechnological products in various industries		PD, UC	5	150	30/0/15	105	E		5			
MEI243	Theory and technology of biohydrometallurgical processing of refractory raw materials		PD, UC	5	150	30/0/15	105	E		5			
HBI211	Scientific foundations of biogeotechnology		PD, UC	5	150	30/0/15	105	E			5		

F KazNRTU 703-05 Educational program

HBI213	Integrated technologies for industrial waste processing		PD, UC	5	150	30/0/15	105	E			5		
HBI214	Quality management in biotechnology		PD, UC	5	150	30/0/15	105	E			5		
HBI217	Fundamentals of plant bioengineering		PD, UC	4	120	30/0/15	75	E				4	
M-3. Practice-oriented module													
AAP256	Research practice		PD, UC	4				R				4	
M-4. Experimental research module													
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R	4				
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R		4			
AAP251	Research work of a master's student, including internship and completion of a master's thesis		RWMS	2				R			2		
AAP255	Research work of a master's student, including internship and completion of a master's thesis		RWMS	14				R				14	
M-5. Module of final attestation													
ECA212	Registration and protection of the master thesis		FA	8								8	
Total based on UNIVERSITY:									30	30	30	30	
									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	0	0	0	0
BD	Cycle of basic disciplines	0	20	15	35
PD	Cycle of profile disciplines	0	53	0	53
Total for theoretical training:		**0**	**73**	**15**	**88**
RWMS	Research Work of Master's Student				24
ERWMS	Experimental Research Work of Master's Student				0
FA	Final attestation				8
TOTAL:					**120**

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

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

Signed:

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

Approved:

Vice Provost on academic development — Kalpeyeva Z. Б.

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

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

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

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