

«Alikhan Bokeikhan University» Educational Institution

Faculty of Information Technology and Economics  
Department of Applied Biology

Group of educational programs: **M082 – Biotechnology**

Direction of preparation: **7M051 - Biological and related Sciences**

**7M05109 – «BIOTECHNOLOGY»**  
(scientific and pedagogical direction)

**THE CATALOGUE OF  
ELECTIVE DISCIPLINES**

Year of entry - 2022

Semey - 2022

**Reviewed and agreed at the meeting of the Educational-Methodical Council of the Faculty of Information Technology and Economics**

Minutes No. 5 from 20.05.22

Chairman of the EMC of the Faculty



Shoibakova E.O.

**Approved at the meeting of Educational-Methodical Council of the University**

Minutes No. 5 from 25.05.22

Chairman of the University EMC



Zharykbassova K.S.

**The awarded degree:**

Master of Natural Science in Education Program 7M05109 «Biotechnology»

Elective course №	The name of the disciplines	The number of credits	Pre-requisites	Post-requisites	A brief description indicating the brief content and expected results of the study (knowledge, abilities, skills, competencies)
<b>THE BASIC DISCIPLINES</b>					
<b>Component of choice</b>					
<b>Module No. 1 Methodology of scientific research</b>					
<b>1</b>	Methodological bases of scientific research in biotechnology and experimental planning	5	Fundamentals of biotechnology (bachelor course)	Molecular genetic bases of biotechnology	<p><b>The short content:</b> History of formation and development of science in Kazakhstan. Scientific knowledge, structure and main stages of research. The main functions of science in modern society. Normative documents regulating scientific activity. Scientific organizations, degrees and academic titles in Kazakhstan and world scientific space. Methods of theoretical research, modern directions of scientific research and planning of scientific experiment in biotechnology.</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies.</p> <p><b>Knowledge</b> about the history of the formation and development of science as an activity in Kazakhstan; methodological foundations of scientific knowledge; normative documents regulating scientific activity, on the system of scientific organizations in Kazakhstan; scientific degrees and academic titles in Kazakhstan and the world scientific space; about the Kazakh system of science management; about Kazakhstani</p>

				<p>normative documents regulating scientific activity; about the system of scientific organizations in Kazakhstan; about the ethical side of scientific research.</p> <p><b>Abilities:</b> to put the purpose and objectives of the forthcoming research; find, use, summarize and analyze relevant literature data on the studied research problem; find ways of achieving the objectives of the study in terms of the formation and development of information technologies; to choose the right object of research; to plan a scientific experiment; to critically analyze experimental data; summarize and arrange the data obtained; to draw conclusions; to write scientific articles; presentations at scientific conferences.</p> <p><b>Skills</b> with laboratory equipment; establishment of conditions to perform the experiment; design of the experimental data in graphs, tables, figures; presentation of experimental data.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</li> </ul> <p><b>2. professional (scientific-research) competences (PC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to plan, organize and conduct research work in the field of biotechnology; carrying</li> </ul>
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					out correct processing of the results of experiments with their further presentation in the form of scientific reports, reports, publications and presentations; substantiation of the conclusion and conclusions.
1	Methodology of scientific research in environmental biotechnology	5	Fundamentals of biotechnology (bachelor course)	Ecological aspects of modern biotechnology	<p><b>The short content:</b> Goals, objectives, subject and object of scientific research in environmental biotechnology. Classification of scientific research, the main scientific directions in environmental biotechnology. Definition and classification of scientific documents depending on the method of providing information. Patent information. Primary unpublished scientific documents. Secondary scientific documents: background, overview, reference and bibliographical. Cumulative scientific information.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies.</p> <p><b>Knowledge</b> of scientific research: purposes, tasks, subject and object research; objects of scientific research in the field of environmental biotechnology; classification of scientific research; major types of research: fundamental, applied and development; main areas of research; requirements for the subject research.</p> <p><b>Abilities:</b> to put the purpose and objectives of the forthcoming research; find, use, summarize and analyze relevant literature data on the studied research problem;</p>

				<p>find ways of achieving the objectives of the study in terms of the formation and development of information technologies; to choose the right object of research; to plan a scientific experiment; to critically analyze experimental data; summarize and arrange the data obtained; to draw conclusions on the accomplished work; writing scientific articles; presentations at scientific conferences.</p> <p><b>Skills</b> with laboratory equipment; establishment of conditions to perform the experiment; design of the experimental data in graphs, tables, figures; presentation of experimental data; presentations to a wider audience.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</li> </ul> <p><b>2. professional (scientific-research) competences (PC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to plan, organize and conduct research work in the field of biotechnology; carrying out correct processing of the results of experiments with their further presentation in the form of scientific reports, reports, publications and presentations; substantiation of the conclusion and conclusions.</li> </ul> <p><b>3. professional (industrial-</b></p>
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					<p><b>technological) competences (PC 2):</b></p> <p>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</p>
<p><b>Module No. 2 Psychological and pedagogical foundations of teaching in higher education</b></p>					
2	Pedagogical ethics of a modern teacher	3	Culturology (bachelor course)	Teaching methodology of specialty disciplines	<p><b>The short content:</b> The subject and tasks of pedagogical ethics. The origin and interrelation of the concepts of "ethics", "morality", "morality", "etiquette"; functions and ethical principles of pedagogical communication; the teacher's communication style, its influence on the training, student's personality upbringing and development and etc. The teacher's image as a guarantee of professional success.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies.</p> <p><b>Knowledge:</b> historical aspects of the formation of ethics as a science; theoretical foundations of ethics, its conceptual and categorical apparatus.</p> <p><b>Abilities:</b> apply ethical norms and standards in professional practice; independently navigate ethical problems and ways to resolve them; apply general moral norms and requirements of professional ethics in practice.</p> <p><b>Skills</b> to possess the conceptual apparatus of professional ethics</p>

					<p>of a specialist; methodological approaches to the choice of theoretical tools appropriate to the task being solved; culture of communication in professional and everyday life, skills of public speech, argumentation, discussion.</p> <p><b>Competences:</b></p> <p><b>1. professional (pedagogical, upbringing) competences (PC 5):</b></p> <p>- the ability to observe pedagogical tact, the rules of pedagogical ethics; to show respect for the personality of students; to adhere to a democratic style in relationships with students; to show commitment to the highest social values, to the ideas of humanistic pedagogy; to be attached to the system of universal and national values in their unity; to build the educational process taking into account national priorities Kazakhstan; to resist any kind of discrimination, extremism; the ability to solve moral and ethical problems that may arise in pedagogical activity.</p> <p><b>2. general professional competences (GPC 2):</b></p> <p>the ability to communicate in oral and written forms in a foreign and state language of the Republic of Kazakhstan to solve the problems of professional activity; leadership of the team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences.</p>
2	Modern pedagogi-	3	Pedagogy	Theory and tech-	<b>The short content:</b> Pedagogical technologies. Classification of



	cal technologies			nology of teaching in the university	<p>pedagogical technologies. Traditional and innovative pedagogical technologies. Modern educational technologies as an objective need. Technologies of personality-oriented learning. Critical thinking technologies. Case technologies. Technologies of creative workshops. Technologies of problem-based learning. Computer (information) technologies. Technologies of programmed learning. Modular learning technologies. Integrated learning technologies.</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies.</p> <p><b>Knowledge:</b> the concept of pedagogical technology, its structure, the methodology of pedagogical technology and the peculiarities of the use of pedagogical technology in the educational process.</p> <p><b>Abilities:</b> design, predict and design pedagogical technologies in professional pedagogical activity; apply pedagogical technologies in the pedagogical process of a modern school.</p> <p><b>Skills creative</b> use of new technologies in professional activity.</p> <p><b>Competences:</b></p> <p><b>1. professional (pedagogical, teaching) competences - PC 4.</b></p> <p>– the ability to independently conduct lectures, seminars, practical classes and laboratory workshops using modern educational technologies; plan and organize independent work of students.</p>
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3	Teaching methodology of specialty disciplines	4	Pedagogical ethics of a modern teacher	Pedagogical practice	<p><b>The short content:</b> Methods of teaching disciplines as a pedagogical science. Goals and objectives. Connection with other sciences. Problems of biotechnological education in Kazakhstan. Methods and classification of teaching biotechnology. Active methods of teaching biotechnology. Planning of classes in the disciplines of educational program «Biotechnology». Methods of concept development. Modern means of evaluation of learning outcomes.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about the patterns underlying the learning process binding disciplines undergraduate of educational program 6B05121 «Biotechnology» of master students; the variety of forms and teaching methods of biotechnology; issues and trends in the development of biotech education and the ways of their solution.</p> <p><b>Abilities:</b> reasoned approach to the problem of choice of methods and forms of learning biotechnology; to make curriculums, syllabuses, glossaries, and other educational-methodical materials; to predict the results of their activities; to use various forms of organization of educational activity in the classroom, to be able to analyze the effectiveness of various types of studies, as well as techniques and</p>
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				<p>methods of teaching; to apply the acquired knowledge and skills at the university in the period of pedagogical practice and the subsequent teaching activities.</p> <p><b>Skills</b> of maintaining aseptic conditions in the biotechnology laboratory; preparation of temporary and permanent micropreparations; possession of methods of cultivation of microorganisms and culture plant and animal cells; design presentations, selection needed for training video materials; use of laboratory equipment.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</li> </ul> <p><b>2. professional (pedagogical, teaching) competences - PC 4.</b></p> <ul style="list-style-type: none"> <li>– the ability to independently conduct lectures, seminars, practical classes and laboratory workshops using modern educational technologies; plan and organize independent work of students.</li> </ul> <p><b>3. professional (pedagogical, methodical) competences (PC 6):</b></p> <ul style="list-style-type: none"> <li>- the ability to develop the teaching materials of the disciplines being read; author's courses in accordance with the mission and goals of the organiza-</li> </ul>
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					tion of education.
3	Theory and technology of teaching in the university	4	Modern pedagogical technologies	Pedagogical practice	<p><b>The short content:</b> Theory and technology of teaching at the University. Goals, objectives, communication with other disciplines. Problems of biotechnological education at present stage. Methods and classification of teaching biotechnology. Planning classes in the disciplines «Objects of biotechnology», «Fundamentals of biotechnology». Methods of concept development. Modern means of evaluation of learning outcomes. The audiovisual technologies of training.</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about the patterns underlying the learning process of undergraduate master students mandatory undergraduate courses of the educational program 6B05121 «Biotechnology»; the variety of forms and teaching methods of biotechnology; issues and trends in the development of biotech education and the ways of their solution.</p> <p><b>Abilities:</b> to draw up plans, lecture notes, development of practical and laboratory classes; reasoned approach to the problem of choice of methods and forms of learning biotechnology; to make curricula, syllabi, glossaries, and other educational-methodical materials; to predict the results of their activities; to use various forms of organization of educational activity in the classroom, to</p>

				<p>be able to analyze the effectiveness of various types of studies, as well as techniques and methods of training; to apply the obtained knowledge and skills at the University in the period of pedagogical practice and subsequent teaching.</p> <p><b>Skills</b> of maintaining aseptic conditions in biotechnological laboratories; preparation of temporary and permanent micropreparations; possession of methods of cultivation of microorganisms and culture plant and animal cells; design presentations, selection needed for training video materials; use of laboratory equipment.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</p> <p><b>2. professional (pedagogical, teaching) competences - PC 4.</b></p> <p>– the ability to independently conduct lectures, seminars, practical classes and laboratory workshops using modern educational technologies; plan and organize independent work of students.</p> <p><b>3. professional (pedagogical, methodical) competences (PC 6):</b></p> <p>- the ability to develop the teaching materials of the disciplines</p>
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					being read; author's courses in accordance with the mission and goals of the organization of education.
<b>Module No. 3 Molecular Fundamentals of Biotechnology</b>					
4	Molecular genetic bases of biotechnology	3	Methodological bases of scientific research in biotechnology and experimental planning	Final attestation	<p><b>The short content:</b> Molecular genetic biotechnology as the main direction in development of General biotechnology. Emergence and history of development of molecular biotechnology. Molecular biotechnological revolution in biology. Recombinant DNA technology. Commercialization of molecular biotechnology. Fundamentals of molecular biotechnology. Main elements and processes used in molecular biotechnology. Structure of DNA. Replication. Decoding of genetic information: RNA and protein.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> of the structure of DNA, its replication, features of the genome in prokaryotes and eukaryotes; the realization of genetic information (protein biosynthesis); the regulation of transcription in prokaryotes (bacteria) and eukaryotes; General principles of construction of recombinant organisms; modern notions of identification, transfer and expression of the target gene; the possibilities of using transgenic organisms – from bacteria to plants and animals; legal aspects and problems of Biosafety while using GMOs.</p>

					<p><b>Abilities:</b> to navigate in questions of molecular genetic biotechnology and highly specialized issues of molecular biotechnology; be familiar with the basic methods of molecular biology: working with cell cultures, etc.</p> <p><b>Skills</b> in modern laboratory; the laboratory equipment: pH meter, analytical balance, automatic pipettes, microscopes; recognize major differences between DNA and RNA; to distinguish the structural organization of nucleic acids.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</li> </ul> <p><b>2. professional (scientific-research) competences (PC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to plan, organize and conduct research work in the field of biotechnology; carrying out correct processing of the results of experiments with their further presentation in the form of scientific reports, reports, publications and presentations; substantiation of the conclusion and conclusions.</li> </ul>
4	Environmental aspects of modern biotechnology	3	Methodology of scientific research in environmental biotechnology	Final attestation	<p><b>The short content:</b> Environmental problems of modern society. Chemical, physical and biological contamination. Atmospheric pollution. «Greenhouse effect». The main measures for pro-</p>

				<p>tection of atmospheric air. Pollution of hydrosphere, lithosphere. Environmental effects of environmental pollution. Biotechnological methods to protect the environment (environmental biotechnology). Anthropogenic factors of environmental pollution. Biological methods for solving environmental problems.</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about the tasks of environmental biotechnology; basic terms in environmental biotechnology; methods of use of microorganisms in wastewater treatment and industrial plants; methods of bioindication of pollution of the environment; use of biotechnology in environmental protection, bioindicators of pollution of water bodies.</p> <p><b>Abilities:</b> use of primary, secondary, and reference books on environmental biotechnology, environmental biotechnology terms; to navigate in the modern directions and methods of ecology; carry out examination of the state of air masses and bodies of water.</p> <p><b>Skills</b> of conducting biomonitoring and bioindication methods for monitoring current changes in the biosphere.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instrument,</p>
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					<p>use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2):</b></p> <p>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</p>
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**The profiling disciplines**

**Module No. 4 Pharmaceutical biotechnology**

<b>1</b>	Biotechnology of medicines and genetically modified foods	5	Fundamentals of biotechnology (bachelor course)	Biotechnology of therapeutic, preventive foods, and foods with special purpose	<p><b>The short content:</b> Modern achievements of biological sciences and biomedical technologies. Innovative ways to create drugs. Regulatory documents related to production, quality control, compliance with genetic and environmental safety, international and domestic standards in relation to received drugs, as well as biological objects - producers. Quality control of medicines. Biotechnology for production of industrial drugs.</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> of modern achievements in fundamental biological sciences and biomedical technologies; the concept of with specific drugs; innovative ways of creating drugs; key regulatory documents relating to the production,</p>
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				<p>quality control, environmental safety, storage, international and domestic standards in relation to biotechnological methods derived medicines and biological objects to their producers.</p> <p><b>Abilities:</b> to maintain optimal conditions for the biosynthesis of the target product; to provide the aseptic conditions of the production process; to implement step-wise control and standardization of drugs derived (determination of antimicrobial activity the antibiotic activity of enzyme preparations, the viability of microorganisms); to obtain finished drug products and diagnostic preparations of medicinal substances of microbiological origin; choose optimal storage conditions therapeutic and diagnostic agents and to assess their quality during prolonged storage; to ensure compliance with regulations, industrial hygiene, environmental, occupational health and safety.</p> <p><b>Skills</b> experience of scientific-technical documentation: laboratory and experimental-industrial regulations, etc.; determining the biological activity of antibiotics, vitamins, hormones, recombinant proteins and immunopreparation.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in</p>
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				<p>the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2, PC 3):</b></p> <ul style="list-style-type: none"> <li>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</li> <li>- the ability to analyze the composition, properties and quality of biotechnological products; development of a quality management system for biotechnological products in production in accordance with the requirements of Kazakhstan and international quality standards in order to ensure the stability of production indicators and the quality of products.</li> </ul>
1	Biotechnology of biologically active substances taking into account the rules of GMP	5	Fundamentals of biotechnology (bachelor course)	<p>Bases of biosafety</p> <p><b>The short content:</b> Biotechnological processes: their classification by types of producers (biological, biochemical and biosimilar). Preparation of equipment and culture media, sterilization, sowing of biological object, isolation and purification of target product, its drying and packaging. Main directions of quality assurance of biotechnological preparations (GLP, GCP, GMP). Concept of biologically active substances (BAS). Classification of BAS. Of biologically active substances of plant, microbial and animal origin.</p> <p><b>The expected results.</b> After the development of the discipline</p>

				<p>master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about biotechnological processes: their classification by types of producers (biological, biochemical and biosimilar). Preparation of equipment and culture media, sterilization, sowing of biological object, isolation and purification of target product, its drying and packaging. Main directions of quality assurance of biotechnological preparations (GLP, GCP, GMP). Concept of biologically active substances (BAS). Classification of BAS, of biologically active substances of plant, microbial and animal origin.</p> <p><b>Abilities:</b> to determine the purity of microorganisms-producers by a method of microscopy; to determine the concentration of viable cells and their enzymatic activity.</p> <p><b>Skills</b> working in aseptic conditions, including use of flambeau; work with microorganisms; design of nutrient medium, to select and calculate the mode of sterilization; choose fermentation and auxiliary equipment, to determine the mode of sterilization; to provide the aseptic conditions of realization of technological process, observance of rules of industrial hygiene.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instru-</p>
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				<p>ments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2, PC 3):</b></p> <ul style="list-style-type: none"> <li>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</li> <li>- the ability to analyze the composition, properties and quality of biotechnological products; development of a quality management system for biotechnological products in production in accordance with the requirements of Kazakhstan and international quality standards in order to ensure the stability of production indicators and the quality of products.</li> </ul>
2	Biotechnology of biologically active substances and additives	5	Objects of biotechnology (bachelor course)	<p>Biotechnology of dairy and probiotic products</p> <p><b>The short content:</b> Modern achievements in field of biotechnology of biologically active substances (BAS) and additives (BAA). Scientific aspects of application of BAS and BAA in biotechnology. Classification of BAS and BAA. Alkaloids, glycosides, phenolic compounds, carotenoids, coumarins: their physiological role. Scientific and practical bases of use of BAS, BAA in production of specialized foodstuff.</p> <p><b>The expected results.</b> After the development of the discipline</p>

				<p>master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about modern achievements in field of biotechnology of biologically active substances (BAS) and additives (BAA); scientific aspects of application of BAS and BAA in biotechnology. Classification of BAS and BAA. Alkaloids, glycosides, phenolic compounds, carotenoids, coumarins: their physiological role. Scientific and practical bases of use of BAS, BAA in production of specialized foodstuff.</p> <p><b>Abilities:</b> to determine the purity of microorganisms-producers by a method of microscopy; to determine the concentration of viable cells and their enzymatic activity.</p> <p><b>Skills</b> working in aseptic conditions, including use of flambeau; work with microorganisms; design of nutrient medium, to select and calculate the mode of sterilization; select enzymatic and accessories, to determine the mode of sterilization; to provide the aseptic conditions of realization of technological process, observance of rules of industrial hygiene.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in</p>
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					<p>the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2, PC 3):</b></p> <ul style="list-style-type: none"> <li>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</li> <li>- the ability to analyze the composition, properties and quality of biotechnological products; development of a quality management system for biotechnological products in production in accordance with the requirements of Kazakhstan and international quality standards in order to ensure the stability of production indicators and the quality of products.</li> </ul>
2	Phytore-sources of medicinal plants	5	Objects of biotechnology (bachelor course)	<p>Bioindication of pollution of water and soil ecosystems</p>	<p><b>The short content:</b> Role of medicinal plants. Importance of herbal remedies in folk and scientific medicine. Flora of the Earth is main source of medicines. Botanical-geographical and resource characteristics of Kazakhstan. Main medicinal plants of Kazakhstan, their botanical characteristics. Terms of flowering, fruiting and collection of medicinal raw materials. Forms of preparation of medicinal raw materials.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p>

				<p><b>Knowledge:</b> about the main stages of development of modern directions of scientific researches in the field of medicinal plants; the characterization of raw materials of medicinal plants; the system of state measures on the rational use and conservation of medicinal plants; basic information on distribution and habitat of medicinal plants; influence of environmental factors on the development of the commodity mass of medicinal plants and the accumulation of biologically active substances; safety instructions when working with medicinal plants and medicinal plant raw materials.</p> <p><b>Abilities:</b> to identify the morphological characteristics of medicinal plants in your living and herbarium; to identify medicinal plant material in solid form using the respective identifiers.</p> <p><b>Skills</b> collecting medicinal raw materials; proper storage of medicinal raw materials and preparation of herbaria of medicinal plants.</p> <p><b>Competences:</b></p> <p><b>1. professional (industrial-technological) competences (PC 2):</b></p> <ul style="list-style-type: none"> <li>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</li> </ul> <p><b>2. general cultural competences (GCC):</b></p> <ul style="list-style-type: none"> <li>- the ability to analyze, synthe-</li> </ul>
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					size and abstract thinking; to professional growth, improvement and development of their intellectual and general cultural level; ability to act in unusual situations.
<b>Module No. 5 Biotechnology management</b>					
<b>3</b>	Quality management of biotechnological products	<b>5</b>	Fundamentals of biotechnology (bachelor course)	Food biochemistry and biotechnology	<p><b>The short content:</b> The concept of «product quality». Basic concepts of product quality management. Different kinds of quality assurance systems. Methods of control, quality analysis in production systems. Methods of organization of works on quality improvement. Methodology of quality and reliability management of man-made systems. Recommendations of Kazakhstan and international standards ISO 9000 to ensure product quality.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about the basic concepts of quality management; various types of systems ensuring quality; methods of monitoring and analysis of quality in production and service systems; methods of organization of work on improvement of quality; the main types of quality costs; the methodology and terminology of quality management and reliability of complex technological systems; the recommendations of Kazakh and international standards of series ISO 9000 to ensure the quality of products; modern methods of forecasting and ensuring a specified level.</p>

					<p><b>Abilities:</b> use the principles of the quality management system and organizational and legal bases of managerial and entrepreneurial activities; create production documentation (work schedules, instructions, material requisitions, equipment), as well as the established reporting on approved standards.</p> <p><b>Skills</b> organizational and managerial work in small groups; analysis and evaluation of the effectiveness of the system of control of production activities.</p> <p><b>Competences:</b></p> <p><b>2. professional (industrial-technological) competences (PC 2, PC 3):</b></p> <ul style="list-style-type: none"> <li>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</li> <li>- the ability to analyze the composition, properties and quality of biotechnological products; development of a quality management system for biotechnological products in production in accordance with the requirements of Kazakhstan and international quality standards in order to ensure the stability of production indicators and the quality of products.</li> </ul>
3	Ecological management in biotechnology	5	Fundamentals of biotechnology (bachelor course)	Biotechnological methods of wastewater	<p><b>The short content:</b> The concept of «environmental management». Goals, objectives and system of environmental management. Environmental mission, policy and</p>

				<p>treatment and emissions of industrial enterprises</p> <p>objectives of industrial enterprises. Goals, objectives and principles of environmental policy development. Corporate environmental management program. The theory of the stake holders. Basic requirements for the environmental management system at the enterprise.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>The knowledge</b> of process management and work organization at the level of primary group structures and middle managers; the normative-organizational documentation in the field of environmental management; current legislation in the field of environmental protection; compliance with ethical standards and risk strategies in the development of biotechnologies.</p> <p><b>Abilities:</b> collect and organize data for environmental impact assessment and environmental audit; conduct an assessment of the economic damage and risks for the natural environment, the economic efficiency of environmental measures, and payment for use of natural resources; to analyze the technological process as a control object.</p> <p><b>Skills</b> apply this knowledge to improve the quality of life of people and the environment.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally op-</p>
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					<p>erate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2):</b></p> <ul style="list-style-type: none"> <li>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</li> </ul>
<b>Module No.6 Microorganisms in the biotechnological process</b>					
<b>4</b>	Bases of microorganism cultivation in biotechnological production	5	Fundamentals of biotechnology (bachelor course)	Scientific-research work of undergraduates	<p><b>The short content:</b> Cultivation of microorganisms as a basis for the production of new foods and medicines. Main representatives of microorganisms used in biotechnology. Selection of strains of microorganisms. Fermentation, biotransformation, microbial synthesis products. Concept microbiotechnological production from culture to final product. Resistance of microorganisms in external environment. Influence of various environmental factors on growth and development of microorganisms.</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about the main representatives of microorganisms used in the biotechnological production; the selection of strains</p>

				<p>and requirements to them; the peculiarities of the cultivation of various microorganisms; fermentation, biotransformation; production of microbial synthesis; the concept microbiotechnological production from culture to the final product.</p> <p><b>Abilities:</b> to characterize the strain for use in production; to choose nutrient medium for cultivation of microorganisms; to make the concept of producing microbial preparation.</p> <p><b>Skills</b> calculation and preparation of nutrient media for cultivation of microorganisms; working in sterile conditions; sterilizing laboratory instruments, glassware, culture media; cultivation of microorganisms.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</li> </ul> <p><b>2. general cultural competences (GCC):</b></p> <ul style="list-style-type: none"> <li>- the ability to analyze, synthesize and abstract thinking; to professional growth, improvement and development of their intellectual and general cultural level; ability to act in unusual situations.</li> </ul> <p><b>3. professional (industrial-technological) competences (PC 2):</b></p>
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					- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.
4	Biotechnological methods of wastewater treatment and emissions of industrial enterprises	5	Ecological management in biotechnology	Final attestation	<p><b>The short content:</b> Sources, types and scale of anthropogenic pollution. Pollution of hydrosphere. Modern methods of wastewater treatment of biotechnological enterprises. Mechanical methods and physico-chemical methods of wastewater treatment. Biological methods of wastewater treatment. Modern methods of purification of gas emissions of biotechnological enterprises. Methods for cleaning gas emissions from dust and aerosols.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about sources of oily waste water in the modern technosphere; composition and properties of the main fractions of oil-containing waste water; processes and equipment for mechanical purification: processes and apparatuses for the physico-chemical treatment.</p> <p><b>Abilities:</b> to explain the causes of changes in the ratio of the fractions of oil pollution of various types; to understand the structure of plants protection of the environment; to know the scope of work included in the commissioning and maintenance of these</p>

					<p>facilities; used in control devices.</p> <p><b>Skills</b> control of compliance with norms and rules of environmental safety in keeping with the changing environment and the conditions of technogenic load on the territory of industrial enterprises.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2):</b></p> <p>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</p>
5	Biotechnology of dairy and probiotic products	5	Biotechnology of biologically active substances and additives	Scientific-research work of undergraduates	<p><b>The short content:</b> Role of dairy and probiotic products in providing adequate nutrition. Composition, biological, nutritional value of dairy and probiotic products. Theoretical and practical essence of technology of various dairy products. Latest technological processes implemented in dairy industry. Main range of products. Methods of control of raw materials, technological processes and finished products.</p> <p><b>The expected results.</b> After the development of the discipline</p>

				<p>master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about the role of dairy and probiotic products in providing nutrition; the composition, properties, biological and nutritional value of dairy and probiotic products; requirements the prepared milk as a raw material for the dairy industry and ways of its improvement; theoretical and practical essence of technological processes of production of various dairy products; the main range of products produced and the fundamental features of their production; the latest technological processes and technologies introduced in the dairy industry; principles of development of technology of new types of dairy products (ecofriendly, medical, etc.); methods of control of raw materials, technological processes and finished products, as well as the requirements of the standards.</p> <p><b>Abilities:</b> to carry out theoretical studies, use of reference and monographic literature in the field of biotechnology for dairy and probiotic products; to choose their own technical means, a rational scheme of production of a given product; to assess the technological efficiency of production and to make proposals for their improvement.</p> <p><b>Skills</b> determination of the chemical composition and organoleptic properties of milk and milk products; to define the microflora of milk and dairy products; posses-</p>
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				<p>sion of methods of environmental security of production and environmental protection.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2, PC 3):</b></p> <p>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</p> <p>- the ability to analyze the composition, properties and quality of biotechnological products; development of a quality management system for biotechnological products in production in accordance with the requirements of Kazakhstan and international quality standards in order to ensure the stability of production indicators and the quality of products.</p>
5	Bioindication of pollution of water and soil ecosystems	5	Phytore-sources of medicinal plants	<p>Final attestation</p> <p><b>The short content:</b> Forms and types of bioindication. Indicators. Ecological bases of bioindication. Criteria for selecting indicators. The possibilities and principles of bioassay. Biological test systems and test organisms. Biomarkers.</p>

				<p>Test organisms (soil and water microorganisms, protozoa, leeches, fish, terrestrial vertebrates, algae, higher plants) and test procedures. Indicators used for bioindication. Bioindication of soil and aquatic ecosystem pollution</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> on the biological monitoring; the forms, levels and types of bioindication; the selection criteria indicative of the types and methods of assessing the ecological condition of communities and ecosystems; methods, bioindicative assessment of soil quality and aquatic ecosystems.</p> <p><b>Abilities:</b> use of biological indicators for bioindication; apply the basic principles of bioassay contamination of soil and water ecosystems; to apply modern methods of analysis to assess the quality of the environment.</p> <p><b>Skills</b> selection criteria and indicators in bioindicative studies; conduct of research; laboratory of modeling and experiment for bioindication and biotesting of soil and water ecosystems.</p> <p><b>Competences :</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in</p>
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					<p>the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2):</b></p> <p>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</p>
<b>Module No.7 Food biotechnology and Biosafety</b>					
<b>6</b>	Food bio-chemistry and bio-technology	5	Quality management of biotechnological products	Scientific-research work of undergraduates	<p><b>The short content:</b> Prospects for development of food biotechnology. Proteins, amino acids, carbohydrates: role in human nutrition. Food allergy. Fatty acid composition of oils, fats. Transformation of proteins, fats in process flow. Hydrolysis of carbohydrates. Increase of biological value of food, drinks, expansion of their range, and use of new technological processes of their preparation. Healthy diet. Functional ingredients and products.</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about the composition of proteins, carbohydrates, lipids, minerals, vitamins, food raw materials, their place in human nutrition; functional properties of proteins, carbohydrates, lipids, vitamins; bases of transformations of proteins, carbohydrates, lipids in the production of food; role of minerals and vitamins in the human body; the</p>

				<p>structure of food components, their transformations under the influence of technological factors; modern methods a comprehensive selection of the main components of food raw materials.</p> <p><b>Abilities:</b> to assess the nutritional and biological value of food products; to use knowledge of the laws of physics, chemistry, and Microbiology, to explain the processes of transformation of the original food raw materials into a finished product; to evaluate the safety of food products; to explain the processes of change in dietary components in the process stream to produce a finished product.</p> <p><b>Skills</b> evaluation of food and biological value of food; possession of methods of analysis and the study of food systems.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</li> </ul> <p><b>2. professional (industrial-technological) competences (PC 3):</b></p> <ul style="list-style-type: none"> <li>- the ability to analyze the composition, properties and quality of biotechnological products; development of a quality management system for biotechnological products in production in</li> </ul>
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					accordance with the requirements of Kazakhstan and international quality standards in order to ensure the stability of production indicators and the quality of products.
6	Bases of toxicology and ecotoxicology	5	Fundamentals of biotechnology (bachelor course)	Final attestation	<p><b>The short content:</b> Basic concepts of toxicology. Classification of harmful substances (poisons) and poisoning. Main stages of interaction of toxins with a biological object. Basic laws of toxicometry and toxicokinetics. Specificity, mechanism of toxic effect of harmful substances. Methods for determination of toxicological characteristics of substances. Exposure to toxic substances on ecosystems. Main tasks of ecotoxicology.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about the basic concepts of toxicology; stages of acute poisoning and the factors determining their development; toxic-kinetical characteristics of different types of poisoning; the major toxicants and the superprecotoxicants.</p> <p><b>Abilities:</b> to apply the theory of receptors toxicity characteristics of the communication of the poison to the receptor; to characterize the factors that determine the development of poisoning and to take measures emergency first aid; to characterize the impact of toxicants on ecosystems and human health.</p> <p><b>Skills</b> draw conclusions about the</p>

					<p>current and projected quality of the human environment and the possible changes in the level of health of the population in specific regions in the implementation of large industrial or social projects; calculation of environmental and economic damage from environmental pollution; application of the basic methods and techniques of research and practical experience in the field of ecotoxicology in the environment.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</li> </ul> <p><b>2. professional (scientific-research) competences (PC 1):</b></p> <ul style="list-style-type: none"> <li>- the ability to plan, organize and conduct research work in the field of biotechnology; carrying out correct processing of the results of experiments with their further presentation in the form of scientific reports, reports, publications and presentations; substantiation of the conclusion and conclusions.</li> </ul>
7	Biotechnology of therapeutic, preventive foods, and foods with special purpose	5	Biotechnology of medicines and genetically modified foods	Scientific-research work of undergraduates	<p><b>The short content:</b> Classification of specialized products by purpose (medical, special and preventive) and composition. Characteristics of specialized products for different purposes. Types of physiologically functional food ingredients. Methodology for the</p>

				<p>development of formulations and technology of food and food products the specialized orientation. Practical aspects of creating specialized food products.</p> <p><b><u>The expected results.</u></b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>Knowledge</b> about main principles of formation of functional properties of raw milk to obtain systems with desired physico-chemical and biological indicators; socio-economic aspects of food and health of the population; major and alternative theories of nutrition; medico-biological requirements for nutrition of different groups of consumers; the dietary characteristics of the therapeutic properties of dairy products, technology of clinical nutrition milk-based.</p> <p><b>Abilities:</b> producing financial calculations and to choose the optimal conditions of carrying out of technological processes; to identify the main characteristics of composition and properties of products, preventive nutrition and functional purpose, to use modern methods of control of technological operations, the quality of raw materials and finished products.</p> <p><b>Skills</b> application of the basic principles of regulation of functional and technological parameters on the basis of commutative and distributive dairy and non-conventional raw materials.</p> <p><b>Competences:</b></p>
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					<p><b>1. general professional competences (GPC 1):</b> - the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2):</b> - the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</p>
7	Bases of biosafety	5	Biotechnology of biologically active substances taking into account the rules of GMP	Final attestation	<p><b>The short content:</b> Biological hazard and safety. Most threatened areas of biohazard. Biological threats: natural (growth of infectious diseases and emergent infections), anthropogenic (of biocrimes, bioterrorism, bioaggression). Biosafety methods. Biological safety levels. Modern problems of genetic safety. Biological safety of natural ecosystems, agrobiocenosis. Biological invasions and biodiversity. The condition of the Kazakhstan and international legislation on Biosafety.</p> <p><b>The expected results.</b> After the development of the discipline master will possess the following knowledge, skills, abilities, competencies:</p> <p><b>The knowledge</b> about biosafety levels; biosafety issues in the</p>



				<p>modern development of the foundations of processes of bioinvasion aquatic ecosystems.</p> <p><b>Abilities:</b> to identify and investigate potential biological threats; to arrange for ensuring biological safety; to operate knowledge on biological invasions; have basic knowledge of Kazakhstan and international legislation in the field of biological safety.</p> <p><b>Skills</b> mastery of methods of assessing the impact of invaders on native species of living organisms and on ecosystems as a whole; the major approaches to the assessment and redress of bioinvasion.</p> <p><b>Competences:</b></p> <p><b>1. general professional competences (GPC 1):</b></p> <p>- the ability to professionally operate modern biotechnological equipment, scientific instruments, use modern information technologies to collect and process the necessary information in the field of biotechnology and related industries.</p> <p><b>2. professional (industrial-technological) competences (PC 2):</b></p> <p>- the ability to organize the work of a team of performers, make executive decisions on monitoring and protecting the environment in order to ensure safety, sanitary, hygienic and environmental conditions of the enterprise.</p>
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**The LIST**  
of elective courses for the educational program 7M05109 – «Biotechnology»

**Form of study:** full-time

**Duration of study** - 2 years

**Year of entry** - 2022 г.

Name of discipline	Code of discipline	Number of credits	Semester
<b>The basic disciplines</b>			
<b>Component of choice 1</b>			
Methodological bases of scientific research in biotechnology and experimental planning	MBSRBtEP 5206	5	1
Methodology of scientific research in environmental biotechnology	MSREBt 5206		
<b>Component of choice 2</b>			
Pedagogical ethics of a modern teacher	PEtMT 5207	3	1
Modern pedagogical technologies	MPT 5207		
<b>Component of choice 3</b>			
Teaching methodology of specialty disciplines	TMSD 5208	4	2
Theory and technology of teaching in the university	TTTU 5208		
<b>Component of choice 4</b>			
Molecular genetic bases of biotechnology	MGBBt 6209	3	3
Ecological aspects of modern biotechnology	EAMBt 6209		
<b>The profiling disciplines</b>			
<b>Component of choice 1</b>			
Biotechnology of medicines and genetically modified products	BtMGMP 5303	5	2
Biotechnology of biologically active substances taking into account the rules of GMP	BtBASTRGMP 5303		
<b>Component of choice 2</b>			
Biotechnology of biologically active substances and additives	BtBASA 5304	5	2
Phytoresources of medicinal plants	FrMP 5304		
<b>Component of choice 3</b>			
Quality management of biotechnological products	QMBtP 5305	5	2
Ecological management in biotechnology	EMBt 5305		
<b>Component of choice 4</b>			
Bases of microorganism cultivation in biotechnological production	BMCBtP 6306	5	3
Biotechnological methods of wastewater treatment and emissions of industrial enterprises	BtMWTEIE 6306		
<b>Component of choice 5</b>			
Biotechnology of dairy and probiotic products	BtDPP 6307	5	3
Bioindication of pollution of water and soil ecosystems	BiPWSEs 6307		

tems			
<b>Component of choice 6</b>			
Food biochemistry and biotechnology	FBcBt 6308	5	3
Bases of toxicology and ecotoxicology	BTEt 6308		
<b>Component of choice 7</b>			
Biotechnology of therapeutic, preventive foods, and foods with special purpose	BtTPFFSP 6309	5	3
Bases of biosafety	BBs 6309		