EDUCATIONAL INSTITUTION "ALIKHAN BOKEIKHAN UNIVERSITY"
Faculty of Information Technology and Economics

Department of Applied Biology

CATALOG OF ELECTIVE DISCIPLINES
6B05121 - BIOTECHNOLOGY

year of admission - 2022

Semey, 2022

Reviewed and approved at a meeting of the Educational and Methodological Council
Faculty of Information Technology and Economics

protocol No. 5 dated "20" 05 2022

Chairman of the faculty _____

Approved at a meeting of the Educational and Methodological Council of the University

Protocol No. 5 dated "25" 05 2022

Chairman of the EMC of the University _____

No.	Name of discipline or module	Number of credits	Prerequisites	Postrequisites	Brief description indicating the purpose of the study, brief content and expected learning outcomes (knowledge, skills, competencies)
GENERAL EDUCATIONAL DISCIPLINES					
Selectable Components (CV)					
Module of economic and legal knowledge					
1	**Fundamentals of market economy and entrepreneurship**	3	School course on the basics of entrepreneurship and business	-	**aim**teaching this discipline is the formation of systemic economic thinking to understand the logic of the economic laws of society, processes and phenomena occurring at all levels, with the possibility of applying knowledge in practice in any conjuncture and in any economic system. Omastering the skills of scientific and practical foundations of organizing business activities, methods of its planning and implementation in modern market conditions. **Content** Fundamentals of the economy - a system of knowledge about economic processes, laws, categories of relations in society at the level of production, distribution, exchange, consumption of material goods. The course examines research, methods, conditions and forms of business organization, as well as issues related to the special interests of business, especially important, the study of the problems of the formation and development of business in society.**Expected learning outcomes: Know:**the study of various scientific theories about a market economy, entrepreneurial activity, consideration of types, areas of entrepreneurial activity, market mechanism. Owns various quantitative methods of business calculations, marketing research, analytical calculations and forecasts, owns the methodology for calculating general and actual indicators of production and business projects; **Be able to:**analyze and substantiate the reality of business plans, market segmentation, competently and professionally assess market conditions for organizing your business, creatively approach the solution of various economic problems, analyze the economic situation in the business sector and give a correct assessment of qualitative changes in the development of the economy; to possess practical skills of independent conduct of economic work at the

					enterprise, quick and correct orientation to the initial information and calculated economic indicators. **Own:**fundamentals of a market economy and entrepreneurship; basic teachings, concepts and directions for the development of a market economy and entrepreneurship; methods for constructing graphs and diagrams illustrating various economic models, and types of business plans; directions of evaluation of economic processes and phenomena; actual problems of the modern economy, ways to identify problems of an economic nature in the analysis of specific situations, micro-methods and owns methods for solving them, taking into account the actions of economic laws at macro levels
1	**Fundamentals of law and anti-corruption culture**	2	School course on the basics of law	-	**aim**studying the course and familiarizing students with the system of knowledge on combating corruption and developing on this basis a civil position in relation to this phenomenon. **Content.**Basic concepts and application of legal relations, as well as legal mechanisms for regulating legal relations, the procedure for applying legal relations. The essence of evolution and its causes; judicial moral and judicial practice for corruption offenses; current anti-corruption laws. **Expected results of the study:** **Know:**the basic concepts and essence of legal relations, as well as legal mechanisms for regulating legal relations, the procedure for applying responsibility in legal relations, the importance of the principles and culture of academic honesty, the measure of moral and legal responsibility for corruption offenses. **Be able to:**has an intolerant attitude towards corrupt behavior, respects the law and the law; **Own:**conducting discussions on legal issues, on the application of norms in the modern period.
Module of economic and natural knowledge					
1	**Fundamentals of market economy and entrepreneurship**	3	School course on the basics of entrepreneurship and business	-	**aim**teaching this discipline is the formation of systemic economic thinking to understand the logic of the economic laws of society, processes and phenomena occurring at all levels, with the possibility of applying knowledge in practice in any conjuncture and in any economic system. Omastering the skills of scientific and practical foundations of organizing business activities, methods of its planning and implementation in modern market conditions. **Content** Fundamentals of the economy - a system of knowledge about economic processes, laws, categories of relations in society at the level of production, distribution, exchange, consumption of material goods. The course examines research, methods, conditions and

					forms of business organization, as well as issues related to the special interests of business, especially important, the study of the problems of the formation and development of business in society.**Expected learning outcomes: Know:**the study of various scientific theories about a market economy, entrepreneurial activity, consideration of types, areas of entrepreneurial activity, market mechanism. Owns various quantitative methods of business calculations, marketing research, analytical calculations and forecasts, owns the methodology for calculating general and actual indicators of production and business projects; **Be able to:**analyze and substantiate the reality of business plans, market segmentation, competently and professionally assess market conditions for organizing your business, creatively approach the solution of various economic problems, analyze the economic situation in the business sector and give a correct assessment of qualitative changes in the development of the economy; to possess practical skills of independent conduct of economic work at the enterprise, quick and correct orientation to the initial information and calculated economic indicators. **Own:**fundamentals of a market economy and entrepreneurship; basic teachings, concepts and directions for the development of a market economy and entrepreneurship; methods for constructing graphs and diagrams illustrating various economic models, and types of business plans; directions of evaluation of economic processes and phenomena; actual problems of the modern economy, ways to identify problems of an economic nature in the analysis of specific situations, micro-methods and owns methods for solving them, taking into account the actions of economic laws at macro levels
1	**Alash studies**	2	School course history of Kazakhstan		**Content. D**discipline "Alashovedenie" focus on the formation of students' ideas about the rotations and feelings of the movement "Alash" in the socio-political and apparent life of Kazakh society; on the development of students' scientific interests in relation to public ideas and public initiatives on the initiative of prominent figures of the Alash movement and the decisions of Alash-Orda; to provide students with knowledge of the conceptual aspects of the socio-political and socio-economic development of Kazakh society in the early twentieth century. The discipline is interdisciplinary in nature and is taken into account in the module of disciplines "Historical and legal knowledge". **Expected results of the study:**

					Know: - the history of the formation and development of the Alash movement, as a special stage in the national liberation struggle of the Kazakh people - the nature of the study of Alash problems in domestic and foreign historiography; - the main stages of the development of the Alash movement, the main directions of activity, about the political program of the Alash intelligentsia; - the relationship of the Alash intelligentsia with the tsarist administration, the interim government, the "white" movement and the Soviet government, about the contribution of the Alash intelligentsia to the development of Soviet Kazakhstan; - historical phenomena from the experience of Kazakh statehood, the government of Alashorda, the autonomy of Alash and the Turkestan Autonomy; - the nature of the policy of the Soviet government in relation to the representatives of the Alash movement and the consecration of their activities in the scientific literature; - the tragic fate of the Alash intelligentsia during the period of political repression; **Be able to:** - analyze aspects of the socio-political and socio-economic development of Kazakh society in the early twentieth century; - critically perceive, analyze and evaluate the diversity of the socio-historical development of Kazakhstani society; be able to analyze historical information, guided by the principles of scientific objectivity and historicism be able to explain and interpret historical events, evaluate their significance for the subsequent period of national and world history; be able to navigate scientific concepts that explain the unity and diversity of the historical process, the specifics of the interpretation of the past by various schools and trends in historical science; be able to use general scientific principles and methods of cognition in the analysis of specific historical problems; to select, analyze and interpret historical sources, historical facts, historical information when solving problems in the field of professional activity; carry out a comparative analysis of historical facts, events and phenomena of public life on the basis of historical sources;

					Own: - categorical - conceptual apparatus of historical disciplines; - methods of historical analysis of the main stages and patterns of development of society in different historical periods; - master the basics of analysis of historical sources and documents, - own the basics and systematization of scientific research and publications; - skills of selection and study of scientific literature and its use in educational and research activities; - identify cause-and-effect relationships, common features and differences in compared historical processes and events.
1	**Fundamentals of life safety and ecology**	2	School course of initial military and technological training	-	**Target.**To form ideas about the safety of life in human life and the possibility of regulating the processes of mutual influence of the environment and humans. **Content**.The discipline "Fundamentals of life safety and ecology" is aimed at forming students' ideas about ecology as a science, about the interdependence and interdependence of a person and the environment, about damage to the environment, the environment, as well as about the environmental problems of our time associated with economic activity . and other entrepreneurial activities of a person in the conditions of intensification of nature management, dangerous situations, civil protection and ways to solve them in the formation of professional qualifications. The discipline is interdisciplinary in nature and includes a module of disciplines "Economic and Natural Knowledge". **Expected learning outcomes: students should know:**the legislative framework for life safety and environmental control, as well as methods for identifying, eliminating the influence of harmful factors on humans and the environment, and providing comfortable conditions for human life and activity; be able to:systematize safety standards for use in professional activities; choose methods of protection against dangers in relation to the scope of their professional activities and choose ways to ensure comfortable living conditions; master the skills of ensuring life safety in industrial, living conditions and in emergency situations, the skills of providing first aid.
BASIC DISCIPLINES					
Selectable Components (CV)					
1	**Phytoresources in biotechnolo**	6	Biotechnol	Plant biotechnology	**Target.**To equip the future biotechnologist with knowledge of the species composition, classification, brief description and use of representatives of the plant

	gy		ogy obj ects		kingdoms, fungi as raw materials or objects of study in biotechnological processes. **Content.** During the study of the course, the following content of the disciplines is revealed: representatives of the plant world as phytoresources in human life; species composition and ecological characteristics of plants of the Earth, the Republic of Kazakhstan considers biotechnologies and prospects for use; branches of biotechnology in which biological objects are used. **Expected results of the study:**Apply in practice the skills of working with specialized laboratory equipment and instruments to solve practical problems. Know: the species composition and ecological characteristics of plants of the Earth, the Republic of Kazakhstan, the Abay region and the city of Semey, used in biotechnology and the prospects for their use; **Be able to**: give a brief description of the flora objects used in the biotechnological process; **Own**put into practiceskills of working with specialized laboratory equipment and devices for solving practical problems
1	**Animal resources in biotechnology**	6	Biotechnology objects	Plant biotechnology	**Target.**To equip the future biotechnologist with knowledge about the species composition, classification, brief description and use of representatives of the animal kingdoms as raw materials or objects of research in biotechnological processes. **Content.**During the study of the course, the following content of the disciplines is revealed: representatives of the plant world as zooresources in human life; species composition and ecological characteristics of animals of the Earth, the Republic of Kazakhstan considers biotechnologies and prospects for use; branches of biotechnology, which include biological objects. **Know:** organization, planning and direct implementation of a complex of works on artificial breeding, cultivation and acclimatization of economically valuable species of fish and invertebrates; **Be able to:** apply the acquired knowledge to solve specific scientific, practical, information retrieval, methodological and educational tasks; use modern methods of studying natural phenomena and processes; **skills:** apply the methodology of field and laboratory ichthyological and hydrobiological studies; apply methods for assessing fish stocks, assessing water bodies; apply methods of fishery research, rules and conditions

					for their implementation;
2	**Cellular biotechnology**	five	Cytology and histology	Fundamentals of Biotechnology	**Target. AT**to equip the future specialist - biotechnologist with modern ideas about the most promising directions in the development of cellular biotechnology in the world, to show its relationship with achievements in the field of molecular biology, cellular and molecular biophysics, biochemistry, molecular genetics, microbiology, molecular immunology and bioinformatics. **Content.**During the study of the course, the following content of the discipline is revealed: a brief history, stages of development of cellular biotechnology; theoretical foundations of cell biotechnology; genomics, proteomics, bioinformatics; objects of cellular biotechnology; cells and sub-cellular macromolecular structures, their use; somatic hybridization; cell biotechnology of microbiological systems; application of cellular biotechnology in eukaryotic systems; cell biotechnology in medicine; commercialization of cell biotechnology. **Expected learning outcomes: Know**about: the subject, tasks of the history of development, objects, methods of cell biotechnology, trends in the development of cell biotechnology in the modern world and its most promising areas, cell biotechnology of microbiological systems, genetic engineering of plants and animals, achievements of cell biotechnology in medicine, environmental aspects of biotechnology; **be able to**: use knowledge and critically analyze scientific experiments; **ownskills**work with specialized laboratory equipment and devices for solving practical problems
2	**Cellular plant breeding**	five	Cytology and histology	Fundamentals of Biotechnology	**Content.**Culture of cells and tissues in vitro. The concept of cell and tissue culture. Possibilities and perspectives of plant cell and tissue culture methods. Experimental morphogenesis. Induced morphogenesis in cell and tissue culture. Principles of cell engineering. Methods of non-traditional selection for crop production. Embryoculture. somaclonal variability. Creation of plants with useful traits using biotechnology. Cell engineering and solution of the problem of nitrogen fixation. Clonal micropropagation and improvement of plant material. Preservation of the gene pool of higher plants in collections and cryobanks. The value of genetic engineering for solving practical problems of crop production, medicine and industry **Expected learning outcomes: Know:**purpose and objectives of plant cell breeding, main directions, methods of cell breeding; variety and source material in plant breeding; obtaining mutant forms using selection at the cellular level; intraspecific and distant hybridization; selection methods in plant breeding; **be able to**use theoretical and practical material in prac-

					tice; **master the skills**organizing and conducting experiments, using knowledge, skills and abilities to work with various objects of biotechnology.
3	**plant physiology**	4	School biology course	Biotechnology of products of plant and animal origin	**Target.**To equip the future specialist - biotechnologist with knowledge about the patterns of life processes occurring in plant organisms and the relationship of these processes with the surrounding environmental conditions. **Content.** Functional types of plants and ecological coenotic strategies. Cellular bases of the organization and functioning of plants. Bioenergetics of plants (photosynthesis and respiration). Physiology of water exchange. Physiology of mineral nutrition. Growth and development of plants. Adaptation of plants to environmental conditions. Plant resistance to stressors. Interaction of plants with components of biocenoses. Ecological and physiological strategies of plants. Physiology of plants and problems of global ecology. **Expected results of the study: with**students should know: Know: aboutthe subject and tasks of plant physiology; scientific and theoretical foundations for the study of life processes in plants; plant cell totipotency and its use in biotechnology; water exchange of plants; photosynthesis process, leaf pigments, light and dark phase; mineral nutrition; plant respiration; growth and development of plants; physiological basis of protection and sustainable development; **be able to:**put into practice the skills of work and set up experiments on the removal of physiological indicators of plants; compare and find differences between experimental and control plants; **own**skills in working with a microscope, specialized laboratory equipment and preparation of micropreparations; sketching objects from life and under a microscope; observation of processes in the plant cell.
3	**Human and Animal Physiology**	4	School biology course	Biotechnology of products of plant and animal origin	**Target.**To equip the future specialist - biotechnologist with knowledge about the patterns of life processes occurring in the human and animal body, as well as about the life processes of the animal body and its constituent parts in their unity and relationship with the environment. **Content.**In the course of studying the course, the content of the disciplines is revealed: methods of studying physiology; physiology of excitable tissues; muscle physiology; mechanisms of regulation of body functions; natural physiology of the nervous system; structure, functions of the spinal cord; brain; sensory systems; nervous regulation of vegetative functions; the internal environment of the body; system of internal organs and their regulation; heat production, heat

					transfer; reproductive system; lactation in humans and animals. **Expected results of the study:**Know about the subject and tasks of human and animal physiology, the history of development, the theoretical and methodological foundations of physiology; physiology of excitable tissues, analyzers, particular physiology of the central nervous system, qualitative differences in physiological functions in animals at different levels of evolutionary development; mechanisms that ensure the interaction of individual parts of the body and the body as a whole with the external environment; **be able to**carry out anthropometric measurements; determine the main physiometric indicators; **own**skills of working with specialized laboratory equipment and devices for solving practical problems and research activities in the field of biotechnology; organize and conduct experiments using the knowledge, skills and abilities of working with animals and humans.
4	**Environmental protection and monitoring**	4	Fundamentals of life safety and ecology	Fundamentals of Ecological Biotechnology	**Target**give special knowledge about the state the environment and to form students' systemic ecological thinking, which will provide an integrated approach to solving the environmental and economic problems of modern nature management. **Content:**Protection monitoring and water resources. Soil protection and monitoring. Protection and monitoring of atmospheric air. Protection of the ozone layer. Regulatory framework for the protection of biological resources in the Republic of Kazakhstan. Red Book of the Republic of Kazakhstan. Biodiversity. Protection of forests and other plant complexes. Animal world and its protection. Landscape protection. Biological monitoring: general grounds and concepts. Theoretical foundations of biomonitoring. **Expected results of the study.** students should know: – theoretical foundations, purpose, tasks and functions of monitoring; – origin, types, sources of environmental pollution; – methods and tools for conducting observations and research in various systems and types of monitoring; - features of the development of ecological systems; – conceptual framework for the classification of environmental monitoring; – features of the creation, development and organizational structure of the National Environmental Monitoring System of the Republic of Kazakhstan; – types of environmental monitoring of the Republic of Kazakhstan; – interaction of the National Environmental Monitoring System with the system for monitoring and forecasting

					natural and man-made emergencies and the system of social and hygienic monitoring in the Republic of Kazakhstan; - a network of observation points, objects of research, controlled indicators for monitoring the quality of the state of the environment on the territory of the Republic of Kazakhstan; – regulatory legal support for the activities of various systems and types of environmental monitoring; **Be able to**use the foundations of knowledge and methodologies, conduct an environmental and economic analysis of environmental problems arising from different types and scales of the impact of natural and anthropogenic factors on the environment and the intensity of the use of natural resources; - to determine the regulations for observations, the composition of environmental information, the procedure for its receipt and provision to consumers of various levels; apply the acquired knowledge and skills to improve scientific and practical activities in order to ensure the development of an integrated approach to the analysis of environmental problems and solving issues of rational nature management; - use information and analytical materials and information technologies in the field of environmental monitoring to determine the strategy for rational use of natural resources; **own**: understanding of the mechanisms of operation of the National Environmental Monitoring System in the context of rational nature management and environmental protection; - skills in practical work using information and analytical materials and information technologies in the field of environmental monitoring; – skills in planning the main stages of environmental monitoring.
4	**Rational use of natural resources**	4	Fundamentals of life safety and ecology	Fundamentals of Ecological Biotechnology	**Target.**familiarization of students with theoretical knowledge and practical skills to understand the importance of preserving the quality of the environment, rational use of natural resources **Content:**Ecological and geographical bases of nature management. Natural systems as objects of human impact. Rational use of natural resources. Protection of nature and human environment. Improving the properties of natural and natural-anthropogenic geosystems. Management of nature management and the state of geosystems **Expected results** **Know:**the basics of the economic system to learn the basic concepts and categories of environmental economics; approaches to the economic valuation of natural resources and the principles of fees for their use, a standard methodology for determining the economic efficiency of environmental protection measures and

					assessing the economic damage to the environment from pollution, the economic mechanism for influencing organizations in the implementation of environmental protection measures **be able to**: apply their knowledge to solve professional problems and analyze the causes and mechanism of environmental quality, predict the impact on the natural environment and human society. To be able to find an integrated approach to the study of economic problems; find an integrated approach to the study of environmental problems; to distinguish between types of liability in case of violation of legislation on environmental protection, to carry out an economic assessment of natural resources, to use in practice the quality standards of the natural environment and industrial enterprises, to subdivide and determine the types of economic damage, to highlight the requirements for the formation and functioning of this mechanism, to select solutions for rational economic business behavior **own**ability to work effectively in a team, to have the ability to work independently; to study legislative and regulatory documents, knowledge in the field of theoretical foundations for managing the "society-nature" system, protecting the health of citizens, methods of economic assessment of natural resources and reproduction of natural fertility, skills in generalizing the accumulated information about the characteristics of resources in Kazakhstan and other countries, about new types of energy, new materials, about the latest achievements in our country in the field of environmental economics
5	**Production of antibiotics, vitamins, steroids, insulin, interferon**	5	General microbiology and biotechnology	Fundamentals of food biotechnology	**Target.P**to provide students with knowledge about biotechnological methods for the production of antibiotics, vitamins, steroids, insulin, interferon using biological objects. Contents: Bioobjects as a means of production of medicinal, prophylactic and diagnostic agents. Their methods with application. The main stages of the biotechnological process for the production and production of drugs, including the environmental aspects of pharmaceutical production. Bank of biomaterials. Biotechnology of medicinal substances. Production of antibiotics. Biotechnology of amino acids, vitamins, lipids and their use as medicines. Preparation and use of enzymes in medicinal products. Enzymes as the basis of the biotransformation process. Immunobiotechnology. Modern aspects of biotechnological production. **Expected results of the study:**the student must know: the basic laws of biotechnology of antibiotics, vitamins, steroids, insulin, interferon; be able to: use theoretical knowledge in the field of biotechnology of antibiotics, vitamins, steroids, insulin, interferon, as well as the

					main sections of microbiology for the development of microbiological processes occurring during production, biologically active substances and secondary metabolites; own: the theoretical foundations of the biotechnology of antibiotics, vitamins, steroids, insulin, interferon.
5	**Biotechnology of biological active substances**	5	General microbiology and biotechnology	Fundamentals of food biotechnology	**Target. P**to provide students with knowledge about biotechnological methods for the production of biologically active substances (BAS) using biological objects. **Content.** During the study of the course, the following disciplines are revealed: the study of the stage, the cultivation of disclosure; obtaining biologically active substances, their use in biology and medicine; cultivation of microscopic algae; biotechnology of biologically active substances enriched with microelements based on microbial biomass; yeast autolysis technology; increasing the efficiency of some biotechnological stages of beer production; complex processing of biomass of industrial enterprises. **Expected results of the study:**students should know: the basic laws of biologically active substances biotechnology; be able to: Apply in practice and use theoretical knowledge in the field of biologically active substances biotechnology, as well as the main sections of microbiology for the development of microbiological processes occurring during production, biologically active substances and secondary metabolites; own: theoretical foundations of biotechnology of biological active substances.
6	**Plant biotechnology**	5	Phyto resources in biotechnology	Agricultural biotechnology	**Target.**Formation of ideas about the current state of knowledge about the biology of cultivated plant cells as an object of plant biotechnology and all the main areas of biotechnology. **Content.**During the study of the course, the content of the discipline is revealed: cultivated plant cells as an object of biotechnology; obtaining and cultivating callus; cell technologies in the biosynthetic industry; clonal micropropagation and improvement of plants; overcoming progam and postgam incompatibility in vitro; haploid technology; cell selection; cell engineering; plant genetic engineering; preservation of the in vitro gene pool. **Expected results of the study:**the student should know about: methods of cultivation of cells, tissues and organs of plants in vitro; processes of dedifferentiation leading to the formation of callus; pathways of in vitro morphogenesis and factors regulating plant regeneration; theoretical and methodological principles of using cultured cells to obtain important metabolites, for clonal micropropagation and plant health improvement, to

					overcome incompatibility during distant hybridization; be able to: put into practice the skills of working with plant cultures; control plant growth; have skills: work in sterile conditions with isolated cells, tissues, callus mass; isolating an explant from a plant object; calculation of concentrations of nutrient solutions; preparation of nutrient solutions; cultivation of plant tissue cultures;
6	**Biotechnology in plant protection**	5	Phyto resources in biotechnology	Agricultural biotechnology	**Target. Oz**familiarization with general issues and theoretical foundations of agricultural biotechnology, to form the necessary theoretical knowledge and practical skills on the use of biotechnology in plant protection. **Content.**During the study of the course, the specific content of the disciplines is revealed: genetic engineering in plant protection; technology for receiving plants resistant to pests; biotechnology of biopreparations for plant protection; biopesticides; entomopathogenic bacterial biological products; biotechnology for the neutralization of antibiotics and their use in plant protection; biotechnological methods for diagnosing phytopathogens; culture of cells, tissues and organs in plant protection. Expected learning outcomes: the student must know: research activities in the field of biotechnology; the basic laws of natural science disciplines in the field of professional activity, the current state of biotechnology in the field of plant protection, the technology for the production of biopreparations for plant protection and their application; **be able to**: to substantiate the use of biotechnological preparations for plant protection, to use biotechnological methods in an integrated plant protection system; **own**skills and experience in conducting microbiological studies of plant samples and biological preparations for plant protection; skills of working with specialized laboratory equipment and devices for solving practical problems.
7	**Animal biotechnology**	5	General and molecular genetics	Modern methods in biotechnology	**Target.**To form an idea about the possibilities of animal genetic and cell engineering, about the ways and methods of using animal cells in biotechnology. **Content.**During the study of the course, the content of the disciplines is revealed: general biological foundations of animal biotechnology; methods of animal biotechnology; biotechnology of reproduction; artificial insemination and embryo transplantation; mammalian chimeras; animal cloning; genetic transformation; cryopreservation of gametes and embryos; applied aspects of cellular and embryogenetic engineering; receive transgenic animals. **Expected learning outcomes: Know**Keywords: general biological foundations of animal biotechnology, experimental approaches to cellular and embryological

					engineering, principles of cloning of genetic transformation of somatic and germ cells of animals; on the application of biotechnological methods in the science and practice of animal husbandry and medicine; **be able to:**apply theoretical knowledge for implementation in science and practice; **own**skills: handling microscopic equipment and specialized laboratory equipment and devices for solving practical problems.
7	**Biotechnology in animal protection**	5	General and molecular genetics	Modern methods in biotechnology	**Target.**Acquaintance with general issues and theoretical foundations of agricultural biotechnology, to form the necessary theoretical knowledge and practical skills on the use of biotechnology in animal protection. **Content.**During the study of the course, the specific content of the disciplines is revealed: the classification of crops and the features of their use in animal husbandry in various soil and climatic conditions; agroclimatic agricultural zoning; organization of work to protect animals at agricultural enterprises; the possibility of biological applications of objects for the protection of animals, methods of biotechnology in the protection of animals.. **Expected results of the study:**the student must know: information about the organization of work to protect animals at an agricultural enterprise; the possibility of using biological objects for the protection of animals, methods of biotechnology in the protection of animals; be able to use biological objects to protect animals; **own**the skills of organizing and conducting experiments, using the knowledge, skills and abilities of working with various objects of biotechnology.
8	**Basics of food biotechnology**	5	Production of antibiotics, vitamins, steroids, insulin, interferon	Standardization and certification of biotechnological products	**Target:**to form knowledge about traditional biotechnological processes used in food technology, their role in shaping the consumer properties of food products, about modern achievements in food biotechnology and the main directions of its development. **Content:**During the study of the course, the content of the disciplines is revealed: food biotechnology based on fermentation processes and other metabolic reactions; yeast production; alcohol production; brewing; winemaking; bakery production; milk processing industry; food biotechnology based on microbial synthesis; food safety and health control; nutritional supplements; problems of biosafety of products of modern biotechnological production. **Expected results of the study**: Know: the latest achievements in the field of biotechnology in the food industry; traditional biotechnological processes used in the food industry; microbiological processes in food production; the influence of enzymes, food additives, biologically active substances on the quality and

					properties of biological raw materials and food products based on it; general food production technology; methods for studying food quality indicators; **be able to**: apply theoretical and practical knowledge and use the knowledge gained to analyze experimental data regarding the selection, characterization and improvement of biotechnology objects, as well as their use in various technological processes of food production; use knowledge of technologies and factors affecting the rate of biochemical processes in food production; **own:**technique for determining the quality indicators of bacterial, yeast and enzyme preparations, food additives, biologically active substances, finished food products; technique for selecting raw materials, assortment and technology for the production of food products that are produced by the food industry.
8	**Isolation and purification of biotechnology products**	5	Production of antibiotics, vitamins, steroids, insulin, interferon	Standardization and certification of biotechnological products	**Target. O**possession of knowledge by students and the acquisition of skills in the isolation and purification of biologically active substances obtained by biotechnological means. **Content.**During the study of the course, the specific content of the disciplines is revealed: technical and technological characteristics of biotechnology products; isolation of proteins, enzymes; biotechnology for the synthesis of amino acids, their purification; excretion, purification of hormone preparations; synthesis of nucleotides, nucleic acids; sources of lipids, sources of their isolation; get fermentation products; get sugars, polysaccharides; getting vitamins; determination of antibiotics, alkaloids, vaccines. **Expected results of the study:**students should know the main groups of biotechnology products and their most important characteristics, the basic concepts and methods of isolation, purification of biotechnology products, methods of chemical, biochemical identification and determination of biotechnology products; **be able to:**solve professional problems and use the basic laws of biochemistry, molecular biology in the development of technologies for the isolation and purification of biologically active substances; use quantitative and qualitative methods for the analysis of biotechnology products; **own**skills of managing the technological process of isolation and purification of finished products.
9	**Basics of physico-chemical analysis of food**	4	Inorganic and Ana	Toxicological analysis of food products	**Target.**Students gaining knowledge about the methods of chemical and physico-chemical analysis, their theoretical foundations, as well as acquiring the skills and abilities to draw theoretical conclusions based on the observed phenomena.

	products		lyti cal Che mis try		**Content.**During the study of the course, the following disciplines are revealed: the study of issues of product quality and finished products: product properties, quality indicators; types and methods of quality control; identification and falsification; organization of food quality control: food quality control; semi-finished products and finished products; significance and classification of measuring methods of control; documenting the quality of products, semi-finished products and finished products; physical and chemical methods for the analysis of products, semi-finished products and finished food products **Expected results of the study:**the student must know: the theoretical foundations of physical and chemical analysis; **be able to**apply use the concepts and methods of physical and chemical analysis and apply physical, chemical and mathematical laws to solve practical problems, draw up analysis schemes, select a method to achieve a specific goal; **own**: basic methods of chemistry definitions and analysis of objects; theoretical foundations of physical and chemical chemistry
9	**Physical and colloidal chemistry**	4	Inor gan ic and Ana lyti cal Che mis try	Toxicological analysis of food products	**Target. O**familiarization with general issues and theoretical foundations of physical and colloidal chemistry, the formation of the necessary theoretical knowledge and practical skills in the use of physical and colloidal chemistry in biotechnology. **Content.**In the course of studying the course, the content of the disciplines is studied: the disclosure of balance; solutions; thermodynamics of chemical composition; the law of manifestation of the masses; electrochemistry; chemical kinetics, catalysis; disperse systems, thermodynamics of hazardous industrial facilities; capture; theory of observation; properties of electrical disperse systems, falls, coagulation; IUD solutions, their properties, gels and jellies; electrical properties of IUD solutions; molecular-kinetic properties of HMS solutions.. **Expected learning outcomes: students should know:**the purpose and objectives of physical and colloidal chemistry, ways to solve them, the basic laws of physics and chemistry, physical and chemical phenomena and patterns used in physical and colloidal chemistry; safety rules for working in a chemical laboratory and with physical equipment; solutions and processes occurring in aqueous solutions; **be able to**apply to use the basic techniques and methods of physical and chemical measurements; work with the main types of instruments used in physical and colloidal chemistry; make calculations on the issues under study; carry out elementary statistical processing of ex-

					perimental data in physical and chemical experiments; **own:**methods of statistical processing of experimental results of physical and chemical studies; technique for conducting basic physico-chemical experiments.
10	**Engineering enzymology**	3	Biochemistry	Pharmaceutical biotechnology	**Target.**To form ideas about the development of engineering industries using biological objects to solve economic problems. **Content.**During the study of the course, the special content of the disciplines is revealed: engineering enzymology as a science, industrial processes using immobilized enzymes, enzymatic conversion of cellulose into sugar, the use of enzymes in electrochemical factors; basic methods of engineering enzymology, biotechnology of primary and secondary metabolites, immobilized enzymes in the food industry, immobilized enzymes in medicine, microanalysis.. **Expected results of the study:**the student must know the directions, achievements and prospects for the development of engineering enzymology; scientific foundations of biocatalysis for the synthesis and modification of organic compounds, the use of immobilized enzymes and proteins in medicine to create new drugs; be able tomanage the technological process of obtaining biotechnological products based on various raw materials and the processes of isolation and purification of finished products; **have the skills to develop technological methods for the use of enzyme preparations; on the implementation of the results of scientific research in production**
10	**Basics of Chemical Technology**	3	Biochemistry	Pharmaceutical biotechnology	**Target. O**familiarization with the general laws of chemical technology, the most typical chemical-technological processes, reactors and chemical-technological systems (CTS), as well as with the basics of chemical technology of a number of industries. **Content.**During the study of the course, the specific content of the disciplines is revealed: technology, classification of chemical technologies; priority directions of development of modern chemical technologies; theoretical foundations of chemical technologies; chemical production, chemical-technological process; widespread food intake; main types of food products; chemical reactors, their classification; chemical-technological systems (CTS); raw materials and energy subsystem of CTS; primary industrial chemical production. **Expected results of the study:**students should know: the principles and methods of assessing the effectiveness of production; general patterns of chemical processes; be able to: calculate the main characteristics of the chemical process;manage the technological process of obtaining biotechnological products based on various raw materials and the pro-

					cesses of isolation and purification of finished products; possess: the skills to perform basic laboratory analyzes to determine the quality indicators of a technological product.
11	**Basics of environmental biotechnology**	6	Environmental protection and monitoring	Final state certification	**Target.**To acquaint students with the main environmental problems of the environment, with the basic principles of biotechnology, the types of bioreactors used to clean the external environment, as well as other objects and methods for cleaning and improving the environment. **Content.**During the study of the course, the content of the disciplines is revealed: the subject and task of environmental biotechnology; interconnection closes in ecosystems; wastewater characteristics; operations in wastewater treatment plants; aerobic and anaerobic wastewater treatment; industrial apparatus for wastewater treatment; biosorption of metals; biological processing and purification of waste from various industries; soil bioremediation; predictive ecology. **Expected results of the study:**the student must know: the main characteristics of wastewater; the importance of microorganisms in maintaining natural balance, new technologies for biopurification based on the use of new generation biocatalysts - immobilized enzymes and whole microbial cells; be able to: apply the acquired knowledge to develop strategies for solving specific environmental problems;argue the importance of living organisms in bioremediation, bioremediation technology and the use of bioreactors to clean the environment; to master the skills of setting up experimental experiments in the laboratory.
11	**Biotechnology of soil and water purification**	6	Environmental protection and monitoring	Final state certification	**Target.**Formation of a complex of knowledge in the field of modern biotechnological methods for cleaning soils and water bodies from pollutants. **Content.**In the course of studying the course, the following disciplines are revealed: the composition of the terrain, water, silt; soil-forming process; soil, water biota; application of biotechnology to clean up polluted soils and water bodies; bioremediation of soils, water bodies; species composition of plants, detection, detection in the cleanup of terrain and water bodies from destruction; microbiological preparations used in cleaning the area, water bodies; biodegradation of oil pollution.. **Expected results of the study:**the student must know: types of microorganisms capable of destroying substances - pollutants; biological methods of soil and water treatment; mechanism of accumulation of pollutants in biological objects; be able to: be guided by regulatory requirements in achieving the desired results of biological treatment of soils and water bodies;to argue the importance of living organisms in

					bioremediation, bioremediation technology; own: approaches to the choice of methods, biological objects and equipment for biological purification of soil and water from pollutants; information on ways to intensify bioremediation processes; skills in drawing up a technological scheme for the processes of biological purification of soils and water bodies from pollutants based on the results of scientific developments.
12	**Agricultural biotechnology**	5	Plant biotechnology	Final state certification	**aim**discipline is the formation of future specialists in technological training in modern areas of biology, knowledge of basic biotechnological processes and industries, the basics of genetic and cell engineering and the possibility of further implementation of their own knowledge in innovative areas of the natural sciences. **Content:**In the course of studying the course, the content of the disciplines is revealed: the content of agricultural biotechnology; genetics and genetic engineering in plant biotechnology; clonal micropropagation methods; renewable forms of plants resistant to adverse environmental diseases; phytohormones and synthetic regulators of plant growth and development in biotechnology and crop production; application of in vitro methods in plant breeding; biotechnology in animal husbandry; embryo transplantation; cloning, obtaining chimeric and transgenic animals; biotechnology and biosafety. **Expected results of the study:**the student should know: about the conditions and factors for the development and creation of finished biotechnological products, the main patterns and methodological approaches used in the creation of new bioproducts needed in various branches of agriculture; **Be able to**use methods and make a creative approach to the production technologies of modern bioproducts for agriculture in the study of biotechnological processes and industries; **own:**skills in drawing up a technological scheme of processesproduction of modern bio-products for agriculture.
12	**Medical and Veterinary Biotechnology**	5	Plant biotechnology	Final state certification	**Target.**mastering the theoretical foundations of biotechnology and acquiring knowledge, skills and abilities in the design, production and control of biological products. **Content:**During the study of the course, the specific content of the disciplines is revealed: the content of medical and veterinary biotechnology; biological objects as a means of production of medicinal, preventive and diagnostic agents for humans and animals; approaches to biotech pharmaceutical and veterinary drugs; use of recombinant DNA methods in medical and veterinary biotechnology (genetically

					engineered microbiological production); biotechnology of immunogens and vaccines; the use of monoclonal antibodies for therapeutic purposes; nanobiotechnology in medical and veterinary biotechnology; a unified GLP, GCP and GMP system for implementation in practice and production of medicines. **Expected results of the study:**the student must know: main and priority directions of development of medical and veterinary biotechnology. the main sources of medicinal, diagnostic, prophylactic agents and related products; innovative biotechnological methods and techniques for improving drug producers and biotechnological processes; **be able to:**apply in practice the acquired theoretical knowledge about the basic biotechnological methods used in the field of medical and veterinary biotechnology; **own:**knowledge of the functioning of the general scheme of biotechnological production, obtaining highly effective producers by methods of genomics, proteomics and bioinformation methods of writing abstracts and articles on the topic being developed, a system of techniques that allow obtaining the necessary information from Internet resources
13	**Basics of Python Programming**	3	Information and Communication Technologies	Modern methods in biotechnology	**Target.**formation of basic concepts of structured programming; formation of programming skills in the Python language. **Content:**Python language. Data types, operations, operators. I/O features. Built-in object types: Numbers Strings Tuples Lists Dictionaries Sets. File I/O. Reading lines with file iterators. Working with binary files. Data processing. Arrays and vector densities. Graphing and data visualization. The numpy library for implementing mathematical objects and calculations. Creation of applications with a graphical interface. Overview of graphics libraries: Tkinter, PyQT. Classes in Python. Registration of data, methods, operations. Inheritance. Multiple study. Composition in the development of classes. **Expected results of the study:**the student should know: basic methods of data collection and processing in Python; be able to: find the data necessary for working in a programming language; own: programming skills in Python; • skills to work with different formats of data files.
13	**Mathematical modeling in biology**	3	Information and Communi	Modern methods in biotechnology	**Target.**mastering modern methods and analysis programs research results and statistical processing using personal computers in various areas of scientific work **Content:**The concept of a model, the rationale for building a model. Types of models and their cognitive capabilities. study of the problem of life Principle as a

			cati on Tec hno logi es		phenomenon. Basic research on models of biological systems. Mathematical methods for studying biological systems. Examples of biological systems models **Expected results of the study:**the student must know: the basic methods of research activities; be able to: identify and systematize the main ideas in scientific texts; critically evaluate any incoming information, regardless of the source; avoid automatic application of standard formulas and techniques when solving problems; possess the skills of collecting, processing, analyzing and systematizing information on the research topic; skills in choosing methods and means for solving research problems

PROFILING DISCIPLINES (PD)

Selectable Components (CV)					
1	**Biotechnol ogy of plant and animal products**	6	plant physio logy	Biologic al food safety	**Target.**To study the modern achievements of food biotechnology in the field of production of products of plant and animal origin. **Content.**In the course of studying the course, the following content of the discipline is revealed: classification of food products by raw materials; secondary resources, prospects for their use; types of plant and animal raw materials, features of use for food products; processes occurring in raw materials during their processing into intermediate and final products and storage; factors influencing the biotechnological processes of food products. **Expected results of the study**: students should know: about new achievements and methods in the biotechnology of the food industry for the production of products of plant and animal origin; **be able to**analyze modern achievements in the field of biotechnology and draw up schemes for the production of the desired product; **own**the skills of managing the technological process of obtaining biotechnological products based on various raw materials and the processes of isolation and purification of finished products.
1	**Biopharma ceutical Technology**	6	plant physio logy	Biologic al food safety	**Target. F**formation of systemic knowledge on the technological foundations of biotechnology and quality control of biological products in various dosage forms based on the microbiological processing of plant materials and other raw materials. **Content.**During the study of the course, the content of the disciplines is revealed: the basic principles of the industrial technology of biological products; rationale for the fermentation of pure cultures; raw material base, environmental problems, biopreparation technologies; technology for the biosynthesis of water-soluble, fat-soluble vitamin-active compounds with coenzyme catalytic functions; technology of biosynthesis of L - amino acids; technology of industrial biosynthesis of biopreparations of antibiotics; technology for the production of protein

					biopreparations; microbial lipid technology. **Expected results of the study**the student must: know: the algorithm for the manufacture of biological products based on modern technologies in accordance with the international system of requirements and standards; principles of creating modern biological products based on plant raw materials and microbiological material; on the main regulatory documents related to the manufacture, quality control, storage and use of biological products; be able to: use the rules and norms of the sanitary and hygienic regime, the rules for ensuring aseptic conditions for the manufacture of biological products in accordance with the current scientific and technical documentation; manage the technological process of obtaining biotechnological products based on various raw materials and the processes of isolation and purification of finished products; have an idea: about the optimization of the technology of biological products based on the rational microbiological processing of plant materials;
2	**Food Processing Equipment Technology**	5	Industrial Biotechnology	Fundamentals of designing biotechnological production	**Target**b. Obtaining knowledge in the field of design and operation of biotechnological machines and devices, which the future specialist will be able to apply in his professional activities. **Content.**During the study of the course, the specific content of the disciplines is revealed: machine-hardware circuits; transport, auxiliary equipment in biotechnology; equipment for sterilization, extraction, pressing, filtration, flotation, cultivation is subject to special environmental hazards; fermenters; equipment for the selection of liquid heterogeneous systems, for purification and concentration, for drying products of microbiological production, for grinding, standardization, granulation and microencapsulation. **Expected results of the study:**students must know the basic laws of the course; understand the essence of the main methods used in the operation of biotechnological machines; have an idea about modern problems of operation of biotechnological machines; be able tooperate modern professional biotechnological equipment and devices, as well as master the skills of organizing, planning and managing existing biotechnological processes and production.
2	**Processes and devices in biotechnology**	5	Industrial Biotechnology	Fundamentals of designing biotechnological production	**Target. O**acquisition by students of theoretical and practical knowledge and skills in the field of device design and operation of biotechnological equipment. **Content.**During the study of the course, the following disciplines are revealed: equipment for microbiological production; theory of modeling of biotechnology processes; thermal processes and devices; thermal processes in enzymes; devices, processes for isolating products of microbial synthesis; mass transfer processes with a fixed phase contact surface; membrane processes in biotechnology; hardware for phytobiotechnological, zoobiotechnological productions; bioreactors for growing

					plants.. **Expected results of the study:**the student must know the basic concepts, stages of biotechnological processes, the main methods of chemical identification of substances; be able to choose the equipment, the type of producers and the conditions for conducting a particular biotechnological process;operate modern professional biotechnological equipment and devices, as well as organize, plan and manage existing biotechnological processes and production; name skills in the use of biotechnological equipment.
3	**Toxicological analysis of food products**	6	Fundamentals of physical and chemical analysis	Final state certification	**Target.**To form ideas about toxic food contaminants and methods for their determination. **Content.**In the course of studying the course, the specific content of the disciplines is revealed: the quality of its food products, control over provision; classification of poisonous, potent in toxicological chemistry; contamination of food raw materials, food products with xentobiotics of chemical, biological origin; food toxicological-genetic assessment; the introduction of "poison", poisoning; isolation, detection and determination after their extraction from biological material.. **Expected learning outcomes: students**must know Know the theoretical basis of food toxicology;methods of conducting a study of the properties of raw materials, semi-finished products and finished food products, allowing you to create information-measuring complexes for express control; systems of quality and safety of production products, assess risks in the field of ensuring the quality and safety of production products, supply, storage and movement of products. Ways of contamination of food raw materials and foodstuffs by xenobiotics of chemical and biological origin. Radioactive contamination, dioxin contamination. Control methods for the use of food additives used in industrial food production. Methods and methods of detoxification of contaminated food and food raw materials **Be able to** apply specialized knowledge in practice and determine the content of harmful substances in food products; monitor and evaluate compliance with environmental, chemical (toxicological analysis) safety of food raw materials, food ingredients and finished products; develop methods for conducting a study of the properties of raw materials, semi-finished products and finished food products, allowing you to create information-measuring complexes for express control; influence the development and implementation of a quality and safety system for production products, assess risks in the field of ensuring the quality and safety of production products, supply, storage and movement of products
3	**Food Chemistry**	6	Fundamentals of	Final state certificati	**Target. And**studying the conceptual apparatus of the discipline, basic theoretical provisions and methods, instilling skills in applying theoretical knowledge to solve practical

			physical and chemical analysis	on	problems. **Content.**During the study of the course, the content of the disciplines is revealed: food chemistry and human nutrition; food raw materials as a biological object; protein substances; carbohydrates; alimentary fiber; lipids; minerals, vitamins; enzymes; water in food; food, biologically active additives; food safety; basics of ecological nutrition; nutraceuticals, probiotics, prebiotics. **Expected results of the study**A: the student must Know: the chemical composition of raw materials, semi-finished products and finished food products; methods for assessing the nutritional value of food products; general patterns of chemical, biochemical and microbiological processes occurring during the storage of raw materials; transformation and interaction of the main chemical components of raw materials in the process of technological processing in the production of food products and the influence of its modes on the composition, properties of the main nutrients, nutritional and biological value of raw materials and finished products; Apply knowledge and be able to determine the chemical qualitative and quantitative composition of the object under study, reasonably choose a test method for specific tasks; **Own**: skills to conduct an experiment with appropriate calculations and formulation of conclusions; basic chemical and physico-chemical methods of analysis to determine the properties and technological indicators of the materials used and finished products.
4	**Biological food safety**	5	Biotechnology of products of plant and animal origin	Final state certification	**Target:**the formation of the necessary theoretical knowledge and practical skills about the concept of biological safety as the absence of unacceptable risk or damage to the health and life of people when consumed in generally accepted quantities of animal products; hygienic characteristics of the main components of raw materials and products of biological origin; the main laws of the Republic of Kazakhstan regulating the safety of raw materials and food products for humans and the environment; contamination of raw materials and products; ways to reduce the harmful effects on humans and the environment; recycling. **Content:**During the study of the course, the following disciplines are revealed: regulatory documents regulating the requirements for the quality and safety of food products, control over their quality and safety; basic quality management research; International HACCP system and ISSO; food paths in the trophological chain; toxicological and hygienic characteristics of toxins, pesticides, detection of metals, radioactive poisoning, antibiotics and hormonal preparations, mycotoxins; microbiological indicators of food safety; antialimentary nutritional factors; technochemical control of food production.

					Expected results of the study: the student must know the general basic information on chemistry, be able to analyze the physico-chemical analysis data, organize and plan the quality of raw materials and finished products; own methods for determining organoleptic, chemical and physical indicators of the microbiological quality of raw materials and finished products
4	**Biological safety of biotechnological production**	5	Biotechnology of products of plant and animal origin	Final state certification	**Target:**to form theoretical knowledge on the biological and biotechnological safety of biotechnology for the production of products and the acquisition of practical skills in monitoring food safety indicators. **Content:**During the study of the course, special disciplines are revealed: the regulatory and legislative framework for ensuring the biosafety of biotechnological industries; security system in the field of genetic engineering activities; possible aspects of biological hazard and environmental risks of genetically modified organs; modern microbial biohazards associated with biotechnological processes; Biosafety products for the production of diagnostic and immunobiological preparations; problems of biosafety on an industrial scale; the safety of working with collection, production and test strains requires monitoring in biotechnological processes; ecological aspects of biotechnological productions. **Expected results of the study**: the student must know the methods of quality control and safety of biotechnological products; be able to prepare micropreparations of microbial cells; conduct microscopy of biological objects (cells, tissues and their parts); have the skills to work with micropreparations; - methods for selecting optimal modes for growing microbial cultures; methods of safety analysis of biotechnological products.
5	**Basics of biotechnology production design**	5	Technological equipment of the food industry	Field trip III	**Target.**Formation of the foundations of technological thinking, obtaining skills in engineering calculations and designing biotechnological productions, raising the need and ability to constantly improve their knowledge, developing students' creative thinking and finding the best approach to solving practical issues, considering general issues of designing food enterprises, choosing and justifying technological schemes, layout of workshops and industrial buildings. **Content.**During the study of the course, the specific content of the disciplines is revealed: product calculations; design of the technological part; selection and calculation of technological equipment; equipment operation statistics; architectural and construction part; calculation of the areas of production shops, laboratories and auxiliary premises; design of industrial premises and layout of the enterprise shop; the main regulatory documents of production used in the design of biotechnology enterprises. **Expected learning outcomes: student**must know: the basic principles of designing food enterprises; norms of technological design of food industry enterprises; basic principles

					of organization of biotechnological production, methods for assessing the effectiveness of production; a schematic diagram of biotechnological production; selection criteria and equipment for the stages of cultivation, isolation and purification of biosynthesis products; the most important structural elements of machines and devices; methods and equipment for transportation of solid, liquid and gaseous media; instrumentation and automatic control systems for biotechnological processes; norms of safety and labor protection; Be able to: draw up a scheme of biotechnological production; formulate arguments and solve problems, problems on biotechnology issues **Own**knowledge of the most important structural elements of machines and apparatuses and the norms of technological design of food industry enterprises
5	**industrial ecology**	5	Technological equipment of the food industry	Field trip III	**Target.**Formation of knowledge in the field of industrial ecology, allowing in the process of production activities to identify sources of environmental pollution at production facilities, determine the concentration of pollutants, evaluate existing and propose new means to reduce pollution, evaluate the environmental effect of environmental protection measures. **Content.**In the course of studying the course, the following disciplines are revealed: environmental justification of design solutions placed at economic facilities engaged in biotechnological activities; environmental control and supervision; types of environmental pollution; pollution of the environment, natural waters, terrain; methods for cleaning gas facilities and wastewater from biotechnological enterprises; protection of subsoil, land, plant and animal resources. **Expected results of the study**: the student must: know: the specifics and mechanism of the toxic effects of harmful substances, energy effects and the combined action of factors; legal, regulatory, technical and organizational foundations of environmental safety; means and methods for improving the safety and environmental friendliness of technical means and technological processes; be able to: identify the main hazards of the human environment, technological processes and equipment, evaluate the effectiveness of various methods and devices for protecting the environment from pollutants and develop recommendations for reducing environmental pollution; use basic means of environmental quality control; operate modern professional biotechnological equipment;
6	**Pharmaceutical biotechnology**	5	Engineering enzymology	Final state certification	**Target:**consists in the formation of students and their acquisition of systematic scientific knowledge about the production of pharmaceutical substances and medicines by biotechnological methods, as well as methods for controlling their quality.

					Content: The general scheme of the biotechnological process of the production process for the production of medicines. Methods with the detection of biotechnological biological objects. Cryobiotechnology as a bank of biomaterials. Antibiotics. Production, biosynthetic pathways, resistance. Biotechnology of amino acids and other active biological compounds and their use as medicines. Enzymes as medicine. Immunobiotechnology. Cellular biomedical technologies. Ecological aspects of pharmaceutical production. **Expected results of the study**: the student must: know the basic terms and definitions, objects and methods of biotechnology; – stages of industrial production, methods of isolation and purification of the most important biotechnological products used in the manufacture of medicines; **be able to**use regulatory legal acts regulating the production and quality assurance of medicines obtained by biotechnological methods; **own**methods of cultivation of isolated cells, tissues and organs of plants and animals in order to obtain pharmaceutical substances and medicines; nomenclature of medicines obtained by biotechnological methods
6	**General pharmacology**	5	Engineering enzymology	Final state certification	**Target:**Formation on the basis of knowledge of the features of pharmacology of the principles of evidence, the ability to competently select the most effective and safe drugs according to their pharmacodynamic and pharmacokinetic characteristics, the interaction of drugs; **Content:**The science of pharmacology: definition, goals, objectives. Brief history of pharmacology, nutritional states. The concept of drugs. Chemical structure, physico-chemical properties of medicines. State Pharmacopoeia. Pharmacology of drugs that affect cholinergic systems. Pharmacology of drugs that affect the adrenergic systems. The concept of the pharmacodynamics of drugs. Types of action of drugs. Doses and concentrations of funds. The main and side effects of the drug. The main and side effects of the drug. **Expected results of the study**: the student must: know the idea of the role of pharmacology in solving applied problems; be able to distinguish between the concepts of a dosage form, a medicinal substance, a medicinal product, a medicinal product, a medicinal raw material, a biologically active food supplement (BAA), a homeopathic medicinal product; possess the skills of a comprehensive analysis, including the possibility of using a pharmacological approach;
7	**Standardization and certification of biotechnolo**	6	Fundamentals of food biotec	Final state certification	**Target.**Preparation of students with an in-depth study of the theoretical and practical foundations for the standardization and certification of biotechnological products. **Content.**During the study of the course, the following disciplines are revealed: concepts, definitions in the field of

	gical products		hnolo gy		standardization, quality management, certification; regulatory and technical documentation of biotechnological products in biotechnological production; standardization methods; scheme types; a sign of a stable economy; the procedure for developing a standard; installation systems; technical regulations; product quality, consumer protection; application area; rules, certification procedures. **Expected results of the study**A: the student must Know: basic concepts and definitions of standardization and certification; the main provisions of systems (complexes) of general technical and organizational and methodological standards; technical regulations; product quality; scope of certification; rules and procedures for certification; **Be able to:**apply theoretical and practical knowledge to the requirements of regulatory documents for the main types of products and processes; apply quality system documentation; use measuring instruments; **Own**knowledge in the field of standardization and certification and the ability to work with regulatory and technical documentation;
7	**Environmental management**	6	Fundamentals of food biotechnology	Final state certification	**Target.**Formation of competencies that allow developing quality management systems for biotechnological products in accordance with the requirements of Kazakhstani and international quality standards. **Content.**In the course of studying the course, the following disciplines are revealed: general "product quality"; system of quality indicators for biotechnological products; the main mechanisms of the quality management system; quality management system: definition, requirements; development of a quality management system at the enterprise; product quality management mechanisms; features of quality management of biotechnological products; safety and quality of biotechnological products; drawing up technical documentation. **Expected results of the study**: the student must know: the laws of development of nature and society in the light of the emergence and development of environmental management; methodology for planning and implementing an environmental management system in an organization; To be able to: use professionally conduct managerial, marketing, commercial, advertising work related to the environmental activities of the organization; develop; apply in practice the norms of environmental law in the system of eco-management; create an eco-management system at different levels of economic activity, aimed at achieving the goals of clean, low-waste and non-waste production; **Own**:methods for assessing the ecological state of an enterprise: to master modern technologies of eco-management, eco-audit

Note: * - means that the discipline is studied for all educational trajectories

LIST OF DISCIPLINES
components of choice for the educational program
6B05121 "Biotechnology"
Duration of study: 4 years, form of study: full-time

Name of discipline or module	Discipline code	Credit	Semester
1. General education disciplines			
Optional component 1			
Module of economic and legal knowledge		5	
Fundamentals of market economy and entrepreneurship	*FMEE1111*	3	2
Fundamentals of law and anti-corruption culture	*FLACC1112*	2	
Module of economic and natural knowledge		5	
Fundamentals of market economy and entrepreneurship	*FMEE 1111*	3	2
Alash studies	*AS 1112*	2	2
Fundamentals of life safety and ecology	*FLSE 1112*		
2. Basic disciplines			
Optional component 1			2
Phytoresources in biotechnology	PhB2214	6	
Animal resources in biotechnology	ARB2214	6	
Optional component 2			3
Cellular biotechnology	CB2215	5	
Cellular plant breeding	CPB2215	5	
Optional component 3			5
Plant physiology	PP3216	4	
Human and Animal Physiology	HAPhy 3216	4	
Optional component 4			4
Environmental protection and monitoring	EPM2217	4	
Rational use of natural resources	RNR 2217	4	
Optional component 5			4
Basics of Python Programming	OPP2218	3	
Mathematical modeling in biology	MMB2218	3	
Optional component 6			4
Production of antibiotics, vitamins, steroids, insulin, interferon	PAVSII2219	5	
Biotechnology of biological active substances	BBAV2219	5	
Optional component 7			5
Plant biotechnology	PB3220	5	
Biotechnology in plant protection	BPP3220	5	
Optional component 8			5
Basics of food biotechnology	BFB 3221	5	
Isolation and purification of biotechnology products	IPBP 3221	5	
Optional component 9			5
Animal biotechnology	AB3222	5	
Biotechnology in Animal Welfare	BAP3222	5	
Optional component 10			6
Basics of physico-chemical analysis of food	BPCAP 3223/	4	

products			
Physical and colloidal chemistry	PCC3223	4	
Optional component 11			
Engineering enzymology	EE 4224	3	7
Basics of Chemical Technology	BCT4224	3	
Optional component 12			
Agricultural biotechnology	AB4225	5	7
Medical and Veterinary Biotechnology	MVB4225	5	
Optional component 13			
Basics of environmental biotechnology	BEB4226	6	7
Biotechnology of soil and water treatment	BSWP4226	6	
3. Major disciplines			
Optional component 1			
Biotechnology of products of plant and animal origin	BPAPP3306	6	6
Biopharmaceutical Technology	BT3306	6	
Optional component 2			
Food Processing Equipment Technology	FPET 3307	5	6
Processes and devices in biotechnology	PDB 3307	5	
Optional component 3			
Biological food safety	BSFP 4308	5	7
Biotechnological safety of biotechnological production	PDB 4308	5	
Optional component 4			
Toxicological analysis of food products	TAFP 4309	6	7
Food Chemistry	FC4309	6	
Optional component 5			
Fundamentals of designing biotechnological production	BBPD 4310	5	7
Industrial ecology	IE4310	5	
Optional component 6			
Pharmaceutical biotechnology	PB4311	5	8
General pharmacology	GPh 4311	5	
Optional component 7			
Standardization and certification of biotechnological products	SCBP 4312	6	8
Environmental management	EM4312	6	