

**NJSC "Satbayev University"
Chemical and Biological Technology Institute**

**CURRICULUM PROGRAM
«BIOECOLOGICAL ENGINEERING»
(Specialized area (1,5 years))**

**Master in Natural Science in
«7M05202, 7M05104 -Bioecological Engineering»**

1st edition
in accordance with the State Education
Standard of Higher Education 2018

Almaty 2020

Разработано:	Рассмотрено: заседание УС Института	Утверждено: УМС КазНИТУ	Страница 1 из 33
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Утверждено на заседании Учебно-методического совета Казахского национального исследовательского технического университета им К.И. Сатпаева. Протокол №3 от 19.12.2019 г.

Квалификация:

- Уровень 7 Национальной рамки квалификаций:
- 7M05 – Естественные науки, математика и статистика
 - 7M051 – Биологические и смежные науки (магистр)
 - 7M052 – Окружающая среда (магистр)

Профессиональная компетенция: владение фундаментальными естественно-научными и биологическими знаниями современной инженерной биотехнологии и инженерной экологии и понимания их назначения для решения некоторых глобальных проблем человечества (экологической, энергетической, сырьевой, продовольственной); способность ориентироваться в вопросах общей экологии и общей биотехнологии, и отдельных ее направлений; знать и уметь использовать в науке и производстве технологические возможности биоэкологической инженерии; быть способным к реализации системы менеджмента качества экологизированных биотехнологий в соответствии с требованиями национальных и международных стандартов качества.

BRIEF DESCRIPTION OF THE PROGRAM

The Master's educational program (hereinafter referred to as OPM) "Bioecological Engineering" in the direction of training 7M051 - "Biological and related sciences" and 7M052 - "Environment" was developed by the K.I. Satpayev Kazakh National Research Technical University.

1 Objective of the OPM “Bioecological Engineering”

Preparation of highly qualified masters of natural sciences with professional knowledge in the field of engineering biotechnology and engineering ecology, who are able to implement the acquired knowledge in engineering design and research and production activities.

2 Types of work

Types of professional activity of the Master of Natural Sciences in the scientific and pedagogical direction of training 7M051 - "Biological and related sciences" and 7M052 - "Environment":

- organizational and managerial support,
- design and development department,
- production and technological infrastructure.

3 Objects of professional activity

The objects of professional activity of graduates are:

- natural and man-made ecosystems; design, control, operation, monitoring and expertise of ecological and biological processes in industrial production;
 - biomass, structures and green technologies for industrial biotechnological processes;
 - microorganisms, cell cultures of plants and animals, biologically active substances;
 - quality control tools for ecosystems, raw materials and products;
 - environmental and biotechnological regulations for the production of products, international standards.

Professional activities: power engineering, mining, mining and metallurgy, oil, gas and chemical industry, mechanical engineering, agro-industrial complex; scientific and production laboratories; laboratories for product quality and safety control; environmental and customs services and organizations; research and design industry institutes; secondary technical and higher educational institutions.

PASSPORT OF THE EDUCATIONAL PROGRAM

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1 Scope and content of the program

The duration of the master's degree program is determined by the amount of acquired academic credits. Upon mastering the established number of academic credits and achieving the expected learning outcomes for obtaining a master's degree, the master's educational program is considered fully mastered. There are 90 academic credits in the specialized master's program with a 1,5- year study period.

Planning of the content of education, the method of organizing and conducting the educational process is carried out by the university and scientific organization independently on the basis of credit technology of training.

The Master's degree program in the profile direction implements educational programs of postgraduate education for the training of managerial personnel with in-depth professional training.

The content of the Master's degree program consists of:

- 1) theoretical training, including the study cycles of basic and major disciplines;
- 2) practical training of undergraduates: various types of practices, scientific or professional internships;
- 3) experimental research work, including the implementation of a master's project - for a specialized master's program;
- 4) final certification.

The content of the PSO. OPM "Bioecological Engineering" is implemented by K.I. SatpayevKazNRTU in the direction of training 7M051 - "Biological and related sciences" and 7M052 - "Environment" and represents a system of documentation that regulates the goals, establishes the necessary conditions, technologies and content of the educational process, which determines the quality of training for undergraduates.

OPM "Bioecological Engineering" provides an opportunity to gain in-depth knowledge, key skills and abilities of the graduate and its further development in the field of engineering biotechnology and environmental engineering. This OP is based on the possibility of providing a master's student with the choice of an appropriate educational trajectory or a specific specialization based on the main educational program, but containing their own individual competencies that reflect the specifics of a particular specialization in two areas: 7M051 - "Biological and related sciences" and 7M052 - "Environment".

The OPM contains the following specializations:

- Engineering biotechnology;
- Industrial biotechnology;
- Engineering ecology;
- Geoecology and environmental management.

Objectives of the educational program:

The Master's degree in 7M051-Biological and Related Sciences and 7M052-Environment should be prepared to solve the following professional tasks in accordance with the direction of the OP and types of professional activity:

1 Design and development activities:

- to calculate energy and material balances of ecological and biotechnological processes;
- to calculate the structural and technological parameters of the main and auxiliary equipment in eco and biotechnology;
- to model, plan and optimize ecotechnological and biotechnological processes;
- to develop an instrumental and technological scheme of the process;
- to design workshops and structures of ecological production facilities and biotechnologies by industry.

2 Design and technological activities:

- to develop an eco-friendly technology for the production of chemicals and biomaterials;
- to improve the technological schemes of existing production facilities with the introduction of new strains of microorganisms;
- to create business plans for eco-technological and biotechnological projects;
- to develop energy-and resource-saving methods in the field of engineering biotechnology and environmental engineering;
- to develop environmental protection measures for enterprises of various profiles;
- to introduce the results of scientific research into production;
- to process the results of observations and experiments using modern methods and analysis tools.

3 Research activities:

- to investigate, obtain and use enzymes, viruses, microorganisms, cell cultures of animals and plants, products of their biosynthesis and biotransformation;
- to create technologies for obtaining new types of products, including products obtained using microbiological synthesis, biocatalysis, bioengineering and bionanotechnology;
- to analyze and generalize the results of the research, publish the results in the form of publications and abstracts of reports, issue pre-patents and patents for inventions.

4 Organizational and managerial activities:

- to manage industrial eco-friendly biotechnological industries;
- to carry out information support of production, labor, and management;
- to carry out activities for the organization of production in accordance with the

regulations;

- to organize the activities of the team, draw up work plans and set production goals;
- to resolve issues of material and technical support, control the tasks implementation.

5 Pedagogical activities:

- to manage the departments of retraining of middle technical personnel of environmental and biotechnological services and enterprises.
- to develop educational and methodological literature for students in conducting classes.

2 Requirements for applicants

The previous level of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established sample and confirm the level of knowledge of the English language with a certificate or diplomas of the established sample.

The procedure for admitting students to a magistracy is established in accordance with the "Standard rules for admission to training in educational organizations that implement educational programs of postgraduate education."

The formation of a contingent of undergraduates is carried out by placing a state educational order for the training of scientific and pedagogical personnel, as well as paying for training at the expense of students' own funds and other sources. The state provides citizens of the Republic of Kazakhstan with the right to receive, on a competitive basis, in accordance with the state educational order, free postgraduate education, if they receive education of this level for the first time.

At the "entrance", a master's student must have all the prerequisites necessary for mastering the corresponding educational master's program. The list of required prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the master student is allowed to master them on a paid basis.

3 Requirements for completing studies and obtaining a diploma

Degree/qualifications awarded: The graduate of this educational program is awarded the academic degree “Master of natural sciences” in the field of 7M051-“Biological and related sciences” and 7M052-“Environment”.

A graduate who has completed master’s degree programs must have the following general professional competencies:

- the ability to independently acquire, comprehend, structure, and use new knowledge and skills in professional activity, to develop their innovative abilities;
- the ability to independently formulate research goals, establish a sequence for solving professional problems;
- the ability to apply in practice the knowledge of fundamental and applied disciplines that determine the focus (profile) of the master's program;
- the ability to professionally choose and creatively use modern technical equipment for solving scientific and practical problems;
- the ability to critically analyze, represent, defend, discuss, and disseminate the results of their professional activities;
- proficiency in compiling and preparation of scientific and technical documentation, scientific reports, reviews, reports and articles;
- willingness to lead a team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional, and cultural differences;
- readiness for communication in oral and written forms in a foreign language to solve problems of professional activity.

A graduate who has completed the master's program must have professional competencies corresponding to the types of professional activity that the master's program is focused on:

production activities:

- the ability to independently carry out production, field and laboratory and interpretation work in solving practical problems;
- the ability to professionally operate modern area and laboratory equipment and instruments in the field of the mastered master's program;
- the ability to use modern methods of processing and interpreting complex information to solve production problems;

project activities:

- the ability to independently compose and submit projects of the research work;
- readiness to design complex research work in solving professional tasks;

organizational and management activities:

- willingness to use practical skills of organizing and managing research work in solving professional problems;
- readiness for practical use of regulatory documents in the planning and organization of scientific and industrial work;

When developing a master's program, all general cultural and professional competencies, related to those types of professional activities for which the master's program is oriented, are included in the set of required results of mastering the master's program.

4 Working curriculum of the educational program

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4.1. Study period 1.5 years

Срок обучения: 1.5 года														
Год обучения	Код	Наименование дисциплины	Компонент	Курсы		Льгот/гр	Источники	Код	Наименование дисциплины	Компонент	Курсы		Льгот/гр	Источники
				ЕСТУ	РК						ЕСТУ	РК		
1	1 семестр							2 семестр						
	LNG205	Иностранный язык (профессиональный)	БД ВК	5	3	0/0/3		BIO240	Оценка экологических рисков	ПД ВК	5	3	2/0/1	
	MNG230	Проектный менеджмент (<i>Менеджмент + Психология управления</i>)	БД ВК	3	2	1/0/1		BIO253	Инженерная биотехнология	ПД ВК	5	3	2/0/1	
	BIO252	Экономическое регулирование ООС и природопользования	БД КВ	5	3	2/0/1			Электив	ПД КВ	5	3	2/0/1	
	BIO258	Современные методы, достижения и проблемы биотехнологии	БД КВ	4	2	1/0/1			Электив	ПД КВ	5	3	2/0/1	
	BIO243	Биотехнология в защите окружающей среды по отраслям промышленности	ПД КВ	5	3	2/0/1			Электив	ПД КВ	5	3	2/0/1	
	BIO 270	Технология основных производств в природопользовании	ПД КВ	5	3	2/0/1			Экспериментально-исследовательская работа магистранта	ЭИРМ	6	4		
		Экспериментально-исследовательская работа магистранта	ЭИР М	6	4									
	Всего:			33	20			Всего:		31	19			
2	3 семестр													
		Экспериментально-исследовательская работа магистранта	ЭИР М	6	4									
		Производственная практика	ПД	10	6									
	ECA2013	Оформление и защита магистерской диссертации (ОнЗМД)	ИА	12	7									
	Всего:			28	17									
	Итого:			92	56									

4.2. Catalog of elective disciplines

	код	Наименование дисциплин	кредиты	Лк/лб/пр	семестр
1	BIO269	Инженерная экология	3	2/0/1	2
	BIO266	Техногенные объекты и техносферная безопасность			
2	BIO257	Применение методов ДНК-технологий в биотехнологиях	3	2/0/1	2
	BIO262	Генетически-модифицированные организмы и биобезопасность			
3	BIO264	Технология возобновляемых источников энергии	3	2/0/1	2
	BIO268	Биотехнологические методы получения энергетических продуктов			
	BIO263	Энергоэффективность производства и потребления			
		Итого	9		

5 Descriptors of the level and scope of knowledge, skills, abilities and competencies

The requirements for the level of preparation of a master's student are determined based on the Dublin descriptors of the second level of higher education (master's) and reflect the acquired competencies, expressed in the achieved learning outcomes.

Learning outcomes are formulated both at the level of the entire educational program of the master's program, and at the level of individual modules or academic discipline.

Descriptors reflect learning outcomes that characterize the student's abilities:

1) to demonstrate a knowledge and present the understanding in the field of biocotechnology of solid waste processing, biotechnology in environmental protection, technologies of basic industries in environmental management, etc., based on advanced knowledge in the field of biotechnology and ecology in the development and (or) application of ideas in the context research;

2) to apply at a professional level their knowledge, understanding and ability to solve problems in a new environment, in a broader interdisciplinary context;

3) to collect and interpret information to form judgments, taking into account social, ethical and scientific considerations;

4) clearly and unambiguously communicate on the given information, ideas, conclusions, problems and solutions, both to specialists and non-specialists;

5) to obtain learning skills necessary for self-continued further education in the field of bioecological engineering.

6 Competencies obtained in master's program training

6.1 Requirements for key competencies of graduates of a specialized master's program must:

1) have a view:

- on current trends in the development of scientific knowledge;
- on specific methodological and philosophical problems of natural (social, humanitarian, economic) sciences;

- on the contradictions and socio-economic consequences of globalization processes;

- on the current state of the economic, political, legal, cultural and technological environment of the world business partnership;

- about the organization of strategic enterprise management, innovation management, leadership theories;

- on the main financial and economic problems of the functioning of enterprises.

2) know:

- the methodology of scientific knowledge;

- the major driving forces and challenges in the structure of the economy;

- the features and rules of investment cooperation;

- at least one foreign language at a professional level, allowing for scientific research and practical activities.

3) be able to:

- apply scientific methods of cognition in professional activities;
- critically analyze existing concepts, theories and approaches to the study of processes and phenomena;
 - integrate the knowledge gained in different disciplines, use it to solve analytical and managerial problems in new unfamiliar conditions;
 - conduct a microeconomic analysis of the economic activity of the enterprise and use its results in the management of the enterprise;
 - obtain information about the source text;
 - post a review;
 - apply in practice new approaches to the organization of marketing and management;
 - make decisions in difficult and non-standard situations in the field of organization and management of economic activities of an enterprise (firm);
 - apply in practice the norms of the legislation of the Republic of Kazakhstan in the field of regulation of economic relations;
 - think creatively and be creative in solving new problems and situations;
 - carry out information-analytical and bibliographic works with the involvement of modern information technologies;
 - summarize the results of experimental research and analytical work in the form of a master's thesis, research article, report, analytical note, etc.

4) have skills:

- in solving standard scientific and professional problems;
- in conducting scientific analysis and solutions of practical problems in the organization and management of economic activities in organizations and enterprises;
 - to investigate the problems in the field of management and marketing and use the results to improve the methods of enterprise management;
 - of professional communication and intercultural communication;
 - of oratory, correct and logical design of thoughts in oral and written form;
 - in expanding and deepening the knowledge necessary for daily professional activities and continuing education in doctoral studies;
 - in the use of information and computer technologies in the field of professional activity.

5) be competent:

- in the field of research methodology in the specialty;

- in the field of contemporary problems of the world economy and the participation of national economies in world economic processes;
- in the organization and management of the enterprise;
- in the implementation of industrial relations with various organizations, including public service bodies;
- in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.

B - Basic knowledge, abilities and skills

B1. - the ability to use the philosophical concepts of natural science to form a scientific worldview;

B2 - the ability to apply knowledge of methodology in bioecological engineering to solve specific professional problems and assess technological risks.

P - Professional competencies:

P.1 - the ability to collect and analyze the initial data required for calculation, modeling and experiment;

P.2 - the ability, on the basis of standard techniques and the current regulatory framework, to calculate profitability and economic indicators characterizing the implementation and operation of the object;

P.3 - the ability to collect, analyze and process the data necessary for solving the specific research tasks, using the data bases of Kazakhstani and international organizations;

P.4 - the ability to analyze and interpret the research results and other information contained in the reporting of organizations, departments and use the information obtained for decision-making;

P.5 - the ability to use modern technical means and information technologies to solve analytical and research problems;

P.6 - the ability to organize and manage the activities of a small group created for the implementation of a specific project;

P.7 - master the methods of conducting patent research, licensing and copyright protection when creating innovative products in the field of professional activity.

O - Universal, social, and ethical competencies

O1 – knowledge of contemporary social and political problems;

O2 –the ability to perceive intercultural differences, the ability to observe and maintain ethical norms and rules;

O3 - communication skills in a foreign language, the ability to work in an international context

C– Special and managerial competencies:

C1 - the ability to lead team work and ensure industrial safety measures;

C2 - ability to plan and organize professional events;

C3-readiness to act in non-standard situations, to have social and ethical responsibility for the decisions made.

6.2 Requirements for the experimental research work of a master student in a specialized master's program:

1) corresponds to the profile of the master's educational program, according to which the master's project is carried out and defended;

2) is based on modern achievements of science, technology and production and contains specific practical recommendations, independent solutions to management problems;

3) it is performed using advanced information technologies;

4) contains experimental and research methodological, practical sections on the main protected provisions.

6.3 Requirements for the organization of practices:

The educational program of the profile master's degree includes industrial practice in the PD cycle.

Industrial practice in the PD cycle is carried out with the aim of consolidating the theoretical knowledge gained in the learning process, acquiring practical skills, competencies and experience of professional activity in the taught educational program of the magistracy, as well as mastering advanced experience.

7 Appendix to the ECTS Diploma

The application is developed according to the following Standards of the European Commission, Council of Europe and UNESCO/CEPES. This document is for academic recognition only and is not an official proof of education. It is not valid without a higher education diploma. The purpose of completing the European Annex is to provide sufficient information about the holder of the diploma, the qualification obtained, the level of this qualification, the content of the study program, the results, the functional purpose of the qualification, as well as information about the national educational system. The application model that will be used to translate grades uses the European Credit Transfer or Transfer System (ECTS).

The European Diploma Supplement provides an opportunity to continue education at foreign universities, as well as to confirm national higher education for foreign employers. When going abroad for professional recognition, additional legalization of the educational diploma will be required. The European Diploma Supplement is completed in English upon individual request and is issued free of charge.

Foreign language (professional)

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Professional English for Project Managers

CODE – LNG205

CREDIT – 3 (0/0/3)

PREREQUISITES – Academic English, Business English, IELTS 5.0-5.5

THE AIM AND OBJECTIVES OF THE COURSE

The aim of the course is to develop students' knowledge of the English language for their ongoing academic research and improve their performance in the field of project management.

BRIEF DESCRIPTION OF THE COURSE

The course is aimed at developing vocabulary and grammar for effective communication in the field of project management and improving reading, writing, listening and speaking skills at the "Intermediate" level. Students are expected to acquire additional vocabulary in Business English and learn grammatical structures that are often used in the context of management. The course consists of 6 modules. The 3rd module of the course ends with an intermediate test, and the 6th module is followed by a test at the end of the course. The course ends with a final exam. Master students also need to study independently (MIS). MIS is an independent work of undergraduates under the guidance of a teacher.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

Upon successful completion of the course, students are able to recognize the main idea and message as well as specific details while listening to monologues, dialogues and group discussions in the context of business and management; understand written and spoken English on topics related to management; write management texts (reports, letters, emails, minutes of meetings), following a generally accepted structure with a higher degree of grammatical accuracy and using business words and phrases, talk about various business situations using appropriate business vocabulary and grammatical structures - in pairs and groups discussions, meetings and negotiations.

Project Management

CODE MNG230

CREDIT 2 (1/0/1)

PREREQUISITES: The discipline "Project Management" is based on the knowledge gained as a result of studying disciplines for undergraduate courses

THE AIM AND OBJECTIVES OF THE COURSE.

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The aim of teaching the discipline "Project Management" is to master the methodology of project management in various fields of activity, learning a culture adequate to modern project management and information technology, create conditions for the introduction of new information technologies in the implementation of projects. The course is based on international guidelines for project management (Project Management Body of Knowledge).

BRIEF DESCRIPTION OF THE COURSE.

The content of the discipline is aimed at studying modern concepts, methods, project management tools in order to apply them in the further practical activities of a specialist to solve problems of planning and implementing projects.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE.

Be able to:

- prepare documents for the initialization phase of the project, such as a feasibility study, project charter, etc.
- develop and analyze documents related to the planning of project activities, apply various methods of decision support;
- operatively control the work implementation and follow deadlines;
- select personnel, resolve contradictions between team members;
- to manage the risks arising from the implementation of projects.

Know:

- Modern standards in the area of project management and their characteristics;
- PMI approach to project management;
- Investment planning;
- Accounting for project risks;
- Methods for optimizing the use of available resources;
- Ways of resolving conflict situations;
- Analysis of actual indicators for timely adjustment of the work progress.

Have skills:

- project management in accordance with modern project management requirements;
- apply in the project management process using MS Project software

Economic regulation of environmental protection and environmental management

CODE - BIO252

CREDIT - 3 (2/0/1)

PREREQUISITES: no

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THE AIM AND OBJECTIVES OF THE COURSE

Aim: the study of economic and industrial relations, the economic consequences of industrial production, methods of ensuring the rational use of natural resources and environmental protection, as well as provides theoretical and practical training in the method of environmental management.

Objectives: Use of economic methods in the field of environmental protection and ensuring rational use of natural resources.

BRIEF DESCRIPTION OF THE COURSE

The discipline "Economic regulation of Environmental management and environmental management" provides an overview of environmental planning activities, payment for emissions to the environment, payment for the use of certain types of natural resources; economic incentives for environmental management, environmental insurance, environmental emissions management, reduction of greenhouse gas emissions and absorption, economic assessment of environmental damage.

KNOWLEDGE, ABILITIES AND SKILLS AT THE END OF THE COURSE

Have an idea of: the role of the economy in the OS problems, the main problems of development of ecological and economic estimation of natural resources; the role of systems analysis in solving social and economic tasks in the field of rational nature management and resource saving.

Know: basic methods of economic assessment of natural resources; methods for determining real damage from the irrational use of natural resources; methods for determining the economic efficiency of environmental protection activities; methods of environmental and economic assessment of projected solutions;

Be able to: calculate payments for emissions to the OS, environmental, economic and actual prevented damages in the organization of environmental protection measures, the effectiveness of environmental protection measures; use regulatory literature and documentation in all areas of environmental protection activities.

Modern methods, achievements and problems of biotechnology

CODE - BIO258

CREDIT - 2 (1/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

Aim: To provide students with the knowledge about modern methods and achievements in the field of fundamental and applied biotechnological science, to ensure the formation of undergraduates' ideas about modern problems in the field of cellular and molecular biotechnology.

Objectives: Formation of undergraduates' knowledge and skills in developing competencies in the field of engineering biotechnology and the latest technologies to produce biotechnological products in compliance with national and international quality standards.

BRIEF DESCRIPTION OF THE COURSE

Modern achievements, methods, and problems of medical, pharmaceutical and food biotechnology. Features of the research development and commercialization of biotechnology in different countries of the world. Target products of biotechnology: recombinant DNA, genetically engineered proteins, monoclonal antibodies, edible vaccines, antibodies, biomaterials. The market for the latest biotechnological products, its structure, and dynamics. Social, legislative, and ethical issues of modern biotechnology.

Biotechnology of new molecules and materials: biosynthesis, properties, applications. World trends in the development of biomaterial science. Problems of synthesis of biomaterials and the validity of increasing the rate of production growth; producers (natural and genetically modified organisms), synthesis technology substrates. Modern methods of research of target products of biotechnology. Methods for the isolation and purification of cellular macromolecules to obtain the target biotechnological product. Biotechnology is the basis of scientific and technological progress and improving the quality of human life under conditions of increasing anthropogenic load.

KNOWLEDGE, SKILLS AND ABILITIES AT THE END OF THE COURSE

After completing the course, the master's student must:

Know the achievements of modern bioengineering, general principles of designing new organisms for biotechnology, genetic methods of medical diagnostics and therapy, problems of modern medical biotechnology;

Master the scientific basics of modern methods for analyzing the most important cellular macromolecules and target products of biotechnology, the methodology of bioengineering cells, tissues and organs, the concept of the need to comply with ethical standards and risk strategies in the development of biotechnological technologies.

Be able to navigate modern trends and methods of biotechnology (genomics, proteomics, genetic engineering, biomaterial science) and use the knowledge gained when writing scientific articles and research projects.

Bioecotechnology in environmental protection by industry

CODE - BIO243

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

Aim: Mastering knowledge on the applied application of biotechnology in solving environmental problems by specific biotechnological methods that combine chemical, biological and engineering knowledge in different industries.

Objectives:

- to consider the engineering and technological aspects of the use of environmental biotechnologies;
- to study the methods and principles of operation of the most important structures of industrial devices and biological treatment facilities;
- to study the specifics of various organisms and their communities intended for biological treatment of water and soil media, air, natural reservoirs, processing of various wastes of human activity;
- to study methods and technologies for the removal of such contaminants as oil and oil products, heavy metals, as well as biodegradation and biocorrosion of various materials, biodeterioration and biofouling.

BRIEF DESCRIPTION OF THE COURSE

The course of lectures of the discipline is based on topical problems of environmental biotechnology, aimed at solving environmental problems by biotechnological methods in the field of wastewater treatment, aerobic and anaerobic biological methods, deodorization of air-gas emissions, microbiological processing of organic waste, principles of organizing low-waste production. The issues of anaerobic digestion and methane generation are sufficiently considered; vermicultivation and vermicomposting; classification of methods and technologies for soil bioremediation; non-biological methods and technologies of bioremediation; biological and combined methods of remediation. Topics of lectures are characterized by novelty, advantage in content and significance for the development of bioecotechnology in the Republic of Kazakhstan.

KNOWLEDGE, ABILITIES AND SKILLS AT THE END OF THE COURSE

be able to:

- reasonably choose objects and research methods for solving the assigned tasks;
- predict the results of their professional activities;
- to give an economic and environmental assessment of various bio-production technologies;

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- carry out a comprehensive analysis of biocotechnology objects and predict the productivity of these objects;
- to summarize the results of experimental research and analytical work in the form of a master's thesis, article, report, etc.

TECHNOLOGY OF BASIC PRODUCTION IN NATURE USE

CODE - BIO 270

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

Formation of undergraduates' understanding of the technologies of the main industrial industries, the knowledge of which is necessary for the ability to navigate in them, as well as for the development and justification of environmental projects and biological technologies.

BRIEF DESCRIPTION OF THE COURSE

In-depth theoretical knowledge of the foundations and applied technological principles of mining, mineral processing, metallurgy, mechanical engineering, oil and gas production, oil and gas processing, chemical production. Methods and technologies for effective work with industrial objects and materials. Fundamentals of transportation and storage of industrial materials. Review of the possibility of using new technologies of biological origin. Justification and scope of application of environmentally friendly alternative technologies.

Objectives:

- be guided by the concept of environmental acceptability of applied production solutions, the use of natural technological principles and solutions;
- develop skills in the development of innovative technologies of biological origin, as well as innovative technologies that reduce the negative impact on the natural environment.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

- to know traditional and new technologies of mining, ore dressing, ore processing into metal, machine building and other industries, transport.
- to be able to choose environmentally acceptable technologies using various methods, to define tasks for the rational use of natural processes.

- to possess the skills to analyze the environmental friendliness of technologies, the essence of natural processes and technologies of biological origin for use in industrial production.

Environmental risk assessment

CODE - BIO240

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

Aim: Mastering the basics of knowledge and skills necessary to address issues of effective environmental risk management.

Objectives:

- study of the risk concept, features of environmental risk and their classification;
- mastering the methods of risk assessment, contributing to the qualitative and quantitative assessment;
- analysis of theoretical and practical issues related to environmental risk management
- study of patterns in identifying environmental risks in the energy industry, mining, mining and metallurgy, mechanical engineering, oil production and other industries.

BRIEF DESCRIPTION OF THE COURSE

The methodology and approaches to solve problems on environmental risks, the methodology and methods of risk assessment, as well as the use of these methods in conducting a qualitative and quantitative risk assessment, modeling and forecasting the development of risk situations in order to develop optimal solutions are considered. The course provides examples of tasks and suggests ways and methods of their solution. The issues of theory and practice of environmental risk management, both in general terms and in the implementation of certain specific types of activities, are also sufficiently considered. The schemes, stages, steps and procedures related to the planning of activities, to manage environmental risks, aimed at reducing their level are described.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

- to monitor the parameters and the level of negative impacts for their compliance with regulatory requirements;
- to predict the development and assessment of emergency situations;
- to collect, select and use the necessary knowledge and effectively apply the knowledge gained in writing a research work;

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- to acquire practical skills in the use of technical and reference literature.

Engineering biotechnology

CODE - BIO253

CREDIT - 3 (2/0/1)

PREREQUISITES - no

THE AIM AND OBJECTIVES OF THE COURSE

Aim: Formation of the basic ideas about the functioning of cell populations and the possibility of managing them in industrial production.

Objectives: Formation of engineering and biological skills of master students to enhance the methods that are currently taking place in engineering biotechnology.

BRIEF DESCRIPTION OF THE COURSE

Scientific foundations of engineering biotechnology. Specificity of design and application of equipment for the implementation of biotechnological processes. Elements of control and management of biotechnological processes. Material and energy balance of microorganism growth. Equipment for biotechnological industrial production. Design, construction and operation of bio scrubbers and bioreactors of single and cascade type in biotechnology.

Biotechnology in traditional energy. Biotechnology in thermal power engineering, hydropower engineering, nuclear power engineering. Block diagram of uranium ore bioleaching. Biotechnology in alternative renewable energy. Sources of alternative energy: biofuel, bioethanol, biogas, biodiesel fuel, bacterial biomass from waste gases, dimethyl ether, biohydrogen, production of flowcharts. Biotechnology for the rational use of coal resources: biotechnology for removing methane by methane-oxidizing bacteria from coal seams and biotechnology for improving the quality of coal. Flowchart of biotechnology for coalbed methane removal.

Biotechnology for increasing oil production. Biotechnology of processing and disposal of waste petroleum products. Principles of biotechnology for processing oil waste. Block diagram of complex biotechnology of soil cleaning from oil products. Processing of organic oil waste, flowcharts: aerobic and anaerobic degradation of organic matter in a comparative aspect. Waste oil of various technologies. Fundamental methods of reducing and eliminating pollution of soils and technogenic soils with oil and oil products. Neutralization and disposal of oily waste. Block diagram of an integrated oil sludge treatment technology. Biological utilization of oil waste. Biotechnological production of bioethanol and biodiesel, used for internal combustion engines; biotechnology in the chemical industry (1-butanol, acetone). Biotechnology for the production of technically significant biopolymers.

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Bio-production technologies in metallurgy: bio-production technologies in ferrous and non-ferrous metallurgy. Producers-microorganisms used in biotechnology for the extraction of metals and technological parameters of the process. The use of bacterial oxidation of sulfide minerals in the mining industry. Bacterial leaching of heaps and dumps: A heap of ore for leaching gold with traditional sodium cyanide as an analogue for bioleaching. Typical scheme for processing heaps or dumps of copper ore by leaching. Characteristics of biometallurgical technologies for processing ores and concentrates of copper, gold. Biotechnology in mechanical engineering: biotechnology of production of means of protection against biological damage.

KNOWLEDGE, ABILITIES AND SKILLS AT THE END OF THE COURSE

After completing the course, the master student must:

- know the engineering foundations of biotechnology;
- have skills in the design and operation of biotechnological processes and devices, depending on the type of raw materials and the direction of the industry;
- to be able to use research and production tools to improve the productive qualities of biological objects.

Engineering ecology

CODE - BIO269

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

Aim: Formation of students' knowledge necessary to reduce the negative impact of the technosphere on the natural environment through the rational and integrated use of raw materials and energy resources or while creating new eco-protective devices and technologies, environmentally friendly production processes, with the combination and cooperation of industries, as well as ecological production of development strategies and policies.

Objectives: The acquisition of theoretical and practical skills necessary for making ecologically, technically and economically sound decisions in the operation of technological processes, production facilities, industrial facilities and complexes by future specialists.

BRIEF DESCRIPTION OF THE COURSE

The place of engineering ecology in the system of knowledge about human and nature. Environmental engineering concept. Technogenic impact (chemical, radioactive contamination; noise, vibration, electricity, and electromagnetic radiation) on

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environmental objects. Combustion and explosion in the environment. Environmental monitoring. Technogenic means and methods of protection. General characteristics of production processes and their environmental features. Solid and liquid industrial waste, lithosphere pollution, waste reduction methods. Environmentally friendly production, closed production cycles. Emissions of techno sphere objects into the air, pollution zones, methods of protection against emissions. Discharges of industrial facilities into the hydrosphere, pollution zones, wastewater treatment systems. Environmental indicators and economic assessment of environmental protection measures.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

After completing the course, the master student must:

- know the engineering fundamentals of ecology.
- have skills in the development of projects for new industrial facilities and individual industries and processes that affect the quality of the environment.
- to be able to manage environmental protection activities.

Technogenic objects and technosphere safety

CODE - BIO266

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

Aim: Formation of strong theoretical knowledge and practical skills in the field of assessment of technogenic objects and processes of techno sphere safety among undergraduates.

Objectives:

- to study the main techno sphere hazards, their properties, and characteristics;
- to study the issues of the current state of environmental and techno sphere safety, its theoretical foundations and environmental and techno sphere threats on the geospheric envelope.
- to calculate the main technological parameters of systems to ensure the environmental safety of man-made objects;
- to study the main methods and systems to ensure techno sphere safety;

BRIEF DESCRIPTION OF THE COURSE

The current state of environmental and techno sphere safety. The main directions of achieving techno sphere safety; ecobioprotective equipment; protection of urbanized territories and natural zones from the dangerous impact of the techno sphere (regional

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protection). Minimization of anthropogenic and technogenic hazards. Understanding of the probable measure of danger causing harm to the natural environment and health of the population living in regions with varying degrees of anthropogenic load. The impact of natural and man-made factors on the components of the environment and society at the global, regional, and local levels. Consider the aspects of the functioning of ecosystems, techno systems and ecological technological systems.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, undergraduates must know:

- the basics of the functioning of man-made objects;
- main techno sphere hazards, their properties, and characteristics;
- the current system of legal acts in the field of technosphere safety;

be able to:

- predict the emergence and development of negative impacts and assess their consequences;

- optimize measures to ensure technosphere safety;

have skills:

- in possessing knowledge in the field of ecology, ecological safety and interaction of natural and man-made objects;

- of systemic research and improvement of the safety of functioning of technogenic objects;

- in identifying the causes and sources of technosphere hazards;

Application of DNA technology methods in biotechnology

CODE - BIO257

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

Aim: providing deep fundamental knowledge in the field of DNA technology and the formation of modern knowledge and current trends in the development of methods and methodology of molecular biology and genetic engineering, problems and prospects of using DNA technology in biotechnology and the formation of skills for their application in professional activities.

Objectives:

- Formation of a personality capable to self-improvement and professional growth with versatile humanitarian and natural science knowledge and interests;

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- The ability to critically rethink the accumulated experience, change, if necessary, the profile of their professional activities, awareness of the social significance of their future profession, possessing high motivation to perform professional activities;
- Ability to participate in scientific research with the subsequent application of the results in practice, striving for self-development, improving their skills and abilities;
- Preparation for continuing education to the next level;
- Acquisition of a high level of subject-specific competencies.

BRIEF DESCRIPTION OF THE COURSE

The course "Application of methods of DNA technology in biotechnology" is compiled on the basis of fundamental and modern scientific provisions, and also contains topical issues studied in all areas of DNA technology development. The topics of the lectures presented in this course are relevant, contain the latest scientific data and are necessary for study, contain modern basic concepts that underlie the study of the discipline.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, students should know:

- basic terms and concepts for DNA technology;
- different levels of organization of living matter;
- living conditions and properties of biological objects;
- patterns of environmental factors influence on biological objects;
- DNA repair processes;

be able to:

- use the knowledge gained in practice;
- use the knowledge gained to interpret the obtained practical and experimental data;

have skills:

- to navigate in modern information flows of knowledge on DNA technology and adapt to dynamically changing phenomena and processes;
- to master the fundamental principles, modern achievements, and problems of DNA technology;

Genetically Modified Organisms and Biosafety

CODE - BIO262

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

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Aim: To acquaint undergraduates with the technologies of creating transgenic organisms, identifying transgenes in plants and raw materials, assessing the biosafety of genetically modified plants and products derived from them, as well as with the problems that arise in connection with the development and introduction of genetically modified organisms in recent years.

Objectives:

- to consider genetically engineering aspects of creating genetically modified organisms and genetically modified products;
- to study methods and technologies for producing GMOs in agriculture, veterinary medicine;
- to study the impact of GM products on human and animal health, as well as the risks associated with their use on the environment, biodiversity of plants, animals and microorganisms;
- to study Kazakhstani legal framework on GMO biosafety and its implementation.

BRIEF DESCRIPTION OF THE COURSE

When creating the course, the latest scientific achievements in genetic and cellular engineering, molecular biology, biochemistry and plant physiology were used, as well as the latest data obtained in the field.

Topics of lectures are characterized by novelty, advantage in content and significance for the development of biocotechnology in the Republic of Kazakhstan.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

be able to:

- give an economic and environmental assessment of bioprocessing technologies for producing GMOs and products;
- conduct a comprehensive analysis of GMO products and predict the productivity of their use;
- summarize the results of experimental research and analytical work in the form of the research thesis, article, report, etc.

Renewable energy technology

CODE - BIO264

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

The aim of the course is to provide deep fundamental knowledge in the field of biotechnology for obtaining alternative energy and the formation of modern knowledge

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and current trends in the development of biotechnological methods for the production of renewable energy sources, problems and prospects for the use of biotechnological methods of obtaining energy and the formation of skills for their use in professional activities.

Objectives:

- Formation of a personality capable to self-improvement and professional growth with versatile humanitarian and natural-scientific knowledge and interests;
- The ability to critically rethink the accumulated experience, change, if necessary, the profile of their professional activities, awareness of the social significance of their future profession, possessing high motivation to carry out professional activities;
- The ability to participate in scientific research with the subsequent application of the results in practice, the desire for self-development, improving their qualifications and skills;
- Preparation for continuing education to the next level;
- Acquisition of a high level of subject-specific competencies.

BRIEF DESCRIPTION OF THE COURSE

The course "Technology of renewable energy sources" is compiled based on fundamental and modern scientific provisions, contains topical issues and problems studied in all areas of development of biotechnology for obtaining renewable energy sources. The topics of the lectures presented in this course are relevant, contain the latest scientific data and are necessary for study, contain modern basic concepts that underlie the study of the discipline.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, students should know:

- basic terms and concepts of biotechnology for obtaining alternative energy sources;
- different levels of organization of living matter;
- living conditions and properties of biological objects;
- patterns of environmental factors influence on biological objects;
- biotechnological processes of formation the renewable energy sources;
- waste-free production technologies;

be able to:

- use the knowledge gained in practice;
- use the knowledge gained to interpret the obtained practical and experimental data.

have skills:

- navigate in modern information flows of knowledge on biotechnology for obtaining alternative energy sources and adapt to dynamically changing phenomena and processes;
- master the fundamental principles, modern achievements of creating waste-free production and the problems of biotechnology for obtaining renewable energy sources;

Biotechnological methods of obtaining energy products

CODE - BIO268

CREDIT - 2 (1/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

The aim of teaching the course "Biotechnological methods of obtaining energy products" is to give undergraduates knowledge aimed at developing new and effective methods of producing energy carriers in connection with an acute shortage of raw materials and energy on a global scale and increasing requirements for environmental safety of technologies.

Objectives:

- ✓ to consider the ways and mechanisms of energy transformation in biological systems;
- ✓ to study the scientific and analytical foundations of bioenergy;
- ✓ to develop new methods of obtaining energy products.

BRIEF DESCRIPTION OF THE COURSE

The course of lectures is intended to provide an in-depth investigation of methods for direct production of biofuels using bacterial fermentation. Biogas plants - methane tanks - using communities of anaerobic methane-forming bacteria, globally the only source of biological methane on Earth, two main directions for converting organic waste into technically convenient types of fuel and energy: thermochemical conversion, direct combustion, pyrolysis, gasification, liquefaction, synthesis. Bioconversion of alcohols, hydrogen, biogas, organic acids, vegetable oils, parallel production of fertilizers.

Topics of lectures are characterized by novelty, advantage in content and significance for the development of bioecotechnology in the Republic of Kazakhstan.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

The course allows undergraduates to use the laws of biology in the production of products using the latest technologies:

- ✓ processes of converting biomass into energy - biomethanogenesis;
- ✓ biotechnological process of ethanol production;
- ✓ biotechnological process for obtaining liquid hydrocarbons;
- ✓ biological production of hydrogen.

Energy efficiency of production and consumption

CODE - BIO263

CREDIT - 3 (2/0/1)

PREREQUISITES: no

THE AIM AND OBJECTIVES OF THE COURSE

The aim of the course is to train undergraduates in the theory, methodology and practice of increasing the efficiency of the use of fuel and energy resources to train a new generation of specialists in the field of rational and efficient use of natural resources.

Objectives:

- to form basic knowledge about renewable (alternative) energy sources, energy efficiency, energy saving in production and consumption;
- to promote the formation of undergraduates' understanding of the sustainable development of the state through energy efficiency, energy conservation and the use of renewable energy sources;
- to develop competencies for making decisions at all levels of the use of fuel and energy resources;
- to prepare a competitive person, ready for active participation in the social, economic, and political life of the country, capable of making responsible decisions.

BRIEF DESCRIPTION OF THE COURSE

The discipline is focused on improving the economic, social and environmental components in the training of technical specialists and is based on the knowledge gained in the study of socio-economic, natural science and general education disciplines.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE

- with a sense of responsibility (in a local and global context), understanding the consequences of the decisions made and the inertia of their manifestation;
- with an analysis of measures to save fuel and energy resources, identifying benchmarks and prospects for energy supply, including the use of renewable energy sources, energy efficiency and energy conservation based on the achieved world experience;
- using knowledge in situations related to the efficient use of fuel and energy resources and developing possible ways to improve the energy system.
- application of indicator methods of statistical ecology based on the results of monitoring studies;
- analysis of processes in technological, environmental, energy efficient and economic aspects;

- development of evaluation criteria for energy efficiency and energy saving in technological processes and consumption of fuel and energy resources;
- setting specific tasks and priorities in environmental and energy saving activities and using the knowledge gained to solve them.
- have an idea of conducting energy-saving surveys of enterprises and technological processes.

Master's project defense

CODE - ECA2013

CREDIT –12

The aim of the master's thesis/project is:

demonstration of the level of scientific/research qualifications of a master student, the ability to independently conduct a scientific search, test the ability to solve specific scientific and practical problems, knowledge of the most general methods and techniques for their solution.

BRIEF DESCRIPTION

Master's thesis/project is a final qualifying scientific work, which is a generalization of the results of independent research by a master's student of one of the topical problems of a particular specialty of the corresponding branch of science, which has internal unity and reflects the course and results of the development of the chosen topic.

Master's thesis/project is the result of the research/experimental research work of the master's student, carried out during the entire period of study of the master's student.

The defense of a master's thesis is the final stage of the master's preparation. Master's thesis/project must meet the following requirements:

- the thesis should conduct the research or solve topical problems in the field of bioecological engineering;
- the thesis should be based on the definition of important scientific problems and their solution;
- the decisions must be scientifically grounded and reliable, have internal unity;
- the thesis/project must be written individually;

Content

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РЕЦЕНЗИЯ
на образовательную программу магистратуры
«Биоэкологическая инженерия»

Рецензируемая образовательная программа (ОП) «Биоэкологическая инженерия» квалификации «7М051 Биологические и смежные науки» и «7М052 Окружающая среда» (магистр естествознания) национальной рамки квалификации представляет собой описание образовательной подготовки, разработанной на основе Государственного общеобразовательного стандарта высшего образования Республики Казахстан (магистратура).

Содержание и структура ОП по направлению подготовки «7М051 Биологические и смежные науки» и «7М052 Окружающая среда» отвечает основным требованиям стандарта и содержит следующую информацию: цели и задачи ОП, характеристику профессиональной деятельности выпускника, академические требования к поступающим, требования для завершения обучения и получение диплома, рабочий учебный план, дескрипторы уровня и объема знаний, умений, навыков и полный перечень общечеловеческих, социально-этических, базовых, профессиональных и специальных компетенций.

Структура Учебного плана ОП «Биоэкологическая инженерия» логично и последовательна. Дисциплины учебного плана раскрывают сущность актуальных на сегодняшний день проблем.

Сильными сторонами рецензируемой ОП является:

- - освоение выпускниками современных методов обучения в высших учебных заведениях, способствующих формированию творческого, инновационного подхода к пониманию профессиональной деятельности;
- - развитие самостоятельности мышления и умение принимать оптимальные решения в определенных ситуациях.


На основании вышесказанного считаю, что образовательная программа «Биоэкологическая инженерия» направления подготовки «7М051 Биологические и смежные науки» и «7М052 Окружающая среда» может быть рекомендована для внедрения в учебный процесс.

Главный специалист
ТОО «Казахстанское Агентство
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ученый секретарь НТС, к.т.н.



Ж.А. Дюсенова

қағазмен өзгерістер жүргізілген
 және ТОО "КАЭЭ" арқылы бекітілген

РЕЦЕНЗИЯ
на образовательную программу «Биоэкологическая инженерия»
для магистратуры
Института химических и биологических технологий
КазННТУ имени К.И. Сатпаева

Представленная образовательная программа (ОП) "Биоэкологическая инженерия» магистратуры Института химических и биологических технологий (ИХиБТ) включает систему документов, разработанных высшим учебным заведением с учетом приоритетных направлений наук и технологий в области биологических и смежных наук, отраженных в требованиях ГОСО высшего образования по указанному направлению подготовки.

Рецензируемая ОП содержит комплекс основных характеристик образования (объем, содержание, планируемый результат), организационные условия, квалификацию, компетенции, краткое описание программы, нормативные документы, характеристику профессиональной и научно-педагогической деятельности, которыми должен обладать магистрант в результате освоения образовательной программы «Биоэкологическая инженерия». В рецензируемой ОП определены:

- планируемые результаты освоения образовательной программы;
- компетенции обучающихся, установленные образовательным стандартом;
- планируемые результаты обучения по каждой дисциплине;
- знания, умения и навыки, характеризующие этапы формирования компетенций и обеспечение достижений, планируемых в результате освоения образовательной программы.

В общей характеристике ОП указаны: квалификация, присваиваемая выпускникам; виды профессиональной деятельности, к которой готовятся выпускники; направленность образовательной программы, необходимой для реализации образовательного процесса.

На основании вышеизложенного считаю, что образовательная программа "Биоэкологическая инженерия» может быть реализована на базе Института химических и биологических технологий КазННТУ имени К.И. Сатпаева.

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