Ministry of Agriculture of the Republic of Kazakhstan
Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»

APPROVE
Chairman of the Board -Rector
of Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»
_____ Tireuov K.M.
Protocol No. 16 of " 28 " 06 2024.

EDUCATIONAL PROGRAM
7M05102-"Plant biotechnology"

Code and classification of the field of education: 7M05 Natural Sciences, mathematics and statistics
Code and classification of training areas: 7M051 "Biological and related sciences"
Code in the International Standard Classification of Education: 0510
Degree/qualification awarded: Master of Natural Sciences in the educational program "Plant Biotechnology"

Astana 2024

Academic Committee:

№	Full name	Academic degree, academic title	Position	Place of employment	Signature
1	Begenova Ainagul Baibolsynovna	Candidate of Veterinary Sciences, Associate Professor	Head of the Department of Microbiology and Biotechnology	Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»	
2	Suranshiev Zhanbolat Amreevich	Candidate of Veterinary Sciences, Associate Professor	Associate Professor of the Department of Microbiology and Biotechnology	Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»	
3	Sergey Borovikov	Candidate of Biological Sciences, Associate Professor	Acting Professor of the Department of Microbiology and Biotechnology	Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»	
4	Bekkuzhina Sara Sabdenovna	Candidate of Biological Sciences, Associate Professor	Acting Professor of the Department of Microbiology and Biotechnology	Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»	
5	Omarova Akkenzhe Berdikhanovna	PhD доктор	Senior Lecturer at the Department of Microbiology and Biotechnology	Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»	
6	Taldau Gulnar		Student, 2nd year	Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»	
7	Kantaeva Tomiris Ruslanovna	Students of EP 7M05102-Plant biotechnology	Student, 2nd year	Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»	
8	Suleymanova Nargiza Sunnatilla kizi	Students of EP 7M05101-Veterinary biotechnology	Student, 2nd year	Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»	

Agreed with representatives of employers:

№	ФИО	Должность	Место работы	Place of employment
1	Abzhalelov Akhan Begmanovich	Researcher, Doctor of Biological Sciences, Professor	Republican Collection of Microorganisms LLP	
2	Sailau Kasenovich Abeldenov	Head of the Laboratory of Molecular Biotechnology, PhD Doctor	National Center of Biotechnology LLP	
3	Shuga Askarovna Manabayeva	Head of the Laboratory of Plant Genetic Engineering, PhD	National Center of Biotechnology LLP	
4	Temirkhanov Aslan Zhanaevich	Chief Scientific Secretary of the Republican Collection of Microorganisms LLP, Candidate of Agricultural Sciences.	Republican Collection of Microorganisms LLP	

The Academic Committee was approved by the order of the Chairman of the Board-Rector of Non-profit Joint-stock Company «Kazakh Agrotechnical Research University named after S.Seifullin»

№ 374-N dated "18" 10 2023.

Educational program -7M05102-"Plant Biotechnology"

Reviewed:
at the meeting of the Department of Microbiology and Biotechnology
Protocol №. 14 from "24" 05 2024 y.

at the meeting of the Faculty Council on Academic Quality
Protocol № 9 from "30" 05 2024y.

at the meeting of the Academic Council of the University
Protocol № 10 from "24" 06 2024y.

Date of update of the EP "____"_____202__ y

The content of the educational program

№	Name of the Page component	Name of the Page component
	Regulatory references	6
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2.	General characteristics of the educational program	8
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Regulatory references

References to the following normative legal acts were used in the development of the educational program:

1 The Constitution of the Republic of Kazakhstan;

2 The Labor Code of the Republic of Kazakhstan;

3 The Law of the Republic of Kazakhstan "On Education";

4 "State mandatory standards of higher and postgraduate education", approved by Order № 2 of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 (hereinafter – SES);

5 "Rules for the organization of the educational process on credit technology of education in organizations of higher and postgraduate education", approved by Order No. 152 of the Minister of Education and Science of the Republic of Kazakhstan dated April 20, 2011;

6 "Standard rules of the organization of higher and postgraduate education", approved by Order of the Minister of Education and

Science of the Republic of Kazakhstan dated October 30, 2018 № 595;

7 "Qualification requirements for educational activities of organizations providing higher and (or) postgraduate education

education, and a list of documents confirming compliance with them", approved by the order of the Minister of Science and Higher Education of the Republic

Kazakhstan № 4 dated January 5, 2024;

8 Order of the Ministry of Education of the Republic of Kazakhstan dated March 20, 2015 № 137 "On approval of requirements for educational organizations to provide distance learning and rules for organizing the educational process for distance learning and in the form of online training in educational programs of higher and (or) postgraduate education";

9 Guidelines for the use of the European Credit Transfer and Accumulation System (ECTS);

10 Standards and guidelines for quality assurance of higher education in the European Higher Education Area (ESG);

11 Guidelines for the development of educational programs of higher and postgraduate education, Appendix 1 to the order of the Director of the National

Center for the Development of Higher Education of the Ministry of Education and Science of the Republic of Kazakhstan dated 05/24/2023 № 601 n/a;

12 "Rules for maintaining the register of educational programs implemented by organizations of higher and (or) postgraduate education, as well as the grounds for inclusion in the register of educational programs and exclusion from it", approved by Order № 106 of the Minister of Science and Higher Education of the Republic of Kazakhstan dated October 12, 2022;

13 Documented procedure "Documentation Management", approved by Order of the Chairman of the Board-Rector № 269-N dated 07/24/2023;

14 Documented procedure "Quality Records Management", approved by Order of the Chairman of the Board-Rector № 218-N dated 04/21/2020.

1 Passport of the educational program

The purpose of the educational program is to train highly qualified personnel to work in the field of plant biotechnology, in research and scientific production institutions of biological and agricultural profile, in breeding centers.

1.2 Learning outcomes

LO 1 – To study the psychology of management in pedagogical activity. Be proficient in a foreign language at a professional level, allowing you to conduct scientific research and be able to show your leadership qualities for the development of the industry. To know the functional and stylistic characteristics of the scientific presentation of the material in the studied foreign language, general scientific terminology and terminological sublanguages to the corresponding specialty in a foreign language.

LO 2 – Analyze current trends in the development of scientific knowledge, current methodological and philosophical problems of science, methodology of scientific knowledge, principles and structure of the organization of scientific activity.

LO 3 - To reveal the psychology of cognitive activity of undergraduates in the learning process. Possess psychological and pedagogical methods and means to increase the effectiveness of teaching and upbringing, modern technologies for the use of leadership abilities to implement the educational process, taking into account the requirements of society, as well as the specifics of the professionalization of teaching staff in the field of plant biotechnology.

LO 4 – to know the current state of scientific research in the field of biological sciences, to use theories and experimental methods to solve research and methodological problems, to master modern methods of conducting scientific experiments and conduct research independently; to acquire skills in generalizing research results and introducing them into production and apply them to solve problematic issues; to interpret the methodology of scientific research and use the acquired knowledge and ideas in the context of scientific research. To formulate the moral guidelines of modern science; problem field, universal principles and moral values of bioethics, ethical problems of manipulation with stem cells and cloning of plants. Compare the legal framework for biosafety regulation in the Republic of Kazakhstan and other countries.

LO 5 – To apply the methods of molecular genetic engineering in scientific research in the field of plant biotechnology; to know the hereditary information, composition, structure, functions and patterns of chromosomes, genes and genomes. To use the acquired knowledge in genetics and plant breeding, obtaining new varieties and improving the existing qualities of agricultural plants. To develop practical skills in the technology of recombinant DNA creation based on the methods of molecular genetic engineering.

LO 6 – To determine the main provisions of the theory of plant immunity, methods for studying immune reactions in plants. To recognize the relationship between plant resistance to diseases and parasites. To describe the vital activity of the fungal cell, the characteristics of fungi, their classification and features of metabolism. To develop a modern classification and technology for obtaining fungal diagnostic drugs for the prevention of fungal plant diseases.

LO 7-To know the methods of assessing the state of agrophytocenoses and techniques for correcting crop cultivation technology in various weather conditions, to distinguish methods and means of identifying phytopathogens and the principles of their application in conducting phytosanitary monitoring of agrocenoses. Possess methods and means of diagnosing plant diseases, including by visual signs, microscopic characteristics, using innovative methods of monitoring plant objects.

LO 8 – To determine the spread of microorganisms and their role in the transformation of substances in nature, the influence of various adverse factors on microorganisms. Classify the morphology and physiology of microorganisms, classical methods of selection of strains of microorganisms, modern methods of selection of microorganisms; methods of storage of producing strains.

LO 9 – Apply basic technological processes, methods of bionanotechnology in plant biotechnology, agriculture, biology. Possess skills in the field of technologies for obtaining nanomaterials and using them in practice. To systematize and analyze the achievements of cell biology. Analyze and market the production of secondary plant metabolites.

LO 10 – Classify the technological diversity of biotechnological target products (biomass, primary and secondary metabolites), methods of their separation and purification; the principle of operation of the main biotechnological equipment, the conditions of valid separation methods for obtaining various products. To draw conclusions about the latest achievements in the field of preparation of various biotechnological products and methods of separation and purification of target products.

2 General characteristics of the educational program Plant biotechnology is a new branch of science and production based on the use of cultured in vitro plant cells. Cultured plant cells, due to their ability to synthesize valuable secondary metabolites peculiar to this species, are used to create cellular technologies in order to obtain economically important substances industrially. The unique feature of cultured cells to regenerate an entire plant in vitro - totipotence - makes it possible to use them for clonal micro-propagation of plants, as well as for the production of virus-free planting material. Biotechnological methods of genetic improvement of plants are based on the production of regenerating plants, which facilitate and accelerate the breeding process. Cellular and genetic engineering open up completely new possibilities for expanding the genetic basis and creating fundamentally new forms of plants.

Taking into account the above, the educational program "Plant Biotechnology" has been developed in accordance with the National Qualifications Framework, professional standards of specialty 7M050 – Biological and Related Sciences, and is coordinated with the Dublin Descriptors and the European Qualifications Framework.

Stakeholders are: laboratories of research institutes and universities of biotechnological, biological, agricultural profile; manufacturing enterprises and laboratories of the processing, microbiological, pharmaceutical industries; agricultural enterprises; laboratories; zoological parks; agro-breeding stations; fish farming and animal breeding plants; universities, colleges; environmental services and organizations;

3 Competence model (portrait) graduate

3.1 Areas of professional activity of undergraduates of the educational program "Plant Biotechnology" in the specialty 7M051 – Biological and related sciences" is the use of cell and tissue cultures for clonal micro-reproduction and plant health improvement, experimental haploidy; the use of molecular and biochemical markers in plant breeding, genetic reconstruction of plants based on methods of cellular and genetic engineering of plants, industrial production of valuable biologically active substances and biological products of plant and microbial origin, immunobiotechnology for the creation of diagnostic and preventive means to combat plant diseases; pedagogical activities in secondary educational institutions. Production activities where methods of biotechnology and genetic engineering are used in plant breeding, methods of environmental

biotechnology, biotechnology of the food industry, practical activities related to laws and other legal acts on biosafety of the application of biotechnological methods in agriculture; pedagogical activities in secondary and higher educational institutions.

3.2 Types of professional activity include: the use of applied biotechnology as a modern stage of innovation in the economy of states; the achievements of the latest biotechnology is genetic transformation – the transfer of foreign (natural or artificial) donor genes into recipient cells of plants and microorganisms; selection from markers, genetic editing.The pace of development of applied biotechnology is determined by the general patterns of scientific research and the application of its results in production. Production and technological: practical application of biotechnology in agriculture; development and implementation of new technological processes; determination of components of raw materials and finished products; analysis and monitoring of the use and creation of biological products; increasing complex resistance to biotic and abiotic environmental stress factors of a natural, man-made and anthropogenic nature; creation of innovative and resource-saving competitive technologies; ensuring the sustainable development of the industry, doubling the gross production of agricultural products while improving its quality. Breeding: conservation of biodiversity of plant resources and expansion of the genetic basis of plants based on the use of modern methods of applied biotechnology; understanding the importance of the global plant gene pool for breeding; prospects for the use of biotechnological methods in plant protection to reduce the pesticide burden on the environment and improve the environmental situation. Experimental research: search for information about the state and prospects of breeding work, new methods of creating source material using biotechnology methods; analysis of data from field and laboratory experiments; planning and modification of the technology of the breeding process using biotechnology methods; present the results in the form of reports, case folders, scientific projects, publications and scientific discussions.

Graduates of the educational program "Plant Biotechnology" can work in research institutes and universities; manufacturing enterprises and laboratories of processing, microbiological, agricultural enterprises; botanical gardens, national parks; organizations and institutions for plant phytosanitary; breeding centers; can carry out biotechnological processes related to the production of biological products.

3.3 General education competencies have an idea of the role of science and education in public life; about current trends in the development of scientific knowledge; about current methodological and philosophical problems of natural sciences; possess the necessary knowledge in the field of pedagogy and psychology; apply interactive teaching methods; think creatively and creatively approach new problems and situations; be fluent in foreign language language at a professional level; have the skills to carry out educational and pedagogical activities on credit technology of education.

3.4 Basic competencies to be able to use the acquired knowledge for the original development and application of ideas in the context of scientific research, critically analyze existing concepts; integrate knowledge gained in the framework of studying basic disciplines to solve research problems; carry out information-analytical and information-bibliographic work involving modern information technologies; think creatively and creatively approach solving new problems and situations; to summarize the results of research and analytical work in the form of a scientific article, report, analytical note, etc.; to have skills in specialized activities, solving standard tasks; to be competent in the field of research methodology; in the field of research activities in universities; in issues of modern educational technologies; in carrying out research in the professional field.

As a result of mastering the basic disciplines, the student must know the organization of a biotechnological laboratory, the principles and methods of microclonal reproduction of plants; be able to prepare sterile nutrient media, have an idea about the cultivation of plant material "in vitro"; have the skills to work on the equipment of a sterile biotechnological laboratory.

3.5 Professional competencies understanding of modern problems of biology and the application of fundamental biological knowledge in the field of plant biotechnology for setting and solving new tasks; the ability to correctly perform field and laboratory biological research in solving specific tasks in agricultural biotechnology using modern equipment and computing tools. Understanding and creative use in scientific and industrial and technological activities of knowledge of fundamental and applied sections of biotechnology: molecular genetics, genetic engineering of agricultural plants and microorganisms, genomic and cellular technologies, clonal micro-reproduction, cellular plant breeding; possession of modern methods in breeding and crop production, processing industry and other areas of agriculture; knowledge of scientific and the legal basis for ensuring biosafety in biotechnology and the use of genetically modified organisms (GMOs).

4 The base of professional practices

Pedagogical practice
1.Department of Microbiology and Biotechnology
2. Universities and colleges of the biological field
Research practice
1. Scientific and production platform of agricultural biotechnology";
2. Accredited "Jointly Kazakh-Chinese Laboratory for Biological Safety";
3. Republican Collection of Microorganisms LLP;
4. National Center of Biotechnology LLP;
5. "Scientific Research Institute of Biological Safety Problems in Otar;
6. District and regional breeding stations;
7. National Laboratory Astana
8. Kazakh Research Institute of Agricultural Products Processing
9.LLP "Scientific and production center of grain farming named after A.I. Baraev"
10. RSE REM "Kazakh Scientific Center for Quarantine and zoonotic infections named after M.Aikimbaev, Almaty
11. Organizations of agrochemical service of plants
12. Laboratories for assessing the quality of plant seeds
13. Phytosanitary services
14. Environmental services
12. Botanical Garden
13. Institute of Plant Biology and Biotechnology

5 The structure of the Master's degree program in the scientific and pedagogical direction

№ п/п	The name of the cycles of disciplines and activities	Total labor intensity	
		in academic hours	in academic credits
1	2	3	4
1.	**Theoretical training**	**2640**	88
1.1	**Cycle of basic disciplines (CBD)**	**1050**	**35**
1)	**University component (UC):**	600	20
	including:		
	History and philosophy of science	150	5
	Foreign language (professional)	150	5
	Pedagogy of higher education	90	3
	Management Psychology	150	5
	Teaching practice	60	2
2)	**Elective Component (EC)**	450	15
	English for Academic purposes/Academic Writing	150	5
	Molecular genetic foundations of biotechnology/ Biotechnology of mushrooms	150	5
	Theory and methods of experiment/ Scientific processing of research materials	150	5
1.2	**Cycle of core disciplines (CCD)**	**1590**	**53**
1)	**University component (UC)**	***1410***	
	Plant immunity	150	5
	Theoretical foundations and applied aspects of plant cell and tissue culture Theoretical foundations and applied aspects of plant cell and tissue culture	210	7
	Selection of industrial strains of microorganisms	180	6
	Biotechnology and marketing of the production of secondary plant metabolites	150	5
	Bionanotechnology	210	7
	Scientific foundations of plant breeding	150	5
	Research practice	360	12
2)	**Component of choice (CCH)**	**180**	**10**
	Bioethics and biosafety in biotechnology /Modern methods of separation and purification of target products	180	6

2	Research work of a graduate student	**720**	**24**
1)	Research work of a graduate student, including internship and completion of a master's thesis (RWGS)	720	24
3	Additional types of training (ATT)		
4	Final attestation (FA)	**240**	**8**
1)	Preparation and defense of a master's thesis (PDMTH)	240	8
	Total	**3600**	**120**

WORKING CURRICULUM
for 2024-2026 academic year
For the modular education program "Plant biotechnology"
by the speciality/group of educational programmes M082 – Biotechnology
Degree: Master's program by specialization (Scientific & pedagogical direction)
Form of education: Full-time (MS 2 years) semester
Entry year: 01-09-2024

Module code	Module name	Discipline	Discipline	Code of subject	Subject name	Academic credits	Control in the academic period					Volume of hours							Distribution of credits per			
														including					1 course		2 course	
							Exams	Differentiated test(practice)	Differentiated test(course paper)	Practice/ SRW	Term paper/ project	Total	In-class learning	Lectures	Practice	Lab practicals	MSI WT	MSI W	1	2	3	4
																			Number of weeks in the			
																			15	15	15	15
General modules																						
1	Social Sciences	BS	UC	IFN 5203	History and philosophy of science	5	1					150.0	45.0	15	30	0	20	85	5.0			
2		BS	UC	PVSH 5204	Pedagogics of higher school	3	2					90.0	30.0	15	15	0	12	48		3.0		
3		BS	UC	PU 5205	Psychology of management	5	2					150.0	45.0	15	30	0	20	85		5.0		
4		BS	UC	PP 6208	Pedagogical training	2				60		60.0		0	0	0	0	0				2.0
5	Professional foreig	BS	UC	IYaP 5202	Foreign language (professional).	5	1					150.0	45.0	0	45	0	20	85	5.0			
6		BS	UC	AYaDAC	English for Academic Purposes	5	1					150.0	45.0	0	45	0	20	85	5.0			
7		BS	UC	AP 5201	Academic writing		1						45.0	0	45	0	20	85				
Modules of specialty/education programm																						
8	Innovative techno	AS	UC	Bio 6303	Bionanotechnology	7	3					210.0	75.0	30	45	0	28	107			7.0	
9		AS	UE	SMROCP	Modern methods of division and purification of target	6	3					180.0	60.0	30	30	0	24	96			6.0	
10		AS	US	BBB 6309	Bioethics and biosafety in biotechnolog		3						60.0	30	30	0	24	96				
11	Biotechnology Research	AS	UC	IR 5301	Plant immunity	5	1					150.0	45.0	15	0	30	20	85	5.0			
12		AS	UC	SPSRM 5302	Selection of industrial stamme of microorganisms	6	2					180.0	60.0	30	0	30	24	96		6.0		
13		AS	UC	IP 5307	Research practice	6				180		180.0		0	0	0	0	0		6.0		
14		AS	UC	BMPVMR	Biotechnology and marketing of the production of	5	3					150.0	45.0	15	30	0	20	85			5.0	
15		AS	UC	IP 6310	Research practice	6				180		180.0		0	0	0	0	0			6.0	
16		AS	UC	TOPAKKTR	Theoretical basics and applied aspects of cell culture	7	4					210.0	75.0	30	45	0	28	107				7.0
17		AS	UC	NOSR 6304	Scientific basis of plant breeding	5	4					150.0	45.0	15	30	0	20	85				5.0
18		BS	UE	BG 5206	Biotechnology of mushrooms	5	2					150.0	45.0	15	30	0	20	85		5.0		
19		BS	US	MGOB 5206	Molecular genetic basics of biotechnology		2						45.0	15	30	0	20	85				
20		BS	UE	NOMI 5207	Fundamentals of scientific research	5	1					150.0	45.0	15	30	0	20	85	5.0			
21		BS	US	TME 5207	Theory and Methods experiment		1						45.0	15	30	0	20	85				
Scientifically research																						
22	Research work	RC	UC	NIRMVVM	Master student's research work, including	5				150		150.0		0	0	0	0	0	5.0			
23		RC	UC	NIRMVVM	Master student's research work, including	5				150		150.0		0	0	0	0	0		5.0		
24		RC	UC	NIRMVVM	Master student's research work, including	6				180		180.0		0	0	0	0	0			6.0	
25		RC	UC	NIRMVVM	Master student's research work, including	8				240		240.0		0	0	0	0	0				8.0
1	**General education subjects(GER)**					**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Core subjects(GER/CS)					0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	University component(GER/UC)					0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Electives(GER/ES)					0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	**Base requirements(BS)**					**35**		**0**	**0**	**60**	**0**	**1050**	**300**	**75**	**225**	**0**	**132**	**558**	**20**	**13**	**0**	**2**
	Core subjects(BS/CS)					0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	University component(BS/UC)					20		0	0	60	0	600	165	45	120	0	72	303	10	8	0	2
	Electives(BS/ES)					15		0	0	0	0	450	135	30	105	0	60	255	10	5	0	0
3	**Profession requirements(VRS)**					**53**		**0**	**0**	**360**	**0**	**1590**	**405**	**165**	**180**	**60**	**164**	**661**	**5**	**12**	**24**	**12**
	Core subjects(VRS/CS)					0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	University component(VRS/UC)					47		0	0	360	0	1410	345	135	150	60	140	565	5	12	18	12
	Electives(VRS/ES)					6		0	0	0	0	180	60	30	30	0	24	96	0	0	6	0
Total of theoretical course						112	14	0	0	1140	0	3360	705	240	405	60	296	1219	30.0	30.0	30.0	22.0
AC	**Additional courses**												0									
FA	**Final attestation**					8							240.0									
	Master dissertation defence					8				4			240									
	Total					120				1144		3600	705	240	405	60	296	1219				

Appendix 1 to the Academic Calendar
Approved by the Scientific Council of the NAO "KATRU named after S.Seifullin", Protocol No. 12 of 28.03.2024

The schedule of the educational process for the 2024-2025 academic year for the Master's degree programs of the Faculty of Veterinary Medicine and Animal Husbandry Technology

2024-2025 academic year

| Course | August | September | | | | | October | | | | | November | | | | | December | | | | | January | | | | | February | | | | | March | | | | | April | | | | | May | | | | | June | | | | | July | | | | | August | | | | |
|---|---|---

The relationship between the achievability of the formed achievability of the formed learning outcomes according to the educational program with the help of academic disciplines

№	Name of the discipline	A brief description of the discipline (30-50 words)	Number of credits	Generated learning outcomes (codes)									
				LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10
The cycle of basic disciplines The university component													
1	History and philosophy of science	Forms the skills of a methodological and dialectical approach to research, generalizes philosophical knowledge, studies the issues of historical development, its structure, analyzes the patterns and trends of scientific knowledge, systematizes the effectiveness of research work.	5		V								
2	Foreign language (professional)	It forms foreign language communicative competence as an important component of professional competence and the culture of scientific writing among students, which allows them to integrate into international scientific activities, allows them to freely operate the scientific and conceptual apparatus in their specialty, expand the scientific and information base, acquire broad scientific knowledge, identify promising areas of professional and scientific activity.	5	V									
3	Higher school pedagogy	It allows undergraduates studying in the scientific and pedagogical field to understand common problems, methodological and theoretical foundations of higher school pedagogy, skills in the analysis of teaching and upbringing, elements of modern planning and organization technologies.	3			V							
4	Management Psychology	Forms the skills of managing organized activities of people through the study of psychological laws and patterns of management and quality of work, forms the ability to make scientifically sound decisions, structure the actions of other people, manage the organization.	5	V									

The cycle of basic disciplines Component of choice													
6	English for academic purposes Academic Writing	***English for academic purposes:*** Comprehensive theoretical and linguistic, practical and information-analytical training in order to perform functions related to the use of a foreign language in professional and scientific activities: proficiency in public speaking, conducting discussions, the ability to work with information from various sources, edit texts of professionally significant content in a foreign language. ***Academic writing.*** The course is aimed at developing and improving academic skills in the field of written English, necessary for successful written communication in an academic, professional and work environment. Students get acquainted with the peculiarities of academic writing, using library catalogs and websites. The practice of writing a discursive essay: outline, main idea, paragraphs and conclusion. Methods of paraphrasing. APA format: links and citations. Students study the types of abbreviations, academic vocabulary, and the use of articles.	5	V									
7	Biotechnology of mushrooms Molecular genetic foundations of biotechnology	***Biotechnology of fungi.*** Microscopic lower and higher fungi. Morphological features of the structure and methods of reproduction of fungi, yeast. Primary and secondary metabolites of fungi, their significance and biotechnologies. Methodology for the search and production of mushroom producing strains, storage of mushroom cultures. Principles of industrial cultivation of molds, yeasts, basidiomycetes. Biosynthesis of antibiotics by mold fungi. Feed antibiotics. Biosynthesis of vitamins, organic acids and solvents, enzymes. ***Molecular genetic foundations of biotechnology .*** Application of knowledge and methods of molecular biology and genetics in scientific research; Hereditary information, composition, structure, functions and patterns of chromosomes, genes and genomes. Obtaining new varieties and improving the existing qualities of	5					V	V				

		agricultural plants. Recombinant DNA based on methods of molecular biology and genetics. Biological systems used in biotechnology, their features. Chimeric proteins and protein stabilization. DNA synthesis and sequencing methods											
	Theory and methods of experiment Scientific processing of research materials	***Theory and methods of experiment.*** Develops the skills of organizing and conducting a scientific experiment, studies the problems of monitoring and methodological approach to substantiating the choice of research methods. Integrates theoretical and practical knowledge in the formulation of scientific experience, with the justification of the obtained results of research work and interpret them. Scientific processing of research materials. ***When studying the discipline, students master the stages of conducting research, including choosing the direction of research,*** setting a scientific and technical problem, conducting theoretical and experimental research in animal husbandry. Undergraduates acquire the skills to search, accumulate and process scientific information, as well as learn how to conduct, process and formalize the results of experimental research. They master the methodological foundations of scientific research.	5				V						V
		The cycle of core disciplines The university component											
8	Plant immunity	The course of the discipline examines the general patterns and classification of plant immunity; concepts of immunity, resistance, tolerance, resistance and its types; characteristics of the manifestation of plant immunity to diseases; theory of immunogenesis, specialization, and variability of pathogens; types of parasitism; types of specialization of pathogens; artificial immunity and methods of increasing disease resistance; methods for assessing plant resistance to diseases; general principles of plant infection; basic methods of accelerated diagnosis of plant resistance.	5						V				
9	Theoretical	The main directions of cell biology, the main mechanisms of	7							V			

	foundations and applied aspects of plant cell and tissue culture	synthesis of secondary metabolites of plants. Epigenetic variability. Distinctive features of cell growth, division and reproduction in in vitro conditions. Fundamentals of signaling and reaction of the cell response and the organism level of plants. The tasks of genetic engineering in the field of creating recombinant DNA molecules to create superproducts.Modes of cell cultivation by industrial and semi-industrial methods. Regulation modes and active synthesis. Turbidostat and chemostat.												
10	Selection of industrial strains of microorganisms	The influence of various adverse factors on microorganisms. morphology, physiology and genetics of microorganisms. The possibilities of using mutagens to produce superproducts. Classical and modern methods of microbial breeding, methods of storing producer strains in a production laboratory and a collection of microorganisms. Identification of microorganisms by cultural-morphological, biochemical, molecular-genetic methods. Production of production cultures of microorganisms.	6								V			
11	Biotechnology and marketing of the production of secondary plant metabolites	The importance of industrial biotechnology for pharmaceuticals and agriculture. Analysis of modern biotechnology and marketing of secondary plant metabolites production. Mastering the methods of isolation of plasmid and nuclear DNA; Determination of the volume and quality of nucleic acids by spectrometry. The performance of laboratory and research work and the skill of working with scientific articles in the field of marketing substances of secondary synthesis of plant cells.	5							V				
	Bionanotechnology	Introduction to nanotechnology, the use of nanotechnology to study living objects, biocompatible nanomaterials, principles of nanobiotechnology, targeted delivery of medicines and physiologically active substances, principles of creating tissue implants based on materials with high biocompatibility. The use of modern computer technology for the analysis and systematization of the results obtained.	7										V	
	Scientific foundations of plant breeding	Fundamentals of plant breeding. The study of the organization and technique of the plant breeding process; the study of the theoretical foundations of seed production; the organization of	5										V	

		seed production and technologies for the production of high-quality seeds, the concept of the variety and its importance in agricultural production;												
		The cycle of core disciplines Component of choice												
12	Bioethics and biosafety in biotechnology	Bioethics and biosafety in biotechnology. The place and role of bioethics in the system of applied ethical knowledge. The impact of different types of GMOs on ecological systems.. Assessment of the environmental risk of using GMOs. Assessment of the aggressiveness of weed plants. Assessment of the probability of the occurrence of direct or indirect effects of transgene products on organisms. The appearance of living organisms resistant or tolerant to transgenic products. International organizations and legal regulation of bioethical problems in connection with the development of biotechnologies	6				V							V
	Modern methods of separation and purification of target products	Modern methods of separation and purification of target products. The concept of a target product in biotechnology. Equipment, consumables and reagents for the isolation and purification of biomass of microorganisms, cells and tissues of plants and animals, cellular macromolecules in the production of biotechnological products by various methods. General principles of separation of substances using: centrifugation, membrane filtration, separation, settling, extraction, coagulation, crystallization, flotation, chromatography, electrophoresis, immunoblotting and other methods..												

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