

Appendix 15. Modular Reference Guide for the Degree Program “Biotechnology”
MASTER'S PROGRAM

M 1. History and Philosophy of Science	2
M 2. Foreign Language (Professional)	3
M 3. Management Psychology	3
M 4. Pedagogy and Psychology of Higher Education	4
M 5. Genetic Engineering and Society	5
M 6 Teaching Practice	6
M7 Research Practice	7
M8.1 Modern Methods in Biotechnology	8
M 8.2 Photobiological Processes and Bioenergetics	9
M9.1 Principles of Waste Management in Biotechnological Production	10
M9.2 Environmental Management of Biotechnological Production	11
M11.1 Equipment of Biotechnological Production Enterprises	12
M 11.2 Equipment for Biotechnological Processes	13
M 12.1 Contemporary Issues in Sectoral Biotechnology	14
M 12.2 Achievements and Prospects of Biotechnology	15
M 16.1 Biotechnology of Biomass Production and Processing	16
M 16.2 Advanced Course in Genetic Engineering	17
M17. 1 Cellular and tissue Biotechnology in agro-industry complex (AIC)	18
M17.2 Kinetics of biochemical processes	19
M13.1 Molecular-genetic research in Biotechnology	20
M13.2 Industrial microbiology	21
M.14.1 Fundamentals of Research Work	23
M14.2 Ensuring genetic safety of biotechnological production	24
M18.1 Ecobiosafety in the agro-industrial and industrial zone	25
M18.2 Environmental aspects of biotechnological processes	26
M.19.1 Technology of the production and storage of biotechnological products	27
M19.2 Achievements of genetic engineering in the agro-industrial complex	28
M20.1 Business in the Field of Biotechnology	29
M20.2 Creation of a production business plan of biotechnological products	31
M 10, M15, M21 Research work of a master's student, including an internship and the completion of a master's thesis	32
M 22. Preparation and Defense of a Master's Thesis	32
1. QMS SKU P 7.38-2024 REGULATIONS ON THE MASTER'S THESIS (PROJECT)	33
Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.	33

Module Title	M 1. History and Philosophy of Science
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD in philosophy, associate professor Spanov M.Zh.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, university component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 30 hours; practical classes – 15 hours; independent work of learners (current) – 60 hours; supervised independent work (midterm) – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor's degree courses M 15 Philosophy
Module Aims and Intended Learning Outcomes	After completing this module, master's student is able to: - analyze key worldview, methodological, and interdisciplinary problems of modern science; - critically evaluate scientific approaches, theories, and paradigms; - apply the categories and principles of the philosophy of science in assessing scientific facts, phenomena, and processes; - formulate and solve tasks arising in the course of research work that require advanced professional knowledge; - analyze and interpret contemporary theory and practice based on socio-humanitarian and natural science methodologies.
Indicative Content	Lectures: History and philosophy of natural and technical sciences; modern European science; science in culture and civilization; the emergence of science, its historical dynamics, and the structure of scientific knowledge; philosophical problems of specific sciences; 21st-century communicative technologies and their role in modern science; philosophical issues in the development of contemporary global civilization; current methodological, philosophical, and social-scientific problems of natural and social sciences, as well as specialized scientific fields in accordance with students' specialization. Practical classes: Subject matter of history and philosophy of science; worldview foundations of science; functions of the philosophy of science; emergence and establishment of science; modern European science; key concepts and directions of non-classical and post-non-classical stages of scientific development; structural levels of scientific knowledge; science as a profession; philosophical foundations of science and the scientific worldview; scientific traditions and revolutions; history and philosophy of natural and technical sciences; history and philosophy of social and human sciences; philosophical problems of the development of modern global civilization.
Forms of Assessment / Examination	Current assessment: preparation of summaries and annotations of scientific articles and monographs, analysis of philosophical dilemmas and ethical issues in scientific knowledge Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. M.Sh. Khasanov, V.F. Petrova. <i>History and Philosophy of Science</i> . Almaty, 2011. 97 p. 2. A.V. Vidershpan. <i>History and Philosophy of Science: Textbook</i> . Kostanay: Kostanay Academy of the Ministry of Internal Affairs of the Republic of Kazakhstan named after Sh. Kabyldaev, 2016. 165 p. 3. E.V. Ushakov. <i>Introduction to Philosophy and Methodology of Science: Textbook</i> . Moscow: Exam Publishing, 2005. 528 p. 4. D. McKaughan, H. VandeWall. <i>The History and Philosophy of Science: A Reader Illustrated Edition</i> . 2018. ISBN 1474232728. 1104 p. 5. M. Heidelberger, F. Stadler. <i>History of Philosophy of Science</i> . 2002. ISBN 978-1-4020-0509-1. 442 p.

Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.
Module Title	M 2. Foreign Language (Professional)
Semester(s) in which the module is taught	1th semester
Module Leader / Coordinator	PhD, associate professor Zhorabekova A.N.
Language of Instruction	English
Relation to the Programme / Curriculum Placement	Basic discipline, university component
Teaching and Learning Methods	Practical classes
Workload (including contact hours and independent study)	Total Workload: 120 hours: practical classes – 45 hours; independent work of learners (current) – 60 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level courses: M 4 Foreign Language 1, M 9 Foreign Language 2, M 20 Professionally-Oriented Foreign Language
Module Aims and Intended Learning Outcomes	After completing this module, master’s student is able to: -use a foreign language in oral and written form for interpersonal and professional communication, including the preparation and writing of scientific texts such as articles, abstracts, and presentations; -understand and interpret specialized literature within their field; -comprehend and interpret spoken professional content (lectures, reports, TV and online programs); -read and translate original professional literature with subsequent analysis; -participate in professional discussions, scientific debates, and round-table conversations; -present scientific research or articles in a foreign language; -utilize lexicographical resources in a foreign language.
Indicative Content	Practical classes: Reading: Developing reading skills through different types of reading (skimming, scanning, intensive, and extensive) of original foreign-language sources with varying levels of content coverage. Writing: Scientific reports, research abstracts, poster presentations, summarizing original foreign-language sources, annotating scientific texts, preparing resumes; fundamentals of business writing and documentation for international scientific collaboration. Listening: Listening to authentic professional materials delivered by native speakers in audio and video formats. Speaking: Delivering scientific reports, presentations, and oral research communications.
Forms of Assessment / Examination	Current assessment: dialogues, round tables, debates. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. L. Soars. <i>New Headway Advanced Student’s Book</i> . Oxford University Press, 2003. 2. L. Soars. <i>New Headway Upper-Intermediate Student’s Book</i> . Oxford University Press, 2003. 3. L.G. Galaganova. <i>English for Master’s Students: Textbook</i> . Kemerovo: KemGU, 2017. 288 p. ISBN 978-5-8353-2114-8. 4. R.S. Rashitova. <i>Collection of Lexical and Grammar Tests in English for Master’s Students: Collection</i> . Ufa: BSPU named after M. Akmulla, 2015. 184 p. 5. <i>McDougal Littell. Writing Research Papers</i> . Longman, 2010.
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 3. Management Psychology
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Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD, associate professor Sakhieva F. A.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total Workload: 120 hours: lectures – 30 hours; practical classes – 15 hours; independent work of learners (current) – 50 hours; independent work of learners (midterm) – 10 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level course M17 Cultural Studies and Psychology
Module Aims and Intended Learning Outcomes	After completing this module, master's student is able to: -observe and identify individual personality traits; -analyze various management situations effectively; -manage group and interpersonal processes, including their own behavior and the behavior of others; -select optimal leadership styles considering changes in the external environment; -choose appropriate motivation methods according to individual psychological characteristics; -make informed decisions; -create a favorable socio-psychological climate; -build effective approaches to employees.
Indicative Content	Lectures: Evolution of management thought; systematic perspectives on management; approaches to management; personality as an object of management; management schools; classical/administrative school and Henri Fayol's management principles; development of behavioral sciences; management science; communication; organization as an open system; classification of management models; Japanese management model. Practical classes: Functions of the management process: organization, motivation, control, linking processes; managerial communication; the role of communication in organizational management; motivation of individual behavior in organizations; conflict in organizations; comparative analysis of Japanese and American management models; socio-psychological foundations of managerial decision-making; issues of group efficiency.
Forms of Assessment / Examination	Current assessment: conflict resolution exercises, SWOT analysis, role-playing. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Akimova, Y.N. <i>Management Psychology: Textbook and Practical Guide for Universities, 2nd ed., revised and expanded</i> . Moscow: Yurayt, 2025. 364 p. ISBN 978-5-534-18847-9. 2. Ivanova, V.S. <i>Management Psychology: Textbook</i> . Tomsk: Tomsk Polytechnic University, 2011. 88 p. 3. Alieva, M.B., Magomedova, E.E., Rajabova, R.V., Umarieva, S.Z., Tsakhaeva, A.A. <i>Management Psychology</i> . Kyiv: Financial Rada Ukraine LLC, 2017. 146 p. 4. Gilbreth, L. <i>The Psychology of Management</i> . ISBN 1720347158. 2018. 254 p. 5. Fisher, J. <i>The Psychology of Management & How to Talk to Anyone</i> . ISBN 9881595711. 2025. 782 p.
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 4. Pedagogy and Psychology of Higher Education
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Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD in pedagogical sciences, associate professor Suleimenova A.A.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total Workload: 120 hours: lectures – 30 hours; practical classes – 15 hours; independent work of learners (current) – 50 hours; independent work of learners (midterm) – 10 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level course M17 Cultural Studies and Psychology
Module Aims and Intended Learning Outcomes	After completing this module, master's student is able to: -solve specific psycho-pedagogical tasks; -adapt to various changes and predict the development of situations; -create optimal conditions for the development of stable personal qualities within a holistic pedagogical process; -conduct research and exploratory work.
Indicative Content	Lectures: Pedagogy within the system of sciences; defining educational goals; model of a specialist's personality; competency-based approach in education; essence and structure of educational content; normative documents regulating educational content; principles and patterns of the learning process; teaching methods; pedagogical technologies; theory of education; psychology of higher education; psychological analysis of student activity; motivation of learning and cognitive activity; features of student personality development; adaptation of first-year students to university conditions. Practical classes: Role of higher education pedagogy within the system of sciences; competency-based approach; factors shaping higher professional education content; information and computer technologies in learning; types and significance of learning assessment; education as socialization; activities and cognitive processes; factors influencing students' learning success; adaptation issues of first-year students; socio-psychological characteristics of student groups; psychodiagnostic methods; personality testing; psycho-pedagogical competence of higher education teachers.
Forms of Assessment / Examination	Current assessment: role-playing games, brainstorming, business games. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Sharipov, F.V. <i>Pedagogy and Psychology of Higher Education: Textbook</i> . Moscow: Logos, 2012. 448 p. ISBN 978-5-98704-587-9 2. Bulanova, M.V. <i>Pedagogy and Psychology of Higher Education</i> . Rostov-on-Don: Phoenix, 2012. 544 p. 3. Grigorovich, L.A., Marcinkovskaya, T.D. <i>Pedagogy and Psychology: Textbook for Universities</i> . Moscow: Gardariki, 2009. 475 p. 4. Okhremenko, I.V. <i>Psychology and Pedagogy of Higher Education: Textbook for Bachelor's and Master's Programs</i> . Moscow: Yurayt, 2024. 175 p. 5. Shershneva, T.V. <i>Pedagogy and Psychology of Higher Education</i> . Minsk: BNTU, 2023. 266 p. ISBN 9789855839331
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 5. Genetic Engineering and Society
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD, associate professor Yermekbaeva Akbope Tontaevna
Language of Instruction	Kazakh, Russian

Relation to the Programme / Curriculum Placement	Major course, university component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total Workload 150 hours: lectures – 30 hours; practical classes – 30 hours; independent work of learners – 45 hours; independent work of students – 12.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level courses: M27.1 Applied Genetics or M27.2 Genetic Monitoring of Natural Populations
Module Aims and Intended Learning Outcomes	After completing this module, master's student is able to: - explain the main methods and directions of genetic engineering; - analyze benefits, risks, and ethical aspects of genetically modified organisms (GMOs); - evaluate the impact of genetic engineering on humans and the environment; - understand legal and social frameworks regulating biotechnology; - argue and defend positions on genetic engineering issues.
Indicative Content	Lectures: Key methods and technologies of genetic engineering: DNA recombination, cloning, genome editing (CRISPR/Cas9); genetically modified organisms: benefits, risks, and bioethical aspects; legal regulation and public perception of genetic engineering; applications of genetic engineering in medicine, agriculture, and ecology; current achievements and future prospects in Kazakhstan and worldwide. Practical classes: Study of human genome structure; analysis of structural and functional roles of transposons; biochemical basis of genetic engineering methods – enzymes; strategies for gene cloning in prokaryotes and eukaryotes, including chemical-enzymatic synthesis of genes and enzymatic synthesis of complex genes; plasmid function analysis; work with vectors (plasmids, phage vectors, artificial constructs such as cosmids, phasmids, shuttle vectors); clone libraries; discussion of cloning applications in yeast, plants, animals, and humans.
Forms of Assessment / Examination	Current assessment: case studies, group discussions and projects, colloquia, written control tasks. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Rodriguez, F., Li, Z., Yang, Y. <i>Genetic Engineering in Biotechnology: Techniques and Applications</i> . 1st ed. Heidelberg: Springer, 2022. 350 p. 2. Zhang, Y., Liu, J., Wang, L. <i>Applications of Molecular Genetics in Biotechnological Research</i> . 3rd ed. Amsterdam: Wiley-VCH, 2024. 330 p. 3. Smith, J., Brown, R., Williams, D. <i>Molecular Genetics in Biotechnology: Recent Advances and Applications</i> . 1st ed. New York: Springer, 2023. 380 p. 4. Johnson, M., Patel, S., Turner, E. <i>Advances in Molecular Genetics for Biotechnology</i> . 2nd ed. London: Elsevier, 2021. 400 p. 5. Müller, T., Keller, C., Reiter, W. <i>Molecular Techniques in Biotechnology: From Theory to Practice</i> . 1st ed. Berlin: De Gruyter, 2020. 375 p.
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 6 Teaching Practice
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Alpamysova G.B.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, university component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total Workload: 120 hours
Number of Credits (ECTS)	4 ECTS

Prerequisites and Recommended Prior Knowledge	Methodology of Teaching Specialized Disciplines, Higher Education Pedagogy
Module Aims and Intended Learning Outcomes	After completing this module, master's students are able to: -plan and conduct lessons in specialized biotechnology disciplines; -teaching materials and assessment tools; -apply modern and active teaching methods in the educational process; -analyze and improve their own pedagogical activity; -demonstrate the culture of scientific-pedagogical thinking and professional teaching skills.
Indicative Content	Development of professional-pedagogical culture and creative potential in biotechnology; formation of skills to plan and conduct lessons in specialized disciplines; development of teaching materials and assessment tools; preparation and conduct of practical and laboratory classes in biotechnology; application of active and innovative teaching methods; cultivation of scientific-pedagogical thinking and teaching mastery.
Forms of Assessment / Examination	Final assessment – pass-fail grading test
Learning and Examination Requirements	-
Reading List (Essential and Recommended Literature)	1. Teaching Practice Experience for Undergraduate Student Teachers: A Case Study of the Department of Education at Sokoine University of Agriculture, Tanzania https://files.eric.ed.gov/fulltext/EJ1103037.pdf 2. Teaching practice: A handbook for student teachers https://www.researchgate.net/publication/320290363_Teaching_practice_A_handbook_for_student_teachers 3. Teaching practice https://www.ucn.dk/media/zeyh4efh/level-1-teaching-practice.pdf
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M7 Research Practice
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	Doctor in chemistry, professor Kedelbayev B.Sh. Doctor of agricultural sciences, professor Alibaev N.N. PhD in agricultural sciences, associate professor Alpamysova G.B.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Practical works
Workload (including contact hours and independent study)	Total Workload: 180 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M6 Teaching Practice
Module Aims and Intended Learning Outcomes	After completing this module, master's students are able to: -apply modern theoretical and methodological approaches to conducting scientific research; -analyze the current state and trends in ecology and biotechnology in Kazakhstan and abroad; -use modern technologies and methods for experimental research; -conduct theoretical and practical studies related to their dissertation topic; -process, interpret, and present scientific experiment results in the form of reports, articles, and presentations.
Indicative Content	Practical study of the latest theoretical, methodological, and technological achievements in domestic and international science in the field of environmental protection; modern methodology of scientific research; analysis of the state and development trends in ecology and science in

	Kazakhstan and globally; technologies for fractionation of petroleum feedstock by different boiling point intervals; modern trends in low-waste and zero-waste production; conducting theoretical and experimental research related to the dissertation topic.
Forms of Assessment / Examination	Final assessment: pass-fail grading test
Learning and Examination Requirements	
Reading List (Essential and Recommended Literature)	1. SMK YKU P 7.05-2024. Rules for Organization and Conduct of Professional Practice of Students and Determination of Organizations as Practice Bases, M. Auezov South Kazakhstan University.
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M8.1 Modern Methods in Biotechnology
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	Elemanova Zhanar Rahmanberdievna
Language of Instruction	Kazakh
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total Workload 120 hours: lectures – 15 hours; laboratory classes – 15 hours; independent work of learners (current) – 50 hours; independent work of learners (midterm) – 10 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level courses: M31.1 Cell Biotechnology or M31.2 Technology of Culturing Plant Cells and Tissues
Module Aims and Intended Learning Outcomes	After completing this module, master’s students are able to: -apply modern methods of molecular biotechnology to solve research problems. -isolate, purify, and analyze nucleic acids and proteins using contemporary instrumental techniques. -use recombinant DNA technologies and genome editing (CRISPR/Cas). -apply PCR methods and bioinformatics analysis to study gene expression. -cultivate microorganisms and analyze biosynthesis products. -interpret experimental results and present them in scientific format
Indicative Content	Lectures: The course covers modern methods of molecular biotechnology; techniques for isolation, purification, and analysis of nucleic acids and proteins; principles of recombinant DNA technology and genome editing using the CRISPR/Cas system. It also includes methods for analyzing gene expression, the application of bioinformatics in processing genetic data, as well as current trends — synthetic biology and nanobiotechnology. Laboratory classes: Students master practical techniques for DNA and protein isolation and analysis, perform polymerase chain reaction (PCR) and electrophoresis, work with plasmid vectors for gene cloning, conduct bioinformatics analysis of sequences, and study the basics of microorganism cultivation and analysis of biosynthesis products.
Forms of Assessment / Examination	Current assessment: successful completion of laboratory work; colloquia; written tests; written and oral questioning. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Lisa A. Seidman <i>Basic Laboratory Methods for Biotechnology</i> : Textbook and Laboratory Reference (3rd ed., 2022) 2. Muhammad Sarwar Khan, Iqar Ahmad Khan, Debmalya Barh. <i>Applied Molecular Biotechnology: The Next Generation of Genetic Engineering</i> (1st ed., 2016) 3. Dongyou Liu. <i>Handbook of Molecular Biotechnology</i> (1st ed., 2024)

	https://www.youtube.com/watch?v=CDw4WPng2iE
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 8.2 Photobiological Processes and Bioenergetics
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Zhanar Rakhmanberdiyevna Elemanova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total Workload 120 hours: lectures – 30 hours; current independent work of learners – 50 hours; midterm independent work of learners – 10 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level courses: M31.1 Cell Biotechnology or M31.2 Technology of Culturing Plant Cells and Tissues
Module Aims and Intended Learning Outcomes	After completing this module, master’s students are able to: -explain the molecular foundations of photobiological and bioenergetic processes in living organisms -analyse the functioning of photosystems and mechanisms of light-to-chemical energy conversion -determine the content of photosynthetic pigments and evaluate photosynthetic efficiency -investigate cellular bioenergetic processes, including respiration and oxidative phosphorylation -apply experimental methods to study photosynthetic and energetic systems -assess the potential applications of photobiological processes in biotechnology and energy production
Indicative Content	Lectures: Fundamentals of photobiology and the nature of light as an energy source for living systems. Molecular mechanisms of photosynthesis in plants, algae, and cyanobacteria. Photosystems I and II, electron transport and ATP formation. Roles of chlorophyll and accessory pigments. Photorespiration, light-dependent and light-independent reactions. Photobiological processes in microorganisms: bacteriorhodopsin and phototrophic bacteria. Cellular bioenergetics: mitochondrial respiratory cycle and oxidative phosphorylation. Modern research and biotechnological applications of photosynthetic systems (biofuels, biophotonic technologies, artificial photosynthesis). Laboratory classes: Determination of chlorophyll and carotenoid content in plant tissues. Study of light-dependent reactions using spectrophotometry. Analysis of photosystem I and II activity in plants and algae. Measurement of photosynthesis rates under different light intensities. Investigation of mitochondrial respiratory activity in plant cells. Observation of phototrophic microorganisms and determination of pigment composition. Experimental modelling of bioenergetic processes and discussion of biotechnological applications
Forms of Assessment / Examination	Current assessment: successful completion of laboratory work; colloquia; written tests; written and oral examinations. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Barber, J., Ruban, A.V. <i>Photosynthesis and Bioenergetics</i> . World Scientific Publishing Co., Singapore, 2018. ISBN: 9789813230293. 2. Govindjee, Olofsson, B.L., Shevela, D.N. <i>Photosynthesis: Solar Energy for Life</i> . World Scientific Publishing Co., Singapore, 2018. ISBN: 9789813223103.

	3. Wang, Q. (Ed.) <i>Microbial Photosynthesis</i> . Springer Nature Singapore Pte Ltd., Singapore, 2020. ISBN: 9789811531095. https://www.youtube.com/watch?v=ld7NUAHGS7U
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M9.1 Principles of Waste Management in Biotechnological Production
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD, associate professor Moldir Alibekovna Turalieva
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total Workload 120 hours: lectures – 30 hours; laboratory classes – 15 hours; independent work of learners (current) – 50 hours; independent work of learners (midterm) – 10 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level courses: M29.1 Plant biotechnology or M29.2 Plant bioprotectors and stimulants
Module Aims and Intended Learning Outcomes	After completing this module, master's students are able to: -apply principles of zero-waste technologies and biological wastewater treatment; -analyze the efficiency of methods for processing organic and industrial waste; -conduct microbiological analysis of drinking and wastewater; -use aerobic and anaerobic treatment methods to produce biogas; -evaluate the environmental efficiency of biotechnological processes and develop solutions to reduce environmental pollution.
Indicative Content	Lectures: Modern trends in environmental biotechnology: zero-waste technologies, biological wastewater treatment, processing of organic and industrial waste with biogas production. Special emphasis is placed on innovative bioreactors, environmental assessment of industrial processes, and the role of biotechnology in improving environmental sustainability. Laboratory classes: Investigation of the efficiency of various disinfection methods and their effects on microorganisms. Study of microflora and microbiological composition of drinking and wastewater. Determination of qualitative and quantitative characteristics of domestic and industrial wastewater. Application of anaerobic treatment methods and biological waste processing in the food, dairy, and pulp-and-paper industries.
Forms of Assessment / Examination	Current assessment: group discussions and projects; colloquia; written tests; written and oral questioning. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Müller, J., Fischer, R., Richter, D. <i>Waste Management in Biotechnological Industries: Challenges and Solutions</i> / J. Müller, R. Fischer, D. Richter. – 1st ed. – Berlin: Springer, 2022. – 310 p. 2. López, M., Sánchez, J. A., Pérez, F. <i>Environmental Impact and Waste Management in Biotechnology</i> / M. López, J. A. Sánchez, F. Pérez. – 2nd ed. – London: Elsevier, 2021. – 330 p. 3. M. Walas. <i>Phase Equilibria in Chemical Engineering</i> . – Boston, EUA: Butterworth, 2023. – 688 p. 4. Kumar, P., Sharma, M., Singh, R. <i>Waste Valorization in Biotechnological Processes</i> / P. Kumar, M. Sharma, R. Singh. – 1st ed. – New York: Wiley, 2023. – 350 p.

	5. Nguyen, D., & Lee, D.S. <i>Anaerobic Biotechnology for Bioenergy Production: Principles and Applications</i> . – Singapore: Springer, 2021. – 412 p https://www.youtube.com/watch?v=0ZiD_Lb3Tm0
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M9.2 Environmental Management of Biotechnological Production
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD, associate professor Turalieva M. A.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total Workload 120 hours: lectures – 30 hours; practical classes – 15 hours; independent work of learners – 50 hours; independent work of atudents – 10 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level courses: M29.1 Plant biotechnology or M29.2 Plant bioprotectors and stimulants
Module Aims and Intended Learning Outcomes	After completing this module, master’s students are able to: -understand the system of environmental management bodies in biotechnological production; -apply methods of managing environmental quality and reducing production costs; -use environmental safety standards and regulations, including the ISO 14000 system; -conduct environmental impact assessment and monitoring of biotechnological processes; -develop measures for processing and disposal of biotechnology-derived waste; -perform basic elements of environmental audit at biotechnological enterprises.
Indicative Content	Lectures: Environmental management structures in biotechnological industries. Environmental costs of biotechnology production and methods for their reduction. Environmental quality standards applied in biotechnological processes. Practical methods of environmental quality management in biotechnology enterprises. Management of waste generated by biotechnological processes. Application of ISO 14000 standards in biotechnological production. Practical classes: Analysis of state regulatory bodies involved in environmental regulation of biotechnology. Structures for integrated environmental management in biotechnology enterprises. Environmental quality standards considering the specifics of biotechnological processes. Standards for permissible environmental impact of biotechnological production. Environmental monitoring in biotechnology industries. Methods of processing and disposing biotechnology-derived waste. Principles of environmental auditing at biotechnological enterprises.
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral questioning. Final assessment – examination.
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Mary K.Theodore <i>Environmental management</i> . Springer. 2021. 2. Rouf Ahmad Bhat, Moonisa Aslam Dervash, Khalid Rehman Hakeem, Khalid Zaffar Masoodi <i>Environmental Biotechnology: Sustainable Remediation of Contamination in Different Environs</i> . 2022 3. <i>Biotechnology for Environmental Sustainability</i> . Pradeep Verma. 2025 https://www.youtube.com/watch?v=6d3D4zCmGNI&list=PLzDbJQcg43Bg0TlhqtqJb14Dzd02Ua_5L

Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.
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Module Title	M11.1 Equipment of Biotechnological Production Enterprises
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD in philosophy, associate professor Moldir Alibekovna Turalieva
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, practical classes, laboratory classes
Workload (including contact hours and independent study)	Total Workload 180 hours: lectures – 30 hours; laboratory classes – 30 hours; practical classes – 15 hours; independent work of learners (current) – 60 hours; independent work of learners (midterm) – 15 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level courses: M29.1 Plant Biotechnology or M29.2 Plant Bioprotectors and Growth Stimulators
Module Aims and Intended Learning Outcomes	After completing this module, master’s students are able to: - select and characterize equipment for different stages of biotechnological production; - explain the operating principles of fermenters, reactors, centrifuges, dryers, and heat exchangers; - perform calculations of bioreactor parameters and technological systems; - apply principles of automation and energy efficiency in equipment design and operation; - ensure biosafety and environmental sustainability of production processes.
Indicative Content	Lectures: Classification of technological approaches in biotechnological production according to equipment requirements. Design and operating principles of core process equipment: fermenters, reactors, separators, centrifuges, dryers. Equipment selection methods depending on production stages. Evaluation of equipment parameters and their impact on bioprocess efficiency. Principles of automation and modernization of biotechnological equipment, including CIP/SIP systems. Equipment for wastewater and gas emissions treatment. Systems of biosafety, occupational safety, and energy efficiency in biotechnology enterprises. Laboratory classes: Study of bioreactor structure and functionality. Selection of mixing devices and internal elements of bioreactors. Determination of raw material parameters. Bioreactor scaling with defined operational regimes. Application of technological calculation methods for bioreactor systems. Selection and characterization of heat exchangers for fermenters. Study of modern sterilization equipment. Structural analysis of laboratory and industrial centrifuges. Drying processes of biosynthesis products: convective and freeze drying. Practical classes: Study of production processes in key biotechnology industries. Investigation of microbiological production using equipment of different capacities. Use of sterilization units for nutrient media preparation. Study of filtration materials and their structural properties. Calculation of “tube-in-tube” heat exchangers. Determination of bioreactor dimensions, shafts, and mixing systems. Preparation of material balances for raw materials and substrates. Selection of biomass separation and extraction methods. Calculation of equipment for separation of culture fluid. Basics of pipeline installation and safe operation.
Forms of Assessment / Examination	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Learning and Examination Requirements	Current assessment: business games and simulations; colloquia, written tests; written and oral questioning. Final assessment – examination.

Reading List (Essential and Recommended Literature)	<p>1. Smith, P., Williams, J., & Thompson, S. <i>Industrial Biotechnology Equipment: Design and Operation</i>. Wiley, 2023.</p> <p>2. Brown, M., Harrison, D., & Clark, T. <i>Equipment and Systems for Biotechnological Production</i>. 2nd ed. Springer, 2022.</p> <p>3. Evans, R., King, A., & Carter, P. <i>Biotechnology Manufacturing: Equipment, Processes and Systems</i>. De Gruyter, 2021.</p> <p>4. Jackson, R., Robinson, S., & Lewis, J. <i>Biotech Equipment for Large Scale Production</i>. 3rd ed. Elsevier, 2024.</p> <p>5. Gordon, H., Patel, R., & Ahmed, S. <i>Advances in Biotech Manufacturing Equipment</i>. Springer, 2020.</p> <p>https://www.youtube.com/watch?v=GB01ibwSPE0</p>
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 11.2 Equipment for Biotechnological Processes
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD in philosophy, associate professor Moldir Alibekovna Turaliyeva
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, practical classes, laboratory classes
Workload (including contact hours and independent study)	Total Workload 180 hours: lectures – 30 hours; laboratory classes – 30 hours; practical classes – 15 hours; independent work of learners (current) – 60 hours; independent work of learners (midterm) – 15 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor-level courses: M29.1 Plant Biotechnology or M29.2 Bioprotectors and Plant Growth Stimulators
Module Aims and Intended Learning Outcomes	<p>After completing this module, master’s students are able to:</p> <ul style="list-style-type: none"> -explain the design and operating principles of core equipment used in biotechnological production; -select and calculate parameters for bioreactors, heat exchangers, centrifuges, and drying units; -apply methods of sterilization, filtration, and biomass separation; -perform material balance calculations for biotechnological processes; -comply with safety and sanitation requirements when operating equipment.
Indicative Content	<p>Lectures: Design and classification of equipment for biotechnological processes. Bioreactors and fermenters: structure and operating principles. Equipment for sterilization, foam removal, and monitoring of medium parameters. Heat exchangers, centrifuges, and apparatus for drying bioproducts. Safety and sanitation requirements in biotechnological production.</p> <p>Laboratory classes: Studying the design of bioreactors and agitators. Parameter calculation and scale-up. Selection of heat exchangers. Sterilization of culture media. Operation of centrifuges. Drying of bioproducts.</p> <p>Practical classes: Equipment for microbiological production. Sterilization and filtration systems. Calculations for heat exchangers and bioreactors. Material balance. Methods of biomass separation. Pipeline assembly and safety.</p>
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral questioning. Final assessment: examination.
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Smith, P., Williams, J., Thompson, S. <i>Industrial Biotechnology Equipment: Design and Operation</i> / P. Smith, J. Williams, S. Thompson. – 1st ed. – London: Wiley, 2023. – 340 p.

	<p>2. Brown, M., Harrison, D., Clark, T. <i>Equipment and Systems for Biotechnological Production</i> / M. Brown, D. Harrison, T. Clark. – 2nd ed. – New York: Springer, 2022. – 375 p.</p> <p>3. Evans, R., King, A., Carter, P. <i>Biotechnology Manufacturing: Equipment, Processes and Systems</i> / R. Evans, A. King, P. Carter. – 1st ed. – Berlin: De Gruyter, 2021. – 400 p.</p> <p>4. Jackson, R., Robinson, S., Lewis, J. <i>Biotech Equipment for Large Scale Production</i> / R. Jackson, S. Robinson, J. Lewis. – 3rd ed. – Amsterdam: Elsevier, 2024. – 420 p.</p> <p>5. Gordon, H., Patel, R., Ahmed, S. <i>Advances in Biotech Manufacturing Equipment</i> / H. Gordon, R. Patel, S. Ahmed. – 1st ed. – Heidelberg: Springer, 2020. – 355 p.</p>
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 12.1 Contemporary Issues in Sectoral Biotechnology
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD, associate professor Ermekbayeva Akbopé Tontaeвна
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory classes, practical classes
Workload (including contact hours and independent study)	Total Workload 180 hours: lectures – 30 hours; laboratory classes – 30 hours; practical classes – 15 hours; independent work of learners – 60 hours; independent work of students – 15 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	Master's level module: M 8.1 Contemporary Methods in Biotechnology
Module Aims and Intended Learning Outcomes	<p>After completing this module, master's students are able to:</p> <ul style="list-style-type: none"> -explain the interdisciplinary nature of biotechnology and its connection with biology, chemistry, and engineering; -apply physical, immunological, and molecular methods in biotechnological research; -use techniques for analyzing proteins, nucleic acids, and membrane structures; -perform cloning operations at molecular, cellular, and organismal levels; -evaluate biotechnological processes in plant and animal production; -analyze and select methods for purification and separation of target bioproducts.
Indicative Content	<p>Lectures: Development of biotechnology as an interdisciplinary field within biology, chemistry, and engineering; Methods for studying membrane structures in biotechnology; Physical methods used in biotechnology; Proteomic analysis methods; Methods for separation and analysis of nucleic acids; Genetic engineering methods in biotechnology; Photorespiration and gluconic acid metabolism.</p> <p>Laboratory classes: Study of immunological methods; Determination of the role of immunobiotechnology; Issues in mineral nutrition of plants; Molecular-level cloning techniques; Cellular and organismal-level cloning techniques; Application of bioinformatics methods in biotechnology; Establishing criteria for membrane fraction purification.</p> <p>Practical classes: Study of plant growth stages; Analysis of modern methods for purification and separation of target products; Evaluation of current challenges in industrial biotechnology and animal breeding, including trait assessment and reproduction methods.</p>
Forms of Assessment / Examination	<p>Current assessment: case studies, group discussions and projects, colloquia, written assignments.</p> <p>Final assessment: examination</p>

Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Wong JF, Hong HJ, Foo SC, Yap MKK, Tan JW. <i>A review on current and future advancements for commercialized microalgae species</i>. Food Sci Hum Well. 2022;11(5):1156–70. 2. Jin H, Chuai W, Li K, Hou G, Wu M, Chen J, et al. <i>Ultrahigh-cell-density heterotrophic cultivation of the unicellular green alga Chlorella sorokiniana for biomass production</i>. Biotechnol Bioeng. 2021;118(10):4138–51. 3. Jin H, Zhang H, Zhou Z, Li K, Hou G, Xu Q, et al. <i>Ultrahigh-cell-density heterotrophic cultivation of the unicellular green microalga Scenedesmus acuminatus and application of the cells to photoautotrophic culture enhance biomass and lipid production</i>. Biotechnol Bioeng. 2020;117(1):96–108. 4. Karst DJ, Ramer K, Hughes EH, Jiang C, Jacobs PJ, Mitchelson FG. <i>Modulation of transmembrane pressure in manufacturing scale tangential flow filtration N-1 perfusion seed culture</i>. Biotechnol Progr. 2020;36(6): e3040 https://www.youtube.com/watch?v=xIx-6392MiA
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 12.2 Achievements and Prospects of Biotechnology
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD, associate professor Ermekbayeva Akbopé Tontaeвна
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory classes, practical classes
Workload (including contact hours and independent study)	Total Workload 180 hours: lectures – 30 hours; laboratory classes – 30 hours; practical classes – 15 hours; independent work of learners – 60 hours; independent work of students – 15 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M 8.1 Contemporary Methods in Biotechnology
Module Aims and Intended Learning Outcomes	<p>After completing this module, master’s students are able to:</p> <ul style="list-style-type: none"> -analyze current achievements and development trends in various biotechnology sectors; -apply modern biotechnological methods and technologies, including PCR, electrophoresis, and cell culture techniques; -evaluate innovative biotechnological solutions in terms of efficiency, sustainability, and bioethics; -design and justify their own biotechnological projects and solutions; -use software tools for modelling and analyzing biotechnological processes; -understand biotechnology development trends in Kazakhstan and globally, and assess their potential for practical implementation.
Indicative Content	<p>Lectures: Modern directions in biotechnology development: medical, agricultural, industrial and environmental biotechnology. Achievements in genetic engineering, cell technologies and synthetic biology. Application of nanobiotechnology and bioinformatics. Biotechnological innovations in the production of pharmaceuticals, enzymes, biofuels and biomaterials. Prospects for microbial consortia and artificial ecosystems. Biosafety and bioethics. Global trends and prospects for biotechnology development in Kazakhstan and the world.</p> <p>Practical classes: Analysis of successful examples of biotechnology implementation in various sectors. Review of modern biotechnological start-ups and research developments. Evaluation of the economic efficiency and environmental sustainability of biotechnological projects. Discussion of commercialization challenges and technology transfer. Development of a mini-project for implementing an innovative biotechnological solution.</p>

	Laboratory classes: Study of modern biotechnological methods: PCR, electrophoresis, cultivation of cells and microorganisms. Determination of biological activity of bioproducts. Analysis of bioprocess efficiency. Modelling new applications of biotechnology using software tools. Case studies of bioproduction using innovative technologies.
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral questioning. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Wong JF, Hong HJ, Foo SC, Yap MKK, Tan JW. <i>A review on current and future advancements for commercialized microalgae species</i> . Food Sci Hum Well. 2022;11(5):1156–70. 2. Jin H, Chuai W, Li K, Hou G, Wu M, Chen J, et al. <i>Ultrahigh-cell-density heterotrophic cultivation of the unicellular green alga Chlorella sorokiniana for biomass production</i> . Biotechnol Bioeng. 2021;118(10):4138–51. 3. Jin H, Zhang H, Zhou Z, Li K, Hou G, Xu Q, et al. <i>Ultrahigh-cell-density heterotrophic cultivation of the unicellular green microalga Scenedesmus acuminatus and application of the cells to photoautotrophic culture enhance biomass and lipid production</i> . Biotechnol Bioeng. 2020;117(1):96–108. 4. Karst DJ, Ramer K, Hughes EH, Jiang C, Jacobs PJ, Mitchelson FG. <i>Modulation of transmembrane pressure in manufacturing scale tangential flow filtration N-1 perfusion seed culture</i> . Biotechnol Progr. 2020;36(6): e3040 https://www.youtube.com/watch?v=uvsyIJKhVIQ
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 16.1 Biotechnology of Biomass Production and Processing
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in chemistry, associate professor Anar Madenovna Yesimova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total Workload 120 hours: lectures – 30 hours; laboratory classes – 15 hours; independent work of learners – 55 hours; independent work of students – 22.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	M 8.1 Modern Methods in Biotechnology
Module Aims and Intended Learning Outcomes	After completing this module, master’s students are able to: -classify biomass sources and determine their potential for biotechnological applications; -explain the principles of cultivating microorganisms, algae, and plants for biomass production; -apply bioconversion technologies for transforming organic raw materials into biogas, bioethanol, and other bioproducts; -analyze the composition and quality of biomass and assess the efficiency of its processing; -use laboratory methods to evaluate protein, lipid, and carbohydrate content in biological materials; -develop approaches to biomass waste utilization considering environmental and energy-related aspects.
Indicative Content	Lectures: Concept and classification of biomass: plant, microbial, animal biomass, and industrial/agricultural waste. Primary raw material sources for biomass production. Technological principles of cultivating microorganisms, algae, and plants as biomass producers. Bioconversion of organic substrates into energy carriers and bioproducts (biogas, bioethanol, biodiesel). Methods of biomass harvesting, concentration, and processing. Biotechnological

	<p>processes for producing protein concentrates, enzymes, vitamins, and biopolymers. Modern technologies for biomass waste utilization and recycling. Environmental and energy aspects of bioprocessing.</p> <p>Laboratory classes: Determination of the composition and properties of various biomass types. Cultivation of microorganisms and algae for biomass production. Measurement of biomass yield and productivity under different conditions. Experimental conversion of biomass into biogas, bioethanol, or biodiesel. Study of fermentation and hydrolysis processes. Evaluation of the effectiveness of different organic waste processing methods. Determination of protein, carbohydrate, and lipid content in biomass.</p>
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral questioning Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> Ye Y, Huang Y, Xia A, Fu Q, Liao Q, Zeng W, et al. <i>Optimizing culture conditions for heterotrophic-assisted photoautotrophic biofilm growth of Chlorella vulgaris to simultaneously improve microalgae biomass and lipid productivity</i>. <i>Bioresour Technol.</i> 2018; 270: 80–7. <i>Biomass for Bioenergy and Biomaterials</i> — Nidhi Adlakha, Sudeep Bhatnagar, Hamed Yazdani (eds.). Published 2023 (Routledge) <i>Biomass and Bioenergy: Processing and Properties</i> — (Springer) Mohammad Jawaid et al. Published 2019–2020 range https://www.youtube.com/watch?v=nV117JLn_u0
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 16.2 Advanced Course in Genetic Engineering
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in chemistry, associate professor Anar Madenovna Yesimova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total Workload 120 hours: lectures – 30 hours; laboratory classes – 15 hours; independent work of learners – 55 hours; independent work of students – 22.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	M 8.1 Modern Methods in Biotechnology
Module Aims and Intended Learning Outcomes	<p>After completing this module, master’s students are able to:</p> <ul style="list-style-type: none"> -understand modern approaches and methods of genetic engineering; -apply genome cloning and editing technologies; -analyze results of molecular experiments and use bioinformatics tools; -evaluate biosafety and ethical considerations associated with gene technologies
Indicative Content	<p>Lectures: The course covers current advances and development trends in genetic engineering. Topics include the molecular basis of heredity, the structure and functions of nucleic acids, and methods for DNA extraction, cloning, and amplification. Vector systems used for gene transfer are examined. Genome editing technologies (CRISPR/Cas, TALEN, ZFN), their capabilities, and limitations are analyzed. Gene modification strategies for microorganisms, plants, and animals are discussed, along with gene expression systems. Issues of biosafety, ethical and legal aspects of genetic technology application, as well as emerging directions such as synthetic biology and personalized medicine, are reviewed.</p> <p>Laboratory classes: Students study methods of DNA extraction and purification, determination of DNA concentration and purity. Laboratory activities include PCR amplification of DNA fragments, cloning, and</p>

	transformation of microorganisms. Students analyze gene editing outcomes and gene expression data. Practical skills are developed in using molecular-genetic tools and bioinformatics software for DNA and protein sequence analysis.
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral questioning Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	4. Ye Y, Huang Y, Xia A, Fu Q, Liao Q, Zeng W, et al. <i>Optimizing culture conditions for heterotrophic-assisted photoautotrophic biofilm growth of Chlorella vulgaris to simultaneously improve microalgae biomass and lipid productivity</i> . Bioresour Technol. 2018;270:80–7. 5. <i>Biomass for Bioenergy and Biomaterials</i> — Nidhi Adlakha, Sudeep Bhatnagar, Hamed Yazdani (eds.). Published 2023 (Routledge) <i>Biomass and Bioenergy: Processing and Properties</i> — (Springer) Mohammad Jawaid et al. Published 2019–2020 range youtube.com/watch?v=Vb81fH3gC7
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M17. 1 Cellular and tissue Biotechnology in agro-industry complex (AIC)
Semester(s) in which the module is taught	<i>3-semester</i>
Module Leader / Coordinator	<i>PhD in agricultural sciences, Associate Professor Yelemanova Zhanar Rakhmanberdievna</i>
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	<i>Total workload – 120 hours: lectures – 30 hours; laboratory classes-15 hours; current IWL - 50 hours; midterm IWL - 10 hours, IWLT- 15 hours</i>
Number of Credits (ECTS)	<i>4 ECTS</i>
Prerequisites and Recommended Prior Knowledge	M12.1 Current issues in industrial Biotechnology M12.2 Achievements and prospects in Biotechnology
Module Aims and Intended Learning Outcomes	After completing the course, master’s students are able to: <ul style="list-style-type: none"> - apply cell and tissue biotechnology methods to solve problems in the agricultural sector. - organize and maintain in vitro plant and animal cell and tissue cultures. - use micropropagation, regeneration, and somatic embryogenesis technologies. - assess the physiological state and viability of cell cultures. - apply cell technologies to improve crop yields and sustainability, as well as animal productivity.

Indicative Content	<p>Lectures: The fundamentals of cell and tissue biotechnology in the agro-industrial complex (AIC) are considered in this course. The principles of culturing plant and animal cells and tissues, organizing in vitro cell cultures, and methods of micropropagation and plant regeneration are studied. Technologies for producing virus-free planting material, somatic embryogenesis, hybridization, and selection using cell cultures are discussed. Aspects of animal cell engineering, the production of transgenic cell lines, and the application of cell technologies to improve the productivity of agricultural crops and animals are covered.</p> <p>Laboratory Classes: Practical training in sterilization methods and nutrient media preparation. Establishing in vitro plant tissue cultures. Micropropagation of plants and obtaining callus cultures. Study of morphogenesis and regeneration. Working with animal cell cultures: over seeding, incubation, and microscopy. Evaluation of cell viability and the use of biotechnological methods to improve plant resilience and productivity.</p>
Forms of Assessment / Examination	<p>Current assessment: successful completion of laboratory work; colloquia, written tests; written and oral quizzes.</p> <p>Final assessment: examination.</p>
Learning and Examination Requirements	During the semester, students must complete all tasks in accordance with the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Freshney, R. I. <i>Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications</i>— Wiley-Blackwell, 7th Edition, 2015. 2. Lanza, R., Langer, R., & Vacanti, J. <i>Principles of Tissue Engineering</i>— Academic Press, 5th Edition, 2020.
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M17.2 Kinetics of biochemical processes
Semester(s) in which the module is taught	3-semester
Module Leader / Coordinator	PhD in agricultural sciences, Associate Professor Yelemanova Zhanar Rakhmanberdiyevna
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	<i>Total workload – 120 hours: lectures – 30 hours; laboratory classes-15 hours; current IWL - 50 hours; midterm IWL - 10 hours, IWLT- 15 hours</i>
Number of Credits (ECTS)	<i>4 ECTS</i>
Prerequisites and Recommended Prior Knowledge	M12.1 Current issues in industrial Biotechnology M12.2 Achievements and prospects in Biotechnology
Module Aims and Intended Learning Outcomes	After completing this course, master’s students are able to: <ul style="list-style-type: none"> • analyze patterns of biochemical reactions and enzymatic processes. • determine kinetic parameters and factors affecting reaction rates. • apply Michaelis-Menten models to describe biochemical processes. • conduct experiments and interpret results to optimize bioprocesses.

Indicative Content	<p>Lectures: The fundamentals of chemical and enzymatic kinetics, the mechanisms of enzyme action, and the principles of biochemical reactions are considered in this course. Michaelis-Menten models, enzyme inhibition and activation, and the effects of temperature, pH, and substrate concentration on reaction rates are explored. Multistage and coenzyme reactions, as well as the kinetics of cellular and enzyme bioreactors, are analyzed. Particular attention is paid to the mathematical modeling of biochemical processes, determining rate constants, and optimizing biotechnological production parameters.</p> <p>Laboratory classes: Determination of enzyme kinetic parameters (K_m and V_{max}) using experimental data. Study of the effect of inhibitors and activators on the rate of enzymatic reactions. Modeling the dependence of reaction rate on substrate concentration. Calculation of energy parameters (activation energy). Experimental study of enzymatic processes under various environmental conditions. Construction of kinetic curves and analysis of the obtained data using software tools.</p>
Forms of Assessment / Examination	<p>Current assessment: successful completion of laboratory work; colloquia, written tests; written and oral quizzes.</p> <p>Final assessment: examination.</p>
Learning and Examination Requirements	During the semester, students must complete all tasks in accordance with the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<p>1. Freshney, R. I. <i>Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications</i>— Wiley-Blackwell, 7th Edition, 2015.</p> <p>2. Lanza, R., Langer, R., & Vacanti, J. <i>Principles of Tissue Engineering</i>— Academic Press, 5th Edition, 2020. https://www.youtube.com/watch?v=X_YXTWU2maY</p>
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M13.1 Molecular-genetic research in Biotechnology
Semester(s) in which the module is taught	2 semester
Module Leader / Coordinator	PhD, Associate Professor Turalieva Moldir Alibekovna
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, practical classes, laboratory work
Workload (including contact hours and independent study)	Total workload – 180 hours: lectures – 15 hours; laboratory classes-30 hours, practical classes – 15 hours; current IWL - 60 hours; midterm IWL - 15 hours, IWLT- 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor's degree modules: M27.1 Applied Genetics or M27.2 Genetic Monitoring of natural populations
Module Aims and Intended Learning Outcomes	<p>After completing this course, master's students are able to:</p> <ul style="list-style-type: none"> - apply modern molecular genetic methods to analyze and modify genetic material. - isolate, amplify, and analyze nucleic acids using PCR and electrophoresis. - conduct gene cloning and evaluate expression using modern tools. - interpret sequencing results and develop genetic constructs. -use molecular genetic technologies in medical, agricultural, and industrial biotechnology research.

Indicative Content	<p>Lectures: Study of genome structure and function. Methods for isolating and analyzing nucleic acids. Polymerase chain reaction (PCR) and its modifications. Principles of DNA and RNA sequencing. Gene cloning and recombinant DNA creation. Gene expression analysis methods: Northern blot, RT-PCR, microarrays. Use of CRISPR/Cas9 and other genome editing technologies. Application of molecular genetic methods in medical, agricultural, and industrial biotechnology.</p> <p>Laboratory classes: Isolation of DNA from cellular material. Set up and perform PCR. Electrophoresis of amplification products. Gene cloning into a vector. Gene expression analysis using RT-PCR. Study of plasmid structure and their use in genetic engineering.</p> <p>Practical classes: Solution of problems in genetic sequence analysis. Determination of primers for amplification. Interpretation of sequencing data. Modeling of genetic constructs. Application of molecular genetic methods for diagnostics and biotechnological research.</p>
Forms of Assessment / Examination	<p>Current assessment: case studies, group discussions and projects, colloquia, written tests.</p> <p>Final assessment: examination.</p>
Learning and Examination Requirements	During the semester, students must complete all tasks in accordance with the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Smith, J., Brown, R., Williams, D. Molecular Genetics in Biotechnology: Recent Advances and Applications / J. Smith, R. Brown, D. Williams. – 1st ed. – New York: Springer, 2023. – 380 p. 2. Johnson, M., Patel, S., Turner, E. Advances in Molecular Genetics for Biotechnology / M. Johnson, S. Patel, E. Turner. – 2nd ed. – London: Elsevier, 2021. – 400 p. 3. Rodriguez, F., Li, Z., Yang, Y. Genetic Engineering in Biotechnology: Techniques and Applications / F. Rodriguez, Z. Li, Y. Yang. – 1st ed. – Heidelberg: Springer, 2022. – 350 p. 4. Zhang, Y., Liu, J., Wang, L. Applications of Molecular Genetics in Biotechnological Research / Y. Zhang, J. Liu, L. Wang. – 3rd ed. – Amsterdam: Wiley-VCH, 2024. – 330 p. 5. Müller, T., Keller, C., Reiter, W. Molecular Techniques in Biotechnology: From Theory to Practice / T. Müller, C. Keller, W. Reiter. – 1st ed. – Berlin: De Gruyter, 2020. – 375 p. <p>https://www.youtube.com/watch?v=6bjTink0Mrl</p>
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M13.2 Industrial microbiology
Semester(s) in which the module is taught	<i>2 semester</i>
Module Leader / Coordinator	PhD, Associate Professor Turalieva Moldir Alibekovna
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, practical classes, laboratory work
Workload (including contact hours and independent study)	Total workload – 180 hours: lectures – 15 hours; laboratory classes-30 hours, practical classes – 15 hours; current IWL - 60 hours; midterm IWL - 15 hours ,IWL- 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	Bachelor's degree modules: M27.1 Applied Genetics or M27.2 Genetic Monitoring of natural populations

Module Aims and Intended Learning Outcomes	<p>After completing this course, master's students are able to:</p> <ul style="list-style-type: none"> - characterize industrial microorganisms and explain their role in the production of bioproducts. - apply methods for the isolation, selection, and cultivation of highly productive strains. - monitor and optimize microbial growth conditions in fermenters. - use PCR and molecular diagnostic methods to identify and monitor cultures. - calculate bioreactor parameters and nutrient media components. - apply methods for the purification and analysis of microbial synthesis products. - ensure biosafety and comply with microbiological production standards.
Indicative Content	<p>Lectures: Industrial microorganisms and their role in the production of biological substances. Methods for isolating and selecting highly productive strains. Cultivation and fermentation: technology and equipment. Control of microbial growth conditions: pH, temperature, aeration. Methods for obtaining and purifying microbial synthesis products. Use of genetically modified organisms in industry. Application of PCR and molecular diagnostics in production monitoring. Bioreactors and stages of bioprocess scaling. Modern technologies in industrial microbiology. Biosafety and standardization of microbiological production.</p> <p>Laboratory classes: Study of the morphology and physiology of industrial strains. Preparation of nutrient media and sterilization. Cultivation of microorganisms in flasks and fermenters. Determination of biomass and product yield. PCR for strain identification. Purification of fermentation products. Measurement of fermentation parameters (pH, temperature). Microscopy and cell staining. Use of molecular biology methods in industrial microbiology.</p> <p>Practical classes: Work with industrial microorganism cultures. Calculation of nutrient medium components. Determination of strain productivity. Conduct of antimicrobial activity tests. Use of PCR to control contamination. Assessment of culture purity. Calculation of bioreactor design based on specified parameters. Analyze of microbiological production flow charts. Use laboratory equipment. Development of process charts based on microbiological processes.</p>
Forms of Assessment / Examination	<p>Current assessment: successful completion of written tests; written and oral quizzes.</p> <p>Final assessment: <i>examination.</i></p>
Learning and Examination Requirements	<p>During the semester, students must complete all tasks in accordance with the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Verma, P. Industrial Microbiology and Biotechnology: An Insight into Current Trends / P. Verma (Ed.). – 1st ed. – Singapore: Springer, 2024. – 701 p. 2. Okafor, N., Okeke, B. C. Modern Industrial Microbiology and Biotechnology / N. Okafor, B. C. Okeke. – 2nd ed. – Boca Raton: CRC Press, 2021. – 488 p. 3. Wilson, D. B., Sahm, H., Stahmann, K.-P., Koffas, M. Industrial Microbiology / D. B. Wilson, H. Sahm, K.-P. Stahmann, M. Koffas (Eds.). – 1st ed. – Weinheim: Wiley-VCH, 2020. – 398 p. 4. Nayak, S. K. Advances in Agricultural and Industrial Microbiology: Volume 1: Microbial Diversity and Application in Agroindustry / S. K. Nayak. – 1st ed. – Singapore: Springer, 2023. – 268 p. 5. Verma, P. Industrial Microbiology and Biotechnology: A New Horizon of the Microbial World / P. Verma (Ed.). – 1st ed. – Singapore: Springer, 2024. – 1038 p. <p>https://www.youtube.com/watch?v=V0BzQQCCwgo</p>

Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.
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Module Title	M.14.1 Fundamentals of Research Work
Semester(s) in which the module is taught	2
Module Leader / Coordinator	PhD, Associate Professor Alpamysova Gulzhaina Baygonysovna PhD Akhmet Ainagul
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total workload: 150 hours: 82.5 hours of contact time, including: lectures – 30 hours; labs – 30 hours; IWMT – 22.5 hours; IWM – 67.5 hours. Current – 55 hours. Interim – 12.5 hours.
Number of Credits (ECTS)	5ECTS
Prerequisites and Recommended Prior Knowledge	M12.1 Current issues in industrial Biotechnology M12.2 Achievements and prospects in Biotechnology
Module Aims and Intended Learning Outcomes	After completing this course, master’s students are able to: - plan and organize scientific research in biotechnology. - formulate the goal, objectives, and hypothesis of the study. - search, analyze, and systematize scientific information using modern databases. - apply methods for processing and interpreting experimental data. - prepare scientific reports, articles, reviews, and presentations. - adhere to ethical standards and rules of scientific integrity. - present research results orally and in writing at a professional level.
Indicative Content	Lectures: The concept and structure of scientific research. Stages of scientific work: choosing a theme, formulating goals, objectives, and hypotheses. Methods of scientific inquiry: theoretical and experimental approaches. Organization and planning of scientific research in biotechnology. Working with scientific literature and databases. Methodology for searching and analyzing scientific information. Preparing abstracts, reviews, and scientific articles. Fundamentals of formatting scientific reports, dissertations, and presentations. Ethical principles in scientific research. Intellectual property protection and copyright. Current trends in the development of biotechnology research. Laboratory classes: Formulation of the theme and objectives of scientific research. Search and analyze scientific sources using databases (Scopus, Web of Science, PubMed). Development of a research plan. Creation of tables and graphs based on experimental data. Preparation of a literature review and bibliography. Work with data processing programs (Excel, Origin). Preparation of a report on laboratory research results. Creation and formation of a scientific article. Preparation of oral presentation and poster for a conference.
Forms of Assessment / Examination	Current assessment: successful completion of written tests; written and oral quizzes. Final assessment: <i>examination.</i>
Learning and Examination Requirements	During the semester, students must complete all tasks in accordance with the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.

Reading List (Essential and Recommended Literature)	<p>1. Kumar, R. Research Methodology: A Step-by-Step Guide for Beginners / Ranjit Kumar. – 3rd ed. – London: SAGE Publications Ltd, 2019. – 440 p.</p> <p>2. Thomas, C. G. Research Methodology and Scientific Writing / C. G. Thomas. – 2nd ed. – New Delhi: Ane Books, 2020. – 628 p.</p> <p>3. Dunn, P. K. Scientific Research and Methodology: An Introduction to Quantitative Research and Statistics in Science, Engineering, and Health / Peter K. Dunn. – 1st ed. – 2021. – 350 p.</p> <p>4. Cooper, H. The Handbook of Research Synthesis and Meta-Analysis / Harris Cooper (Ed.). – 2nd ed. – New York: Russell Sage Foundation, 2019. – 600 p.</p> <p>https://www.youtube.com/watch?v=btZE1COWF5o</p>
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M14.2 Ensuring genetic safety of biotechnological production
Semester(s) in which the module is taught	2 semester
Module Leader / Coordinator	PhD, Associate Professor Alpamysova Gulzhaina Baygonysovna
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total workload: 150 hours: 82.5 hours of contact time, including: lectures – 30 hours; labs – 30 hours; IWMT – 22.5 hours; IWM – 67.5 hours. Current – 55 hours. Interim – 12.5 hours.
Number of Credits (ECTS)	5ECTS
Prerequisites and Recommended Prior Knowledge	M12.1 Current issues in industrial Biotechnology M12.2 Achievements and prospects in Biotechnology
Module Aims and Intended Learning Outcomes	After completing the course, master’s students are able to: <ul style="list-style-type: none"> - assess and minimize risks when working with GMOs and cell cultures. - apply methods for monitoring genetic stability and biocontainment. - comply with regulatory requirements and ethical standards for genetic safety. - develop measures to prevent leaks and biosafety breaches.
Indicative Content	<p>Lectures:</p> <p>This course covers the fundamentals of genetic safety in biotechnology production, including risk assessment of genetically modified organisms (GMOs) and their impact on the environment and human health. The mechanisms of horizontal gene transfer, biocontainment, and genetic isolation systems are considered. The international and national biosafety regulations, principles of working with GMOs in laboratory and industrial settings, and requirements for biotechnology facilities to ensure the genetic stability of production strains are considered. Particular attention is paid to methods for monitoring and controlling GMO leaks, risk mitigation strategies, and the ethical and legal aspects of genetic safety.</p> <p>Laboratory classes:</p> <p>Master students gain practical methods for assessing the genetic stability of microorganisms and cell cultures used in biotechnology. They conduct experiments to monitor potential mutations and horizontal transfer of genetic material. They also study molecular diagnostic methods for identifying GMOs and determining their traces in food products and the environment. They master biocontainment procedures and the safe disposal of biotechnological waste. They conduct simulations of biosafety breaches and develop risk prevention measures.</p>
Forms of Assessment / Examination	<p>Current assessment: successful completion of written tests; written and oral quizzes.</p> <p>Final assessment: <i>examination.</i></p>

Learning and Examination Requirements	During the semester, students must complete all tasks in accordance with the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Kumar, R. <i>Research Methodology: A Step-by-Step Guide for Beginners</i> / Ranjit Kumar. – 3rd ed. – London: SAGE Publications Ltd, 2019. – 440 p. 2. Thomas, C. G. <i>Research Methodology and Scientific Writing</i> / C. G. Thomas. – 2nd ed. – New Delhi: Ane Books, 2020. – 628 p. 3. Dunn, P. K. <i>Scientific Research and Methodology: An Introduction to Quantitative Research and Statistics in Science, Engineering, and Health</i> / Peter K. Dunn. – 1st ed. – 2021. – 350 p. 4. Cooper, H. <i>The Handbook of Research Synthesis and Meta-Analysis</i> / Harris Cooper (Ed.). – 2nd ed. – New York: Russell Sage Foundation, 2019. – 600 p. https://www.youtube.com/watch?v=TSxtsyscP94
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M18.1 Ecobiosafety in the agro-industrial and industrial zone
Semester(s) in which the module is taught	<i>3semester</i>
Module Leader / Coordinator	PhD in agricultural sciences, Associate Professor Akhanov Usen Kudaibergenovich
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, practical classes, laboratory work
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 30 hours; practical lessons – 30 hours; laboratory classes – 30 hours; current IWL – 82,5 hours; IWLТ – 37.5 hours.
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M16.1. Biotechnology of biomass production and processing M16.2. Advanced course in Genetic Engineering
Module Aims and Intended Learning Outcomes	After completing the course, master’s students are able to: - Analyze environmental issues and assess safety in agriculture. - Apply biodegradation and environmental biotechnology methods. - Assess the impact of industrial pollutants on the environment. - Comply with biosafety, bioethics, and sanitary regulations.
Indicative Content	Lectures: Current state of environmental safety. Analysis of environmental problems in modern agriculture in the Republic of Kazakhstan. Ways to ensure environmental safety and measures to improve environmental safety. Laboratory classes; The role of microorganisms in the biodegradation of organic matter in the environment. Environmental biotechnology in the food industry. Pollution with dioxins and polycyclic aromatic hydrocarbons. Practical classes; Understanding biosecurity, biosafety, and bioethics. Fundamentals of sanitary regulations for occupational hygiene in biotechnological production and microbiological control in environmental biotechnology.
Forms of Assessment / Examination	Current assessment: tests, quizzes, and assignments with feedback; written and oral surveys. Final assessment: <i>examination</i>
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.

Reading List (Essential and Recommended Literature)	<p>1. R. Ian Freshney. Culture of animal cells. A practical guide / Binomial Knowledge Lab, 2020, https://www.labirint.ru/books/478280/</p> <p>2. B. Singh, S.K. Gautam, M.S. Chauhan. Textbook of Animal Biotechnology / The Energy and Resources Institute (TERI), 2021. ISBN 817993327X, 9788179933275. – 620p.</p> <p>3. Electronic textbook "Fundamentals of biotechnology", code access http://www.biotechnolog.ru/intro.htm</p> <p>4. H. Hauser, R. Wagner. Animal Cell Biotechnology: In Biologics Production / De Gruyter, 2024. https://doi.org/10.1515/9783110278965.</p> <p>5. Textbook on the discipline "Transplantation and cryopreservation of embryos of farm animals": for undergraduates spec. 6M070100 - "Biotechnology" / O. Beketauov [et al.]. - Shymkent: SKSU, 2021. - 104 p. https://www.youtube.com/watch?v=1Qv3B2x63O0</p>
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M18.2 Environmental aspects of biotechnological processes
Semester(s) in which the module is taught	<i>3 semester</i>
Module Leader / Coordinator	PhD in agricultural sciences, Associate Professor Akhanov Usen Kudaibergenovich
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, practical classes, laboratory work
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 30 hours; practical lessons – 30 hours; laboratory classes – 30 hours; current IWL – 82,5 hours; IWLТ – 37.5 hours.
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M16.1. Biotechnology of biomass production and processing M16.2. Advanced course in Genetic Engineering
Module Aims and Intended Learning Outcomes	After completing the course, master's students are able to: - Assess the environmental impact of agriculture and analyze pollution problems. - Apply biotechnological methods and treatment facilities to reduce environmental impacts. - Monitor aeration, mixing, and purification of water and waste gases. - Comply with biosecurity, biosafety, bioethics, and sanitary regulations in biotech production.
Indicative Content	Lectures: <i>The impact of agriculture on the environment. Problems caused by the agricultural industry. Solutions to agricultural pollution. Wastewater treatment plants and biotechnological methods.</i> Laboratory classes: Method for foam formation and suppression during aeration and mixing in the biosynthesis process. Residual water treatment. Expertise of waste gas treatment units and occupational safety and health measures in biotechnology production. Practical classes: Understanding biosecurity, biosafety, and bioethics. Fundamentals of sanitary and occupational hygiene rules in biotechnology production. Microbiological control in environmental biotechnology.
Forms of Assessment / Examination	Current assessment: tests, quizzes, and assignments with feedback; written and oral surveys. Final assessment: <i>examination</i>
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.

Reading List (Essential and Recommended Literature)	<p>1. <u>R. Ian Freshney</u>. Culture of animal cells. A practical guide / Binomial Knowledge Lab, 2020, https://www.labirint.ru/books/478280/</p> <p>2. B. Singh, S.K. Gautam, M.S. Chauhan. Textbook of Animal Biotechnology / The Energy and Resources Institute (TERI), 2021. ISBN817993327X, 9788179933275. – 620p.</p> <p>3. Electronic textbook "Fundamentals of biotechnology", code access http://www.biotechnolog.ru/intro.htm</p> <p>4. H. Hauser, R. Wagner. Animal Cell Biotechnology: In Biologics Production/ De Gruyter, 2024. https://doi.org/10.1515/9783110278965. Textbook on the discipline "Transplantation and cryopreservation of embryos of farm animals": for undergraduates spec. 6M070100 - "Biotechnology" / O. Beketauov [et al.]. - Shymkent: SKSU, 2021. - 104 p. https://www.youtube.com/watch?v=gJ-Njv0UsII</p>
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M.19.1 Technology of the production and storage of biotechnological products
Semester(s) in which the module is taught	<i>3 semester</i>
Module Leader / Coordinator	PhD, senior lecturer Tleukeeva Asel Erzhanovna
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	<i>Lectures, practical classes, laboratory work</i>
Workload (including contact hours and independent study)	Total workload – 150 hours: lectures – 30 hours; practical lessons – 30 hours; current IWL – 60 hours; midterm IWL – 12.5 hours; IWLT – 22.5 hours.
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M18.1 Eco-biosecurity in the agro-industrial and industrial zones M18.2 Environmental aspects of biotechnological processes
Module Aims and Intended Learning Outcomes	After completing the course, master’s students are able to: - Apply technologies for obtaining, isolating, and purifying bioproducts. - Use methods for stabilizing and storing bioproducts, including drying, freezing, and lyophilization. - Monitor product quality and evaluate their biological activity. - Plan technological processes and develop instructions for the production and storage of bioproducts. - Ensure biosafety and regulatory compliance when working with bioproducts.

Indicative Content	<p>Lectures: The principles and methods of bioproducts production in biotechnological processes, including fermentation, microbiological synthesis, and cell technologies are considered in this course. The processes of isolating, purifying, and concentrating biosynthetic products, including filtration, centrifugation, and precipitation are studied. Methods for stabilizing and storing bioproducts are discussed, including drying, freezing, lyophilization, and storage in stabilizer solutions. Particular attention is paid to quality control, biosafety, and compliance with storage standards to preserve the activity and properties of bioproducts.</p> <p>Laboratory classes: The biomass yield determination and products under various fermentation conditions. Study of methods of filtration, centrifugation, and precipitation of bioproducts. Conduct of product stabilization tests using drying, lyophilization, and freezing. Quality control of the resulting products (enzyme activity, microbial viability). Evaluation of the effectiveness of storage and stabilization methods.</p> <p>Practical classes: Calculation and plan of technological processes of obtaining and purifying bioproducts. Determination of optimal storage and stabilization conditions for different types of products. Analysis of biotechnological process flow charts. Preparation of instructions and process maps on the production and storage of bioproducts. Biosafety monitoring and compliance with storage standards.</p>
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral questioning. Final assessment: <i>examination</i>
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Biotechnology for Waste Biomass Utilization — Edited by Prakash K. Sarangi & Latika Bhatia. Published 2023. 2. Industrial Microbiology and Biotechnology: A New Horizon of the Microbial World — Edited by Pradeep Verma. Published 2024. https://www.youtube.com/watch?v=IFcF4DsuC9A
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M19.2 Achievements of genetic engineering in the agro-industrial complex
Semester(s) in which the module is taught	<i>3 semester</i>
Module Leader / Coordinator	PhD, senior lecturer Tleukeeva Asel Erzhanovna
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Elective component
Teaching and Learning Methods	<i>Lectures, practical classes, laboratory work</i>
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 30 hours; practical lessons – 30 hours; laboratory classes – 30 hours; current IWL – 60 hours; midterm IWL – 12.5 hours; IWLT – 22.5 hours.
Number of Credits (ECTS)	7 ECTS

Module Aims and Intended Learning Outcomes	<p>After completing the course, master's students acquire the following knowledge and skills:</p> <ol style="list-style-type: none"> 1. Understand the nature, mechanisms, and patterns of life processes in organisms, including microorganisms, plants, and animals, enabling them to apply this knowledge to agricultural and biotechnological applications; 2. Understand key achievements and current development trends in biotechnology, with an emphasis on applications in agriculture and the food industry; 3. Master modern methods of genetic engineering, protein engineering, enzymology, chromosome and cell engineering used to create new varieties, breeds, and biopreparations; 4. Understand the most important technological processes for processing plant and animal raw materials, as well as the principles of producing environmentally friendly and functional food products;
Indicative Content	<p>Lecture: General concept of genetic engineering. History of development and its role in the agro-industrial complex. Biological systems used in agricultural Biotechnology. Goals and Objectives of agricultural Biotechnology. Biotechnology is used in crop production, animal husbandry, veterinary medicine, molecular biology, the food industry, ecology, and other sectors of the agro-industrial complex. Environmental control using agrobiotechnological microorganisms. Waste-free technology in Agriculture and prospects for its implementation. Genetic engineering. Methods and applications in modern agricultural production. Cellular Engineering. Methods and Applications in Agriculture. Biomass is the basis for the growth of animal, plant, and microbial cells for agricultural and functional purposes. Practical lessons: Polymerase chain reaction, its purpose and application in Agrobiotechnology. Methods for DNA and RNA extraction. Creation and use of a GenBank of agricultural organisms. The global GenBank database and its applications in agricultural science. Modern sequencing and biochip analysis in crop and livestock production. Technology of production, storage, and transportation of agrobiotech products. Aspects of the further socioeconomic development of agricultural biotechnology globally and in Kazakhstan at the current stage.</p>
Forms of Assessment / Examination	Final assessment: <i>examination</i>
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain min 30– max 60 points for current assessment min.20, max–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Brown, T. A. (2020). <i>Gene Cloning and DNA Analysis: An Introduction</i> (7th ed.). Wiley-Blackwell. 2. Peacock, J. W., & Christou, P. (Eds.). (2019). <i>Molecular Approaches to Crop Improvement</i>. Springer. 3. Singh, B. D., & Singh, A. K. (2021). <i>Marker-Assisted Plant Breeding: Principles and Practices</i>. Springer. 4. Glick, B. R., & Patten, C. L. (2017). <i>Molecular Biotechnology: Principles and Applications of Recombinant DNA</i> (5th ed.). ASM Press. 5. Halford, N. G. (2011). <i>Genetically Modified Crops</i>. Imperial College Press. https://www.youtube.com/watch?v=jxQC4ZCq-dU&t=206s
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M20.1 Business in the Field of Biotechnology
Semester(s) in which the module is taught	<i>3semester</i>
Module Leader / Coordinator	<i>Doctor of agricultural sciences, Professor Alibaev Nuradin</i>

Language of Instruction	<i>Kazakh, Russian</i>
Relation to the Programme / Curriculum Placement	<i>Major course, elective component</i>
Teaching and Learning Methods	<i>Lectures, practical classes, laboratory work</i>
Workload (including contact hours and independent study)	<i>Total Workload: 150 hours: Lectures – 30 hours; Practical classes – 30 hours; current IWL – 55 hours; midterm IWL – 12,5 hours, IWLT- 22,5 hours</i>
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M19.2 Achievements of genetic engineering in the agro-industrial complex
Module Aims and Intended Learning Outcomes	After completing this course, master's students are able to: <ul style="list-style-type: none"> - analyze business models and market opportunities in the biotechnology industry. - develop commercialization strategies for innovative bioproducts. - evaluate the economic viability of projects and develop financial plans. - manage risks and attract investment for biotechnology startups. - apply intellectual property, licensing, and regulatory requirements. - prepare presentations and materials for investors and partners in the biotechnology business.
Indicative Content	<p>Lectures: The fundamentals of business activity in the biotechnology industry are considered. The biotechnology product commercialization models, market assessment, strategic planning, and project management are studied. Financial aspects are discussed, including investments, grants, venture capital financing, risk management, and the economic viability of biotechnology projects. Legal and regulatory issues are explored, including intellectual property, licensing, and regulatory requirements for bioproducts. Particular attention is paid to biotechnology startups, innovation strategies, and sustainable development of the industry.</p> <p>Practical classes: Analysis of biotechnology company business models. Development of a commercialization strategy for an innovative product. Assessment of the economic viability and preparing a financial plan for a project. Solution of case studies on risk management and investing in biotechnology startups. Preparation of presentations for potential investors. Explore of licensing, patent protection, and regulatory compliance issues in the biotechnology business.</p>
Forms of Assessment / Examination	Current control: written control works; written and oral surveys. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain min 30– max 60 points for current assessment min.20, max –40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Cyranoski D, Gilbert N, Ledford H, Nayar A, Yahia M. The PhD factory. Nature. 2011;472(7343):276–9. 2. Kahn S, Ginther DK. The impact of postdoctoral training on early careers in biomedicine. Nature Biotechnology. 2017;35(1):90–4. 3. Sauermaun H, Roach M. Science PhD career preferences: Levels, changes, and advisor encouragement. PLoS ONE. 2012;7(5):e36307. 4. Fuhrmann C, Halme D, O'Sullivan P, Lindstaedt B. Improving graduate education to support a branching career pipeline: Recommendations based on a survey of doctoral students in the basic biomedical sciences. CBE-Life Sciences Education. 2011;10(3):239–49. 5. Arsenov, V. V. Innovative development of the agro-industrial complex / V.V. Arsenov, P.I. Ivantsov. - M.: Academy of Management under the President of the Republic of Belarus, 2018. - 164 p. https://www.youtube.com/watch?v=s_D1NRMex00
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M20.2 Creation of a production business plan of biotechnological products
Semester(s) in which the module is taught	<i>3-semester</i>
Module Leader / Coordinator	<i>Doctor of agricultural sciences, Professor Alibaev Nuradin</i>
Language of Instruction	<i>Kazakh, Russian</i>
Relation to the Programme / Curriculum Placement	<i>Major course, elective component</i>
Teaching and Learning Methods	<i>Lectures, practical classes, laboratory work</i>
Workload (including contact hours and independent study)	<i>Total Workload: 150 hours: Lectures – 30 hours; Practical classes – 30 hours; current IWL – 55 hours; midterm IWL – 12,5 hours, IWLT- 22,5 hours</i>
Number of Credits (ECTS)	<i>5 ECTS</i>
Prerequisites and Recommended Prior Knowledge	M19.2 Achievements of genetic engineering in the agro-industrial complex
Module Aims and Intended Learning Outcomes	<p>After completing of the course, master’s students are able to:</p> <ul style="list-style-type: none"> - develop a comprehensive business plan for biotech production. - conduct market, competitor, and target audience analysis. - calculate project costs, revenues, profitability, and payback. - determine the necessary resources, equipment, and personnel for production. - develop marketing, logistics, and risk management strategies. - prepare business plan presentations and convincingly defend projects to investors.
Indicative Content	<p>Lectures: The course considers the fundamental principles of developing a business plan for biotech production. The preparation stages include analyzing the market, competitive environment, target audience, and potential clients. Financial calculations are discussed, including estimating costs, revenues, profitability, and project payback. Production and logistics strategies, equipment, and personnel requirements are explored. Risk management, legal, and regulatory aspects are considered, including licensing and compliance with biosafety standards. Particular attention is paid to investment attractiveness and preparing a presentation for potential investors.</p> <p>Practical classes: Development of a business plan for a specific biotech product. Conduct of a market and competitive analysis. Calculation of project costs, revenues, and profitability. Determination of the necessary resources, equipment, and personnel. Development of a marketing and logistics strategy. Assessment of risks and development of mitigation measures. Preparation of a business plan presentation for potential investors and presenting the project.</p>
Forms of Assessment / Examination	<p>Current assessment: colloquia, written tests, written and oral quizzes</p> <p>Final assessment: examination</p>
Learning and Examination Requirements	During the semester, students must complete all assignments according to the syllabus and obtain min 30– max 60 points for current assessment min.20, max–40 points for the final examination.
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> 1. Shimasaki, C. <i>Biotechnology Entrepreneurship: Leading, Managing and Commercializing Innovative Technologies</i>. Academic Press, Singapore, 2020. ISBN: 978-0-12-815585-1. 2. Mermelstein, F., Prince, R., Novina, C. (Eds.) <i>Biotechnology: From Idea to Market</i>. PDA, Bethesda, USA, 2019. ISBN: 978-1-942911-37-1. 3. Friedman, Y. <i>Building Biotechnology: Business, Regulations, Patents, Law, Policy and Science</i>. ThinkBiotech, USA, 2011. ISBN: 978-1-934899-28-1. <p>https://www.youtube.com/watch?v=-JfTyZJBFXk</p>
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 10, M15, M21 Research work of a master's student, including an internship and the completion of a master's thesis
Semester(s) in which the module is taught	1,2 semestr; 3,4,5 trimestrs
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Alpamysova G.B., PhD in biological sciences, Prof. Saparbekova A.A., Doctor of technical sciences, Professor Kedelbaev B.Sh.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Basic discipline, university component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total Workload: 720 hours.
Number of Credits (ECTS)	24 ECTS
Prerequisites and Recommended Prior Knowledge	Pedagogical internship, Methods of teaching major disciplines, Research internship
Module Aims and Intended Learning Outcomes	After completing this course, master's students will have gained: <ul style="list-style-type: none"> - be able to formulate research questions, goals, and objectives, and to select appropriate methods and approaches to address them. - be able to collect, process, and analyze data, and to draw conclusions based on the results. - be able to present research results to scientific communities, including preparing and delivering conference presentations. - be able to evaluate existing research, analyze its strengths and limitations, and develop original ideas and approaches. - be able to prepare scientific publications formatted in accordance with academic standards. - master various research methods, including experimental, sociological, and statistical approaches. - be able to find, analyze, and critically evaluate scientific sources and literature reviews.
Indicative Content	Evaluates an analytical review of known methods for producing inorganic compounds in accordance with the goals and objectives of the thesis research, and experimental research work according to the academic period plan using the department's laboratory equipment. Selects and justifies the production process flow diagram in accordance with the master's thesis theme. Determines the economic viability of the technology being developed.
Forms of Assessment / Examination	Final assessment –differential test
Learning and Examination Requirements	-
Reading List (Essential and Recommended Literature)	QMS SKU PR 7.28-2024 Organization and conduct of scientific (Experimental) research work of master's and doctoral students QMS SKU PR 7.29-2024 Organization of scientific internships of master's and doctoral students
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.

Module Title	M 22. Preparation and Defense of a Master's Thesis
Semester(s) in which the module is taught	5 trimestr
Module Leader / Coordinator	PhD in biological sciences, Professor Saparbekova A.A., Doctor of agricultural Sciences, sciences, Professor Alibaev N.N., PhD in agricultural sciences, associate professor Alpamysova G., Doctor of technical sciences, Professor Kedelbaev B.Sh., PhD in Chemical Sciences, associate professor Esimova A.M.
Language of Instruction	Kazakh, Russian

Relation to the Programme / Curriculum Placement	Basic discipline, university component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total Workload: 240 hours:
Number of Credits (ECTS)	8 ECTS
Prerequisites and Recommended Prior Knowledge	Pedagogical internship, Methods of teaching major disciplines, Research internship, MSRW
Module Aims and Intended Learning Outcomes	<p>After completing this module, the master's student will be able to:</p> <ul style="list-style-type: none"> - identify current problems in biotechnology, drawing on modern theoretical, methodological, and technological advances in science and engineering; - independently conduct scientific research, including theoretical and/or practical solutions to the problems posed in the thesis; - correctly format a master's dissertation in accordance with scientific, educational, methodological, and industry standards; - be able to prepare scientific articles based on research results for publication in scientific journals, in the proceedings of international scientific and practical conferences, etc. - present research results consistently and logically, using scientific style and appropriate terminology. - critically evaluate their work, correct mistakes, and improve the quality of the text before submitting it for defense; - formulate conclusion, findings, and proposals on the work completed, taking into account all stages of the research and the results obtained; - create and present presentations for the thesis defense, including highlighting key findings and conclusions; - be able to competently present the thesis, clearly and confidently answer questions from members of the thesis council, arguing their findings and conclusions.
Indicative Content	<p>The final qualification work of a master's program graduate is a prepared and properly formatted master's thesis, confirming the competencies acquired during the course of study in accordance with the chosen degree program – Biotechnology.</p> <p>The defense of the master's thesis is conducted at an open meeting of the Certification Committee, attended by the committee chair and at least half of its members. The procedure and regulations for the defense of the master's thesis are established by the chairman.</p>
Forms of Assessment / Examination	Final control – defense
Learning and Examination Requirements	-
Reading List (Essential and Recommended Literature)	1. QMS SKU P 7.38-2024 REGULATIONS ON THE MASTER'S THESIS (PROJECT)
Last Revision Date of the Degree Program	Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.