

## Appendix 14. Modular Reference Guide for the Degree Program "Biotechnology" (Bachelor's Degree) **Ошибка! Закладка не определена.**

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Module Title	<b>M 1 History of Kazakhstan</b>
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD in history, associate professor S.M. Dzhunusbaev
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General Education Course
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– 55 hours; supervised independent work – 35 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	Knowledge of the History of Kazakhstan and World History in the scope of general secondary, technical, and vocational education
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: - list key historical events, dates, and figures that played an important role in the history of Kazakhstan - demonstrate objective knowledge of the main stages of Kazakhstan’s history from ancient times to the present - apply historical knowledge to analyze contemporary socio-political situations - compare the development stages of Kazakhstan across different historical periods - critically evaluate historical facts, the actions of historical figures, and the outcomes of political decisions - prepare independent historical reviews, essays, or projects based on the studied materials
Indicative Content	<b>Lectures:</b> Ancient humans and the formation of nomadic civilization; Turkic civilization and the Great Steppe; Kazakh Khanate; Kazakhstan in the modern era; Kazakhstan under the Soviet administrative-command system; Declaration of Kazakhstan’s independence; State system, socio-political development, foreign policy, and international relations <b>Practical classes:</b> Concept of nomadic civilization; Formation of Turkic civilization; Establishment of the Kazakh Khanate; Integration into the Soviet administrative-command system; Creation of independent Kazakhstan; Understanding socio-political development and its role in foreign policy; Methods and techniques for analyzing the causes of historical events in Kazakhstan.
Forms of Assessment / Examination	Current assessment: colloquia, written and oral tests. Final assessment: state 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. Dzhunusbaev, S.M. <i>Modern History of Kazakhstan</i> . Shymkent: M. Auezov University, 2022. 138 p. 2. Batyrbekkyzy, G., Kabanova, G. <i>Socio-Political Activity of the Kazakh Intelligentsia in the Early 20th Century</i> . Shymkent: M. Auezov University, 2022. 138 p. 3. Kosanbaev, S.K., Muldakhmetova, Zh.I., Mukasheva, A.O. <i>Lecture Notes on the History of Kazakhstan for Students of All Educational Programs</i> . Shymkent: M. Auezov University, 2022. 196 p. 4. Dzhunusbaev, S.M. <i>Science, Culture, and Public Education in the Postwar Years. Case Study</i> . Shymkent: M. Auezov University, 2022. 5. Omarbekov, T.O., Khabizhanova, G.B., Nurtazina, N.D. <i>History of Kazakhstan (Kazakh Eli)</i> . Almaty: Kazakh University, 2018. 402 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	<b>M 2, M 9 Kazakh (Russian) Language</b>
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD in philology, associate professor Utegenova G.Zh
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General Education Course
Teaching and Learning Methods	Practical classes
Workload (including contact hours and independent study)	Total workload – 150 hours: practical classes – 60 hours; independent work of learners (current) – 55 hours; independent work of learners (midterm) – 12.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	School-level Kazakh language course Professional Kazakh Language, Educational Practice
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: 1) provide social protection for students within the framework of the national idea of spiritual modernization—a general education discipline aimed at developing a humanitarian worldview; 2) teach future specialists that language is a connecting link in the acquisition of world-class knowledge, shaping their understanding based on national consciousness and cultural code, and ensuring perfect mastery of the state language by specialists working towards the country's development; and expand the scope of application of the Kazakh language in the training of specialists capable of ensuring modernization.
Indicative Content	The course ensures high-level acquisition of the Kazakh language as a social, intercultural, professional, and communicative tool, based on the cultural values of the Kazakh nation. It develops communicative competence across all forms of communication in accordance with proficiency levels A2, B1, B2, and C1, and includes instruction for foreign learners at level A1.
Forms of Assessment / Examination	Current assessment: 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. Karabaeva, Kh.A. <i>Qazaq tili: Til ūstartuǵa arnalǵan oqý quraly (2nd ed.)</i> . Almaty: Qazaq University, 2020. 148 p. ISBN 978-601-04-0651-3 2. Ashirova, A.T. <i>Qazaq tili: Oqý quraly</i> . Almaty: Qazaq University, 2021. 126 p. ISBN 978-601-04-0305-5 3. Beisenbai, A.B. <i>Qazirgi qazaq tili: Oqý quraly</i> . Almaty: Epigraf, 2018. 4. Ter-Minasova, S.G. <i>Language and Intercultural Communication</i> . Almaty: National Translation Bureau, 2018. 320 p. 5. Muratova, A.N. <i>Qazaq tili: Oqý quraly</i> . Almaty: Evero Publishing, 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	<b>M 4, M 10 Foreign Language</b>
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD, senior lecturer Satylkhanova G.A.
Language of Instruction	English
Relation to the Programme / Curriculum Placement	General Education Course, compulsory component
Teaching and Learning Methods	Practical classes
Workload (including contact hours and independent study)	Total workload – 150 hours: practical classes – 60 hours; independent work of learners (current)– 55 hours; supervised independent work – 35 hours
Number of Credits (ECTS)	5 ECTS

Prerequisites and Recommended Prior Knowledge	Basic foreign language course (school-level course)
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: - master basic lexical and grammatical structures necessary for everyday and academic communication - understand the main content of adapted texts and audio materials - engage in dialogues and monologues on familiar topics such as education, family, leisure, travel and others - compose short written texts, including personal letters, notes, and short descriptions - demonstrate reading comprehension skills and extract essential information from written texts - show awareness of sociocultural features of the target-language countries - appropriately express communicative intentions using relevant linguistic means in accordance with sociocultural norms - apply linguistic analysis techniques to identify causes and consequences in texts of academic and social character
Indicative Content	The course content is structured according to cognitive-linguocultural complexes aligned with international proficiency levels A1, A2, B1, and B2. These complexes include thematic areas and typical communicative situations in sociocultural, educational, and professional contexts. Language training is implemented through simulated activities for oral and written communication, writing tasks, and listening comprehension practice.
Forms of Assessment / Examination	Current assessment: listening tasks, problematic topics, discussions. 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. Murphy, R. <i>Essential Grammar in Use</i> (3rd ed.). Cambridge University Press. 2. Kay, S., & Jones, V. <i>New Intermediate Student's Book + CD-ROM</i> . Macmillan ELT. 3. English File (3rd edition) <i>Intermediate Student's Book</i> . Oxford University Press. 4. Kay, S., & Jones, V. <i>New Intermediate Workbook</i> . Macmillan ELT. 5. English File (3rd edition) <i>Intermediate Workbook</i> . Oxford University Press. 6. Ashimova, T.S., Mamekova, S.K., & Makulbek, A.B. <i>Methodical Instructions of SIW and SIWT for Students of the First Year of Technical Specialties</i> . M. Auezov SKU, Shymkent, 2021. 7. Torebek, D.O., & Yeszhanova, L.Sh. <i>Methodical Instruction for Foreign Students of the 1st Course</i> . M. Auezov SKSU, Shymkent, 2019.
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Module Title	<b>M 5, M 11, M 18, M 26 Physical Education</b>
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	Master of sciences, senior lecturer M. Chirva
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General education course, compulsory component
Teaching and Learning Methods	Practical classes
Workload (including contact hours and independent study)	Total workload – 60 hours: practical classes – 30 hours, independent work of learners – 30 hours.
Number of Credits (ECTS)	2 ECTS
Prerequisites and Recommended Prior Knowledge	School-level Physical Education course

Module Aims and Intended Learning Outcomes	After completing this module, students are able to -use basic scientifically grounded knowledge about the role of physical education and sports in developing vital physical qualities, maintaining health, and supporting optimal professional performance; -demonstrate a value-based attitude towards physical education and a sustainable interest in regular physical exercise and sports; -apply methods of physical training and body hardening to strengthen health and increase resistance to negative external factors; -demonstrate discipline, teamwork skills, readiness for mutual support, and effective group interaction; -develop psychological resilience, self-confidence, determination, courage, initiative, persistence, endurance, and self-control; -improve essential physical qualities such as endurance, strength, speed, agility, and flexibility; -develop communication skills, including the ability to use information from various sources and present it appropriately; -acquire skills of critical thinking, self-development, and research activity in the field of physical education and sports.
Indicative Content	<b>Practical classes:</b> formation of students' social and personal competencies and their ability to purposefully use means and methods of physical culture to maintain and strengthen their health, prepare for professional activity, cope with physical load, neuropsychological stress, and negative environmental factors.
Forms of Assessment / Examination	Current assessment: presidential physical fitness test. Final assessment: pass-fail grading test
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. Barchukov, I. S. <i>Physical Education: Textbook for University Students</i> . Moscow: Akademiya, 2013. 528 p. 2. Chirva, M. N. et al. <i>Outdoor Games and Relays in Volleyball Classes: Methodological Recommendations</i> . Shymkent: SKSU, 2018. 3. Shymirbekov, A. et al. <i>Guidelines for Studying the Discipline "Physical Education and Sport."</i> Shymkent: SKSU, 2018. 4. Marchibaeva, U. S., Sidorova, R. V., & Mendybaeva, N. A. <i>Physical Education. Methodological Course</i> . Almaty: New Book, 2018. 104 p. 5. Tleulov, E. D. <i>Methodological Instructions for Practical Classes in "Methods of Teaching Physical Education and Sports."</i> Shymkent: SKSU.
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	<b>M5 Higher Mathematics</b>
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD in pedagogical sciences, associate professor D. A. Zhunisbekova
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 – 150 hours: lectures – 30 hours; practical classes – 30 hours; independent work of learners – 55 hours; supervised independent work – 35 hours.
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	School-level Mathematics course
Module Aims and Intended Learning Outcomes	After completing this module, students is be able to -formulate the basic theorems, definitions, and formulas of higher mathematics;

	<ul style="list-style-type: none"> <li>-apply different methods for solving practical problems in higher mathematics;</li> <li>-use general scientific and general cultural skills for working with scientific information;</li> <li>-logically summarise the results of solving practical mathematical problems;</li> <li>-make informed decisions in preparation for future professional activity.</li> </ul>
Indicative Content	<p><b>Lectures:</b> Matrices. Matrix operations. Determinants of the second and third order and their properties. Minors and cofactors. Inverse matrix. Vector algebra. Analytical geometry. Second-order curves and surfaces. Differential and integral calculus of functions of one variable. Functions. Limits and their properties. Special limits. Derivatives and differentials of functions. Higher-order derivatives and differentials. Function analysis and graphing. Indefinite integral. Methods of integration. Definite integral and its applications.</p> <p><b>Practical classes:</b> Calculation of second- and third-order determinants. Solution of systems of linear algebraic equations. Linear operations with vectors and matrices. Determining equations of second-order curves. Limit calculation. Derivatives and differentials of functions. Indefinite and definite integrals.</p>
Forms of Assessment / Examination	<p>Current assessment: problem solving, tests</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"> <li>1. Ovchinnikov, A. V. <i>Algebra and Geometry: Lecture Course</i>. Moscow State University, 2016. 360 p.</li> <li>2. Beklemishev, D. V. <i>Course in Analytical Geometry and Linear Algebra</i>. 19th ed. St. Petersburg: Lan', 2022. 448 p.</li> <li>3. Zadorozhnyi, V. N., Zalmez, V. F., Trifonov, A. Yu., &amp; Shapovalov, A. V. <i>Higher Mathematics for Technical Universities (5 vols.)</i>. Tomsk Polytechnic University, 2014.</li> <li>4. Zhunisebekova, D. A., &amp; Utenov, N. M. <i>Algebra and Geometry: Textbook</i>. Shymkent: M. Auezov University, 2022. 123 p.</li> <li>5. Zhunisebekova, D. A. <i>Lecture Notes on Mathematical Analysis</i>. Shymkent: M. Auezov University, 2020. 160 p.</li> <li>6. Vygodsky, M. <i>Higher Mathematics: Handbook</i>. URSS Publishing Group, 2021. 870 p.</li> <li>7. Bittinger, M. L., Ellenbogen, D. J., &amp; Sargent, S. A. <i>Calculus and its Applications</i>. Pearson Education, 2012. 729 p.</li> </ol>
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	<b>M 6 General Chemistry</b>
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	Master of science, senior lecturer A. M. Serikbayeva
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 – 15 hours; laboratory classes – 30 hours; independent work of students – 50 hours; supervised independent work – 25 hours.
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	School-level Chemistry course
Module Aims and Intended Learning Outcomes	<p>After completing this module, students is be able to</p> <ul style="list-style-type: none"> <li>-know the fundamental laws of chemistry and principles of the structure of matter;</li> <li>-apply theoretical knowledge in performing chemical experiments;</li> </ul>

	<p>-demonstrate practical skills in working with laboratory equipment and reagents;</p> <p>-conduct experiments individually and in groups, analyse results and formulate conclusions;</p> <p>-work effectively in a team, discuss outcomes and participate in scientific discussions;</p> <p>-comply with safety regulations and environmental responsibility in the laboratory.</p>
Indicative Content	<p><b>Lectures:</b> Basic concepts and laws of chemistry. Atomic structure and chemical bonding. General patterns of chemical reactions. Definition and classification of solutions. Classification and properties of organic compounds. Scientific search for information on chemical substances and environmental processes in the biosphere caused by pollution.</p> <p><b>Practical classes:</b> Laboratory safety rules. Working with laboratory equipment and glassware. Study of physical and chemical properties of substances. Preparation and dilution of solutions of specified concentration. Qualitative reactions for ions (cations and anions). Ionic exchange reactions in electrolyte solutions. Acid-base reactions and pH determination. Redox reactions. Titration method. Electrolysis and electrochemical processes. Reaction rate and influencing factors. Chemical equilibrium and the influence of external conditions.</p>
Forms of Assessment / Examination	<p>Current assessment: colloquia, written and oral quizzes, problem-solving.</p> <p>Final assessment: examination</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. Nazarbekova, S. P., Tleuov, A. S., Aueshov, A. P., Beisbekova, R. D., &amp; Toktibayeva, K. R. <i>Lectures on Chemistry</i>. Shymkent: OKMU, 2013.</li> <li>2. Glinka, N. L. <i>General Chemistry</i>. Moscow: KNORUS, 2010. 752 p.</li> <li>3. Khomchenko, I. G. <i>General Chemistry</i>. Moscow: New Wave, 2010. 464 p.</li> <li>4. Nazarbekova, S. P., Tleuov, A. S., Aueshov, A. P., Beisbekova, R. D., &amp; Toktibayeva, K. R. <i>Energetics and Kinetics of Chemical Processes</i>. Shymkent: SKSU, 2013.</li> <li>5. Nazarbekova, S. P., Tleuov, A. S., Aueshov, A. P., Beisbekova, R. D., &amp; Toktibayeva, K. R. <i>Chemistry Practicum</i>. Shymkent: SKSU, 2013.</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M 7.1 Fundamentals of Biotechnology</b>
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Akhanov U.K.
Language of Instruction	Kazakh
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	<p>Lectures: discussions, brainstorming, problem-based learning, conference format, lecture-consultation, visual lecture</p> <p>Laboratory classes: group research activities</p>
Workload (including contact hours and independent study)	Total workload – 90 hours: lectures – 15 hours, laboratory classes – 15 hours, independent work of learners (current) – 45 hours, independent work of learners (midterm) – 7.5 hours, supervised independent work – 7.5 hours
Number of Credits (ECTS)	3 ECTS
Prerequisites and Recommended Prior Knowledge	School-level Biology course
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <p>-explain the principles of industrial production of antibiotics, enzymes, amino acids, polysaccharides, etc.</p> <p>-independently conduct experiments and work with microbial cultures</p>

	<p>-handle major biotechnology objects such as microorganisms, plant and animal cells</p> <p>-understand purity and activity requirements of various cultures and preparations used in biotechnology</p> <p>-evaluate approaches to cultivating plant and animal cells in nutrient media</p> <p>-understand methods of cultivating different biological objects in various media</p>
Indicative Content	<p><b>Lectures:</b> Major directions of biotechnology development, advantages and characteristics of biotechnological processes. Objects and methods of biotechnology. Genetic and cellular engineering. Current challenges of biotechnology in Kazakhstan.</p> <p><b>Laboratory classes:</b> Organization of a biotechnology laboratory. Safety regulations. Preparation and microscopy of microbial samples. Preparation of staining solutions. Study of microbial structure and properties.</p>
Forms of Assessment / Examination	<p>Current assessment: tests, quizzes, feedback-based assignments, written and oral questioning.</p> <p>Final assessment: written examination</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. Zagoskina, N. V., &amp; Nazarenko, L. V. (Eds.). (2025). <i>Fundamentals of Biotechnology: Textbook and Practical Manual for Secondary Professional Education (4th ed.)</i>. Moscow: Urait.</li> <li>2. Yesimova, A. M. (2021). <i>Biologiialyq belsendi zattardyn biotekhnologiiasy</i>. Almaty: Evero Publishing.</li> <li>3. Biryukov, V. V. (2024). <i>Fundamentals of Industrial Biotechnology: Textbook for Higher Education Institutions</i>. Moscow: Koloss.</li> <li>4. Chechina, O. N. (2023). <i>General Biotechnology (2nd revised and expanded ed.)</i>. Moscow: Urait.</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M 7.2 Fundamentals of Academic Writing</b>
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Akhanov U.K.
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, supervised independent work – 25 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	M6 Chemistry
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-independently use modern methods of academic research and writing and apply them within their field of study</li> <li>-apply knowledge and understanding of facts, theories, and complex relationships within their area of specialization</li> <li>-understand the principles and culture of academic integrity</li> <li>-participate in professional discussions in their discipline and related fields in a foreign language</li> <li>-conduct research while observing principles of academic ethics, understanding personal responsibility for the research purpose, methods, and outcomes</li> </ul>

	-demonstrate methods of professional information retrieval, techniques of analytical and synthetic information processing, and rules for writing annotations and summaries of academic texts
Indicative Content	<b>Lectures:</b> Academic discourse: style and genres of scholarly writing. Key features of academic style. Nonlinear text organization: from method to technology. Paragraph structure and topic sentences. Academic text as a system. Introduction and conclusion: functions, structure, and interrelation. Skeleton structure of essays, theses, and research papers. Principles and techniques of argumentation. <b>Practical classes:</b> Functional and stylistic features of official and journalistic writing. Genres: résumé, review, annotation, etc. Types and characteristics of formal and publicistic registers. Oral presentation: language structure, logical transitions, rhetorical devices. Preparing conference abstracts and applications for participation in academic events.
Forms of Assessment / Examination	Current assessment: group projects, discussions, essays, 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. Korotkina, I. B. (2020). <i>Akademicheskoe pis'mo: protsess, produkt i praktika</i> . Moscow: Urait. 2. Kuvshinskaya, Yu. M. (2020). <i>Akademicheskoe pis'mo: ot issledovaniia k tekstu</i> . Moscow: Urait. 3. Menailo, V. V. (2019). <i>Akademicheskoe pis'mo. Leksika. Developing Academic Literacy</i> . Moscow: Urait. 4. Kirillova, O. V. (2017). <i>Methodological Guidelines for the Preparation and Publication of Articles in Journals Indexed in International Scientific Databases</i> . Moscow. 5. Bailey, S. (2018). <i>Academic Writing: A Handbook for International Students (5th ed.)</i> . London: Routledge.
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	<b>M 8.1 Fundamentals of Anti-Corruption Culture</b>
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	PhD in pedagogy, associate professor Tleulov B. E.
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 – 90 hours: lectures – 15 hours, practical classes – 15 hours, independent work of learners – 45 hours, supervised independent work – 15 hours
Number of Credits (ECTS)	3 ECTS
Prerequisites and Recommended Prior Knowledge	School-level courses: History of Kazakhstan, “Man. Society. Law”
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -describe the concept of corruption, its essence and defining characteristics -explain forms and mechanisms of corruption and their practical manifestations -compare corruption phenomena at national and international levels -analyse corruption problems by identifying key elements and interrelations -determine criteria and main elements of anti-corruption policies in global and national contexts -evaluate the effectiveness of different anti-corruption measures and strategies -apply acquired knowledge to participate in the development and discussion of anti-corruption measures

Indicative Content	<p><b>Lectures:</b> The concept, features and legal nature of corruption as a socio-legal phenomenon. Legal principles of anti-corruption policy. Legal status of civil servants and anti-corruption behavioural requirements. Criminal liability for corruption offenses. Role of authorized state bodies in combating corruption. Criminal law instruments against corruption.</p> <p><b>Practical classes:</b> Corruption and principles of its prevention. Combating corruption in the civil service. Concept of the subject of corruption offences. Anti-Corruption Service of the Republic of Kazakhstan: powers, structure and functions. Causes and forms of corruption. Criminal law mechanisms of counteraction</p>
Forms of Assessment / Examination	<p>Current assessment: debates, intellectual quizzes.</p> <p>Final assessment: examination</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. <i>Countering Corruption and Improving Public Services Standards: Experience of New Zealand, Australia and Malaysia.</i> (2006). London: DAI.</li> <li>2. Rogow, A. A. (2005). <i>Power, Corruption and Honesty</i> (Russ. ed.). Moscow: RAGS.</li> <li>3. Karpovich, O. G., &amp; Shulepov, N. A. (2014). <i>White-Collar Crime in the USA Through the Lens of the Global Financial and Economic Crisis.</i> Moscow: UNITY-DANA.</li> <li>4. Abdykarimov, O. A. (2005). <i>Current Issues in Combating Corruption in the Republic of Kazakhstan.</i> Astana: Academy of Public Administration under the President of RK.</li> <li>5. Maulenov, G. S. (2005). <i>Corruption as a Social Phenomenon and Measures for its Prevention.</i> Astana: Academy of Public Administration under the President of RK</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M 8.2 Abai Studies</b>
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	Master of science, head of the scientific center "History and Ethnology" Torgautova Sh.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 – 90 hours: lectures – 15 hours; practical classes – 15 hours; independent work of learners – 45 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	3 ECTS
Prerequisites and Recommended Prior Knowledge	History of Kazakhstan and World History at the level of general secondary education and technical/vocational education programs
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-demonstrate knowledge of the methodology and key concepts of Abai Studies;</li> <li>-understand the specifics and patterns of the literary process shaping the artistic uniqueness of Kazakh literature of the 19th–20th centuries, and its connection to historical developments;</li> <li>-identify fundamental patterns, typical phenomena, and transitional cases in literary processes;</li> <li>-apply methods for studying literary processes and interpret the literary works of Abai Kunanbaev;</li> <li>-discuss ethical and moral principles in the concept of the “holistic human” proposed by Abai, fostering deep thinking, diligence, and development of socially responsible professional citizens.</li> </ul>

Indicative Content	<p><b>Lectures:</b> Historical overview of Kazakhstan’s history and Kazakh literature of the 19th–20th centuries; studies of Abai’s legacy from the 20th to 21st century; chronology of Abai’s works.</p> <p><b>Practical classes:</b> Abai as a great poet, ethnographer, and founder of Kazakh written literature; Abai as compiler of the legal code “Karaboly Regulations” and its social significance; Abai as a thinker, religious scholar, and philosopher; Abai’s role in education and science, the concept of the “Holistic Human”; Abai’s Book of Words; the epic novel <i>The Path of Abai</i> by M. Auezov; K. Tokayev <i>Abai and Kazakhstan in the 21st Century: role and significance</i></p>
Forms of Assessment / Examination	<p>Current assessment: debates, intellectual quizzes.</p> <p>Final assessment: state 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"> <li>1. Abai Kunanbayev. <i>Book of Words</i>. ISBN 978-601-82142-2-6. 2025. Sana Publishing.</li> <li>2. A.U. Suzhikova. <i>The Great Abai</i>. 2025. ISBN 978-601-01-4789-8. – 295 p.</li> <li>3. T. Gabbas. <i>Abai. Monograph. For researchers, doctoral and master’s students</i>. Almaty: Shabyt, 2020. – 168 p.</li> <li>4. Makyn, Kairzhan Khadji. <i>The Flame Kindled by Abai: Enlightenment Articles and Reflections</i>. Almaty: Tamyр, 2020. – 335 p.</li> <li>5. Abai. <i>Book of Words / Abai</i>. Semey: Abai International Club, 2005. – 181 p. (Library Journal “Amanat”; No. 15)</li> </ol>
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	<b>M 8.3 Mukhtar Studies</b>
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	Master of science, head of the scientific center "History and Ethnology" Torgautova Sh.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 – 90 hours: lectures – 15 hours; practical classes – 15 hours; independent work of learners – 45 hours; supervised independent work – 15 hours.
Number of Credits (ECTS)	3 ECTS
Prerequisites and Recommended Prior Knowledge	Prerequisites: History of Kazakhstan and World History as covered in secondary, technical, and vocational education programs
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-know the history of the formation and development of Mukhtar studies and read the prose works of the writer;</li> <li>-read and collect information on the creative activity of Mukhtar Auezov;</li> <li>-master the key dates of Mukhtar Auezov’s life and creative work; understand the significance and role of Mukhtartanu (Mukhtar studies) in Kazakh literature.</li> </ul>
Indicative Content	<p><b>Lectures:</b> Life and creative path of M. Auezov during Semipalatinsk, Tashkent, and Saint Petersburg periods; M. Auezov’s activity in the journals “Sholpan” and “Abai”.</p> <p><b>Practical classes:</b> M. Auezov’s journalism; literary review of short stories “A Day of the Defenseless”, “Steppe Pictures”, “The Reading Citizen”, “Grey Furious”, the play “Enlik-Kebek”, novellas “Hard Times”, “The Event at Kara-Karash”; monographs “Abai Kunanbayev”; the epic novel “The Path of Abai”.</p>
Forms of Assessment / Examination	<p>Current assessment: debates, intellectual 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 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Kalshabekov A.B. <i>Mukhtartanu</i> . Video lecture, YUKU, Shymkent, 2020. 2. Kuzembayev E. <i>Mukhtartanu</i> : Textbook. Almaty: Ekonomika, 2006. – 336 p. – ISBN 9965-783-12-8 3. Pyraly G. <i>Modern Mukhtar Studies</i> . 2014. – 320 p. – ISBN 978-601-7448-71-7 4. Auezov M. <i>The Path of Abai</i> (set of four books). 2024. – ISBN 978-601-7910-45-7 5. Kushkimbayeva A. <i>The Language Personality of Mukhtar Auezov</i> . 2024. – 167 p. – ISBN 978-625-594-33-646
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	<b>M 8.4 Fundamentals of Artificial Intelligence</b>
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD in technical sciences, associate professor Ismailov Kh.B.
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 – 90 hours: lectures – 15 hours; practical classes – 15 hours; independent work of learners - 45 hours; supervised independent work- 15 hours
Number of Credits (ECTS)	3 ECTS
Prerequisites and Recommended Prior Knowledge	School-level Informatics course
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: - demonstrate understanding of the basic principles of artificial intelligence and its applications across various fields; - use AI tools to solve practical tasks without the need for programming; - apply large language models (LLMs) for text processing, content generation, and natural language interaction; - analyse and visualise data using AI tools and interpret outcomes based on analytical results; - assess the capabilities and limitations of AI and integrate AI-Sana programme approaches to unlock the potential of artificial intelligence in educational and professional contexts.
Indicative Content	<b>Lectures:</b> Introduction. Artificial neural networks – main properties and applications. Electronics and computer computation; the biological neuron and its mathematical model; structure of artificial neurons; classification and properties of neural networks; single-layer and multi-layer artificial neural networks; linear separability and perceptron representation. <b>Practical classes:</b> Key concepts and objects of neural networks; problems solved by artificial neural networks; characteristics of neural networks; training of artificial neural networks; back-propagation learning algorithm.
Forms of Assessment / Examination	Current assessment: group and mini-projects on developing chatbots and AI services. Final assessment: examination
Learning and Examination Requirements	During the semester, students must complete all tasks 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. Borovskaya, E.V., & Davydova, N.A. <i>Fundamentals of Artificial Intelligence</i> : Textbook. 4th ed. Moscow: Laboratory of Knowledge, 2020. – 130 p. 2. Galushkin, A.I. <i>Theory of Neural Networks</i> . Moscow: Radiotekhnika Publishing, 2000.

	<p>3. Markoff, J. <i>Machines of Loving Grace: The Quest for Common Ground Between Humans and Robots</i>. 2020. ISBN 978-5-00139-243-9.</p> <p>4. Russell, S., &amp; Norvig, P. <i>Artificial Intelligence: A Modern Approach</i> (AIMA-2). 2nd ed. ISBN 978-5-8459-1968-7, 2015.</p> <p>5. Knuth, D.E. <i>The Art of Computer Programming</i>, Vol. 1: Fundamental Algorithms. 3rd ed. ISBN 978-5-8459-1984-7, 2015.</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	<b>M 12.1 Information and Communication Technologies</b>
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD, associate professor Shaimerdenova G. S.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General Education Course, compulsory component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total workload – 150 hours: lectures – 30 hours; laboratory classes– 30 hours; independent work of learners -55 hours; supervised independent work -35 hours.
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M 12.1 Higher Mathematics, M 12.2 Probability Theory and Mathematical Statistics
Module Aims and Intended Learning Outcomes	To develop students’ ability to critically evaluate and analyse processes, methods of searching, storing, and processing information, as well as means of collecting and transmitting data through digital technologies. It also focuses on fostering a new “digital” mindset and equipping students with knowledge and skills for using modern information and communication technologies in various fields of activity.
Indicative Content	<p><b>Lectures:</b> Introduction and architecture of computer systems. Software. Operating systems. Human–computer interaction. Database systems. Database management. Networks and telecommunications. Cybersecurity. Internet technologies. Cloud and mobile technologies. Multimedia technologies. Smart technologies. Electronic technologies. E-business. E-government.</p> <p><b>Laboratory sessions:</b> Calculation of computer system performance metrics: speed, efficiency, energy consumption, Amdahl’s law, CPU time. Examination of operating system properties. File and directory management. Identifying requirements for developing a “user-friendly” website. Database structure design, creation of tables and queries. Working with the relational database MySQL. Database administration in MySQL using phpMyAdmin. Working with single-table databases</p>
Forms of Assessment / Examination	Current assessment: colloquia, written and oral questioning, problem-solving 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)	<p>1. Dzhusupbekova G. T., Mombekova S. S., Shaimerdenova G. S. <i>Lecture Notes on “Information and Communication Technologies” for Students of All Educational Programmes</i>. 132 p., 2023.</p> <p>2. Zhailaubayev N. M., Mombekova S. S., Turganbekova M. <i>Collection of Lectures on “Information and Communication Technologies” for Students of All Educational Programmes</i>. 136 p., 2023.</p> <p>3. Utelbayeva A. K., Bibulova D. A., Rakhymbek N. Zh. <i>Collection of Lectures on the Subject “Information and Communication Technologies” for Students of All Educational Programmes</i>. 135 p., 2023.</p> <p>4. Karatayeva M. S., Abdikerim G. Zh., Temirbekova F. E. <i>Laboratory Works for Students of All Educational Programmes in the Subject “Information and Communication Technologies”</i>. 103 p., 2023.</p>

	5. Kumar, R. <i>Information and Communication Technologies</i> . Laxmi Publications Pvt Ltd., 2009. ISBN 978-8131805190
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	<b>M 13 Physics</b>
Semester(s) in which the module is taught	1st semester
Module Leader / Coordinator	Doctor of pedagogical sciences, professor Ponomarenko E. V.
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: lectures – 30 hours; laboratory classes– 30 hours; independent work of learners -55 hours; supervised independent work -35 hours.
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	School-level Physics course
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -identify the physical content of applied problems, propose methods, and develop algorithms for their solution based on the analysis of problem situations and the application of core physical concepts; -apply an interdisciplinary approach and establish analogies between theoretical and conceptual patterns of classical and modern physics; -plan and perform laboratory experiments and process their results using methods of scientific research, dimensional analysis, and mathematical statistics; -critically evaluate the reliability and validity of theoretical and experimental research results; -develop and select the most effective methods of obtaining and applying information to increase the scientific and technological level of modern technologies in the field of ecology.
Indicative Content	<b>Lectures:</b> Structure and objectives of the physics course. Measurement of physical quantities. Mechanical motion. Types of forces in mechanics. Rotation of a rigid body. Conservation laws as consequences of space and time symmetry. Physics of continuous media. General characteristics of mechanical oscillations and waves. Fundamentals of molecular-kinetic theory. Fundamentals of thermodynamics. Van der Waals equation. Fundamentals of electrostatics. Electric capacitance. General characteristics and conditions for the existence of electric current. Main characteristics of the magnetic field. Types of magnetic materials. Faraday’s law. <b>Laboratory classes:</b> Mathematical processing of direct measurement results. Mathematical processing of indirect measurement results. Study of the laws of rotational motion using the Oberbeck pendulum. Determination of a liquid’s viscosity coefficient by Stokes’ method. Study of diffraction phenomena. Study of light dispersion.
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral questioning, completion of test assignments, participation in a group project, performance and defense of laboratory work results. Final assessment: examination.
Learning and Examination Requirements	During the semester, students must complete all tasks 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. Trofimova T. I. <i>Physics Course</i> . Moscow: Alfa+, 2020. – 560 p. 2. Trofimova T. I. <i>Problem Book for the Physics Course</i> . Moscow: Oniks 21 vek, 2019. – 384 p. 3. Karaoglu B. <i>Classical Physics: A Two-Semester Coursebook</i> . Springer, 2020. – 408 p.

	<p>4. Stavrov I. <i>Curvature of Space and Time, with an Introduction to Geometric Analysis</i>. American Mathematical Society, 2020. – 123 p.</p> <p>5. Halliday D. et al. <i>Principles of Physics: Extended International Adaptation</i>. Wiley, 2023. – 145 p.</p> <p>6. Balkose D. et al. <i>Physics and Mechanics of New Materials: Synthesis, Processing, and Emerging Applications</i>. CRC Press, 2024. – 304 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	<b>M14.1 Laboratory Practice</b>
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Elemanova Z. R.
Language of Instruction	Kazakh
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Laboratory work
Workload (including contact hours and independent study)	Total workload – 150 hours: laboratory classes – 60 hours; independent work of learners (current) – 55 hours; independent work of learners (midterm) – 12.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M7.1 Fundamentals of Biotechnology or M7.2 Fundamentals of Academic Writing
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-organize and safely conduct laboratory work following sanitary and technical requirements;</li> <li>-use laboratory equipment, instruments, and measuring tools for chemical and biological analyses;</li> <li>-prepare solutions of specified concentration and measure physical and chemical parameters of substances;</li> <li>-apply titrimetric, photometric, and qualitative analytical methods to determine sample composition;</li> <li>-document laboratory experiment results, analyze data, and assess measurement accuracy;</li> <li>-follow proper waste disposal procedures and maintain order in the laboratory environment.</li> </ul>
Indicative Content	<p><b>Laboratory classes:</b> Introduction to laboratory organization, equipment, and instruments; Safety rules, sanitary norms, and proper handling of reagents; Calibration of laboratory equipment and verification of measurement accuracy; Preparation of solutions of specified concentration, working with volumetric glassware, pipettes, and burettes; Performing weighings, temperature and pH measurements, and determination of substance concentration using titrimetric and photometric methods; Conducting qualitative reactions for cation and anion identification; Maintaining laboratory notebooks, preparing protocols and reports; Working with microscopes, centrifuges, and other equipment; following waste disposal rules and keeping the workspace clean.</p>
Forms of Assessment / Examination	<p>Current assessment: successful completion of laboratory tasks; colloquia; written control works; written and oral quizzes.</p> <p>Final assessment: state 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)	<p>1. Seidman, L. A., Moore, C. J., &amp; Mowery, J. <i>Basic Laboratory Methods for Biotechnology: Textbook and Laboratory Reference, 3rd ed.</i>, CRC Press, 2022.</p> <p>2. Seidman, L. A., Kraus, M. E., Brandner, D. L., &amp; Mowery, J. <i>Laboratory Manual for Biotechnology and Laboratory Science: The Basics (Revised Edition)</i>, Routledge, 2023.</p>

	3. Elzagheid, M. <i>Chemical Laboratory: Safety and Techniques</i> , Walter de Gruyter GmbH & Co KG, 2022.
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	<b>M14.2 Refrigeration Technology</b>
Semester(s) in which the module is taught	2nd semester
Module Leader / Coordinator	PhD, associate professor Ermekbayeva Akbopé Tontayevna Master of sciences, lecturer Kudasova Dariha Eradilovna
Language of Instruction	Russian
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Laboratory work
Workload (including contact hours and independent study)	Total workload – 150 hours: laboratory classes – 60 hours; independent work of learners – 55 hours; independent work of students – 22.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M19 Chemistry
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: Knowledge: Understand the thermodynamic values of refrigeration processes, theoretical foundations of industrial refrigeration methods, principles of design for refrigeration machines and systems, including main and auxiliary equipment. Skills: Identify main refrigerants and their properties, safely operate refrigeration equipment, apply methods and techniques for refrigeration treatment of food products, and understand the main processes occurring in food products. Abilities: Perform calculations of parameters for refrigeration processes, estimate product and cooling requirements, calculate refrigeration machines, devices, and systems, and select main and auxiliary equipment. Competences: Apply knowledge of heat transfer and humidity control in food processing; demonstrate competence in the design and operation of refrigeration equipment for biotechnological and food industry applications.
Indicative Content	Cooling in the food industry and the development of refrigeration technology; Fundamentals of artificial cooling; Basic thermodynamic laws; Carnot cycle; classification of refrigeration equipment; Vapor compression, absorption cooling, and ejector refrigeration equipment; Heat transfer in refrigeration technology, types of heat exchange; Theory of similarity; Application of refrigeration technology in biotechnological and food industry processes.
Forms of Assessment / Examination	Current assessment: colloquia, written control works, written and oral quizzes. 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. Ghapani, A., Nemati Lay, E., Noushabadi, A. S., Asadi, J., Eisapour, M., Dashti, A., & Mohammadi, A. H. <i>Developing the machine learning models to estimate thermodynamic and transport properties of refrigerants</i> . International Journal of Green Energy. <a href="https://doi.org/10.1080/15435075.2025.2464156">https://doi.org/10.1080/15435075.2025.2464156</a> 2. Azizov, D., & Saidiev, F. <i>Fundamentals of Refrigeration Technology and Technical Maintenance of Refrigeration Systems</i> . Tashkent: Baktria Press, 2017. – 176 p. 3. Bhatia, A., & B.E. <i>Fundamentals of Mechanical Refrigeration Systems</i> . <a href="https://www.pdhonline.com/index.cgi">https://www.pdhonline.com/index.cgi</a> 4. <i>Selection of Fluids Optimizing Performance and Costs of a Refrigeration Ejector Cycle Driven by Low-Temperature Waste Heat</i> . 16th International Conference on Sustainable Energy Technologies – SET 2017

	5. Viegas, H. <i>Liquid Carbon Dioxide Transport Refrigeration System</i> . Proceedings of the 21st International Congress of Refrigeration, Washington, DC, USA, 17–22 August 2003. International Institute of Refrigeration (IIR/IIF), Paris, France.
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	<b>M 15 Philosophy</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in philosophy, associate professor N.A. Ibraeva
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General Education Course, compulsory 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 – 55 hours; supervised independent work – 35 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M 1 History of Kazakhstan, M 2.1 Abai Studies, M 2.2 Mukhtar Studies, M 2.3 Fundamentals of Anti-Corruption Culture, M 2.4 Fundamentals of Artificial Intelligence
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: - understand the place and role of philosophy in the life of society and the individual, as well as the main stages of the development of world and Kazakh philosophical thought - identify historical and contemporary philosophical movements - describe the main methods and principles of philosophy - apply philosophical methodology to analyse social and political problems - analyse contemporary social and political issues
Indicative Content	<b>Lectures:</b> History of philosophical thought. Key problems, concepts and categories of philosophy. Classical and neo-classical philosophy. Dialectics and synergetics, possibilities and limits of knowledge. Philosophical anthropology. Social philosophy. Philosophical reflection on global contemporary challenges. <b>Practical classes:</b> Concept of philosophical knowledge. Relationship between philosophy and specific sciences. Philosophy of the Ancient East, Classical Antiquity, Medieval philosophy of the East and West, Renaissance philosophy, Early Modern philosophy. Classical German philosophy: Kant’s ethics, Hegel’s logic, Feuerbach’s anthropological materialism. Western European philosophy of the late 17th – early 21st centuries. Kazakh philosophy: history and modernity. Concepts of “being” and “consciousness.” Dialectics and synergetics. Theory of cognition, specifics of scientific knowledge. The problem of the human being in philosophy. Philosophy of society. Philosophy of global challenges.
Forms of Assessment / Examination	Current assessment: defence of essays, presentations on assigned topics, oral questioning, written tests. Final assessment: state 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. Khasanov, M. Sh., Petrova, V. F., & Khasanova, A. M. (2019). <i>Osnovy filosofii</i> (Fundamentals of Philosophy). Almaty: SSK. 2. Khasanov, M. Sh., & Petrova, V. F. (2015). <i>Vvedenie v filosofiyu</i> (Introduction to Philosophy) (2nd ed., revised and expanded). Almaty: Kazakh University. 3. Altaev, Zh., Kasabek, A., & Masalimova, A. (2019). <i>Kazakhskaya filosofiya</i> (Kazakh Philosophy) (4th ed.). Almaty: Epigraf. 4. Grayling, A. C. (2019). <i>The History of Philosophy</i> . ISBN-10: 198487876X.

	5. Lee, D., & Mode, A. (2024). <i>365 Days of Philosophy: A Year of Daily Lessons from the World's Greatest Thinkers, from Socrates to Sartre</i> . ISBN 979-8336800685.
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	<b>M 16 Sociology and Political Science</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD, associate professor Montayev A.B.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General Education Course, compulsory component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 120 hours: lectures – 15 hours; practical classes – 30 hours; independent work of learners – 50 hours; supervised independent work – 25 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	M 1 History of Kazakhstan, M 2.1 Abai Studies, M 2.2 Mukhtar Studies, M 2.3 Fundamentals of Anti-Corruption Culture, M 2.4 Fundamentals of Artificial Intelligence
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: - understand the fundamental principles of public policy management - build effective communication based on the goals and context of interaction and conduct sociological research - apply methods of applied sociology - formulate contemporary sociological and political theories - analyse social and political phenomena using basic theories and methods of sociology and political science
Indicative Content	<b>Lectures:</b> History of formation and development of sociology and political science. Contemporary sociological and political theories. Applied sociology and its challenges. Structure of the political sphere of society. Methodology and methods of sociological research. Sociology of personality and deviant behaviour. Sociology of labour and economy. Political power. Civil society. Political modernisation. Contemporary conflicts and methods of resolution. World politics and geopolitics. <b>Practical classes:</b> Specific features of sociology as an independent science. Key paradigms of political science. History of the development of sociological science. Directions of modern sociological thought. Sociological research as a form of cognitive activity. Sociological methods of research. Theories of social development. Social structure of society: groups, organisations, institutions. Sociological study of the individual. Social deviance. Systems of social structure and stratification. Labour, work and economic life
Forms of Assessment / Examination	Current assessment: discussions, debates, written tests. 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. Akbayeva, A., & Akbayeva, L. (2020). <i>Sotsiologiya</i> (Sociology). Almaty: Lantar Treid. 2. Lapin, N. I. (2025). <i>Obshchaya sotsiologiya</i> (General Sociology). Moscow: Yurayt. 3. Mukhaev, R. T. (2025). <i>Politologiya. Teoriya i mekhanizmy funktsionirovaniya politiki</i> (Political Science: Theory and Mechanisms of Political Functioning) (6th ed.). Moscow: Yurayt. 4. Schaefer, R. (2023). <i>Sociology: A Brief Introduction</i> (14th ed.). 5. Myneni, S. R. (2023). <i>Political Science</i> . Allahabad Law Agency.
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	<b>M 17 Cultural Studies and Psychology</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in philosophy, associate professor Ibraeva N.A.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General Education Course, compulsory component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 120 hours: lectures – 15 hours; practical classes – 30 hours; independent work of learners – 50 hours; supervised independent work – 25 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	M 1 History of Kazakhstan, M 2.1 Abai Studies, M 2.2 Mukhtar Studies, M 2.3 Fundamentals of Anti-Corruption Culture, M 2.4 Fundamentals of Artificial Intelligence
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -demonstrate knowledge and understanding of the field of study, including elements of the most advanced knowledge in this area -apply methodological and research skills in scientific inquiry, teaching and educational work -formulate and solve tasks arising in research activities that require advanced professional knowledge -navigate key issues in the development of contemporary culture, science, technology and innovation
Indicative Content	<b>Lectures:</b> Fundamental regularities of world cultural development; structure of cultural processes; interaction between cultures; major concepts, schools and stages in cultural theory; analysis of contemporary cultural practices from the perspective of intercultural dialogue; cultural codes and symbols; development of critical reflection on cultural phenomena. <b>Practical classes:</b> Concept of culture; functions of culture; typology of cultures; symbol and sign in culture; intercultural communication; contemporary cultural processes; culture and globalisation.
Forms of Assessment / Examination	Current assessment: role-playing activities, psychological tests, student presentations, oral questioning, written tests. Final assessment: test 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. Storey, J. (2021). <i>Cultural Theory and Popular Culture: An Introduction</i> . Routledge. 2. Ferraro, G. P., & Briody, E. K. (2020). <i>The Cultural Dimension of Global Business</i> . Routledge. 3. Matsumoto, D., & Juang, L. (2022). <i>Culture and Psychology</i> . Cengage Learning. 4. Zholdubaeva, A. K. (2014). <i>Kul'turologiya: praktikum</i> (Cultural Studies: Practice Manual). Almaty: al-Farabi KazNU. 5. Ilyin, E. P. (2014). <i>Psikhologiya obshcheniya i mezlichnostnykh otnoshenii</i> (Psychology of Communication and Interpersonal Relations). Saint Petersburg: Piter.
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	<b>M 19 Professional Kazakh (Russian) Language</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in philology, associate professor Utegenova G.Zh.

Language of Instruction	Kazakh, Russian
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 – 90 hours: practical classes – 30 hours; independent work of learners (current) – 45 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	3 ECTS
Prerequisites and Recommended Prior Knowledge	M 8 Kazakh (Russian) Language
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the norms of modern Kazakh (Russian) literary language and the specifics of professional discourse -use the Kazakh language in oral and written professional communication -apply skills for creating and formatting business and academic texts within their field of study -analyse, edit and correctly interpret professional texts
Indicative Content	<b>Practical classes</b> focus on the development of communicative competence in all forms of language activity within a professional context, ensuring confident command of the Kazakh language as a social, intercultural and professional tool, in accordance with proficiency levels A2, B1, B2, C1 for native speakers and A1 for learners of Kazakh as a foreign language.
Forms of Assessment / Examination	Current assessment: written tests; written and oral questioning. Final assessment: written 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. Karabaeva, Kh. A. (2020). <i>Qazaq tili: til ustartuğa arnalğan oqu quraly</i> (2nd ed.). Almaty: Qazaq Universiteti. 2. Ashirova, A. T. (2021). <i>Qazaq tili: oqu quraly</i> . Almaty: Qazaq Universiteti. 3. Beisenbai, A. B. (2018). <i>Qazirgi qazaq tili</i> . Almaty: Epigraf. 4. Ter-Minasova, S. G. (2018). <i>Til jäne mädeniet aralyq kommunikacija</i> (Kazakh translation). Almaty: Ultyq Audarma Byurosy. 5. Muratova, A. N. (2020). <i>Qazaq tili: oqu quraly</i> . Almaty: Evero Publishing.
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	<b>M20 Professionally-Oriented Foreign Language</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in philology, associate professor Kudasova D.E.
Language of Instruction	Kazakh, Russian, 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 – 90 hours: practical classes – 30 hours; independent work of learners – 45 hours; independent work of students – 7.5 hours; supervised independent work – 7.5 hours.
Number of Credits (ECTS)	3 ECTS
Prerequisites and Recommended Prior Knowledge	M2 Kazakh (Russian) language. M3 Foreign language
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -use professional biotechnology vocabulary in a foreign language -understand and explain biotechnological processes and terminology -analyse and translate scientific texts -conduct oral and written communication in academic and professional environments -describe technological processes and safety aspects -consider environmental aspects of the industry

	-discuss innovations in biotechnology -prepare and defend mini-projects in a foreign language
Indicative Content	<b>Practical classes:</b> The course covers professionally oriented foreign language skills with a focus on biotechnology, including key terminology, processes, and chemical compounds. It introduces microbiological methods, modern equipment, and scientific article analysis, as well as translation and interpretation of specialized texts. Special attention is given to oral and written academic communication: discussing experiments, writing reports, abstracts, and business correspondence. Students study the application of English in research and industrial settings, including technology descriptions and safety issues. The course also addresses environmental considerations and innovations in biotechnology—microencapsulation, fermentation, genetic engineering—within the framework of scientific style. The programme concludes with preparation and defence of a mini-project or presentation in a foreign language.
Forms of Assessment / Examination	Current assessment: dialogues and role plays, presentations and reports, mini-projects, portfolio. 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"> <li>1. Meiramova, S. A., Zakaria, F., Akylbayeva, A. G., Kozhakhmetova, G. A., Bennett, M., Maxyutova, A. F., Alshinbayeva, Zh. K., Mussagozhina, K. K., &amp; Shaibakova, D. D. <i>Profession-Oriented English for Agriculture, Science and Technology: Workbook</i>. Almaty: Evero, 2020, 108 p.</li> <li>2. Kerimbekova, M., Savelova, T., Qiunjiina, O., &amp; Shubakova, M. <i>Workbook on Professionally-Oriented English Language for Biology Students</i>. Almaty: Evero, 2020, 100 p.</li> <li>3. Ismailova, G. K., Dyusekeneva, I. M., Kakimova, Zh. Kh., Asenova, B. K., Baibalinova, G. M., Mirasheva, G. O., &amp; Khasenova, K. E. <i>Terminological Dictionary for Biotechnology Specialties</i>. Almaty, 2020, 316 p.</li> <li>4. Kunzhigitova, G. B., &amp; Burkitbaev, T. S. <i>Teaching Suggestions for Practical Exercises in Professionally-Oriented English</i>. Almaty: Evero, 2020, 164 p.</li> <li>5. Thain, M., &amp; Hickman, M. <i>The Penguin Dictionary of Biology</i> (12th ed.). Penguin Books, 2020.</li> <li>6. Young, L. <i>English for Biotechnologists: Reading and Vocabulary Development</i>. Springer, 2019.</li> <li>7. Glazer, A. N., &amp; Nikaido, H. <i>Microbial Biotechnology: Fundamentals of Applied Microbiology</i>. Cambridge University Press, 2020.</li> <li>8. Shuler, M. L., &amp; Kargi, F. <i>Bioprocess Engineering: Basic Concepts</i> (3rd ed.). Prentice Hall, 2017.</li> <li>9. Stanbury, P. F., Whitaker, A., &amp; Hall, S. J. <i>Principles of Fermentation Technology</i> (3rd ed.). Elsevier, 2017.</li> <li>10. Brown, R. <i>English for Science and Technology: Biotechnology</i>. Oxford University Press, 2019.</li> <li>11. Dorozhkin, V. M. <i>English for Biotechnology Students: Textbook</i>. Moscow: Akademiya, 2021.</li> <li>12. Smirnova, E. P. <i>Professional English in Biotechnology</i>. Saint Petersburg: Lan<sup>7</sup>, 2022.</li> </ol>
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	<b>M21.1 Microbiology and Virology</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in biology, professor Almira Amangeldyevna Saparbekova Senior lecturer Gulnara Sultanbekovna Rysbayeva
Language of Instruction	Kazakh, Russian, English

Relation to the Programme / Curriculum Placement	Elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total workload – 180 hours lectures – 30 hours; laboratory classes – 45 hours; independent work of students – 15 hours; independent work of learners - 60 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M 6. Chemistry, M 7. Inorganic Chemistry
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: - determine the taxonomy and hereditary variability of microorganisms - evaluate the role of microorganisms in biogeochemical cycles, industry, and agriculture - prepare and stain microbial specimens using basic and advanced techniques - apply methods of identification and quantitative assessment of harmful microorganisms - interpret microbiological and virological research data - use industrial microorganisms and microbial preparations for practical purposes
Indicative Content	<b>Lectures:</b> Taxonomic units, species, strain, clone. Methods and criteria for prokaryote classification. Morphophysiological traits. Microbial ecology. Energy accumulation in bacterial cells. Oxygen demand in microorganisms. Virus morphology and structure. Virion composition. Simple and complex viruses. Structure and properties of bacteriophages. <b>Laboratory classes:</b> Microscopy of prepared slides. Preparation of stained bacterial samples. Gram reaction by Kregensen rapid method. Preparation of nutrient media (MPA example). Air microflora plating and colony counting. Morphology of moulds and yeasts. Antibiotic susceptibility testing. Analysis of biochemical and physiological traits. Cultivation of aerobes and anaerobes. Microbial genetics.
Forms of Assessment / Examination	Current assessment: group discussions, case studies, colloquia, written tests, oral questioning Final assessment: state 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. Stevens, A. M., Ditty, J. L., Parales, R. E., & Merkel, S. M. <i>Microbial Physiology: Unity and Diversity</i> . ISBN 978-1-683-67369-9 2. Zverev, V. V., Boichenko, M. N. (Eds.). <i>Medical Microbiology, Virology, Immunology</i> (Vol. 1). GEOTAR-Media, 2020. 3. Jorgensen, J. H., & Pfaller, M. A. <i>Manual of Clinical Microbiology</i> (11th ed.). ASM Press, 2015. 4. Kuranova, N. G. <i>Microbiology. Part 2. Metabolism of Prokaryotes</i> . Prometey, 2017.
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	<b>M 21.2 Sanitation and Hygiene of Biotechnological Production</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in biology, professor Almira Amangeldiyevna Saparbekova Senior lecturer Gulnara Sultanbekovna Rysbayeva
Language of Instruction	Kazakh, Russian, English
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 – 180 hours: lectures – 30 hours; practical classes – 45 hours; independent work of students – 15 hours; independent work of learners – 60 hours; supervised independent work – 30 hours

Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M 6. Chemistry, M 7. Inorganic Chemistry
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -explain morphological and biochemical features of microorganisms and general metabolic patterns, including the influence of chemical and biological factors on microbial development -determine microbial taxonomy and identify sanitary-indicative microorganisms -conduct experimental assessment of the sanitary condition of food products -prepare and study microbiological samples using simple and complex staining methods -isolate and identify pure microbial cultures -work independently with scientific and methodological literature -monitor microbial flora of samples and assess sanitation of industrial environments
Indicative Content	<b>Lectures:</b> Sanitary and hygienic control in food industry; requirements for the production environment and personal hygiene; safety of food reserves; sanitary assessment of industrial facilities and environment. <b>Practical classes:</b> Microbial morphology and staining methods; preparation of nutrient media; sterilization and disinfection; biochemical properties of bacteria; sanitary inspection of dairy industry; monitoring compliance with hygiene regulations.
Forms of Assessment / Examination	Current assessment: graphical assignments, colloquia, written control works, 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. Ann M. Stevens, Jayna L. Ditty, Rebecca E. Parales, Susan M. Merkel. <i>Microbial Physiology: Unity and Diversity</i> . ISBN 978-1-683-67369-9. 2. Pivovarov, Yu. P., Al' Sabunchi A. A. <i>Ecological and Hygienic Problems in Developing Countries</i> . Moscow: Onebook, 2014. 3. Zverev V. V., Boychenko M. N., Bykov A. S. <i>Medical Microbiology, Virology, Immunology</i> . Vol. 1–2. GEOTAR-Media, 2022. 4. Warren Levinson et al. <i>Medical Microbiology &amp; Immunology: A Guide to Clinical Infectious Diseases</i> . 15th ed. ISBN 978-1-25-964449-8.
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	<b>M 22.1 Biotechnology of Microorganisms</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in biology, professor Almira Amangeldiyevna Saparbekova Senior lecturer Gulnara Sultanbekovna Rysbayeva
Language of Instruction	Kazakh, Russian, English
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 – 60 hours; independent work of students – 15 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	M 6. Chemistry, M 7. Inorganic Chemistry
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the diversity of biotechnological processes based on microbial applications

	<p>-explain principles of microbial cultivation and strain production</p> <p>-analyse raw materials and final products, assess purity and activity of cultures</p> <p>-work with microbial cultures and monitor their growth parameters</p> <p>-design biotechnological process schemes and predict mass production outcomes</p> <p>-apply aerobic and anaerobic biodegradation methods for waste processing and soil restoration</p> <p>-employ modern microbial biotechnology research techniques</p>
Indicative Content	<p><b>Lectures:</b> Introduction to microbial biotechnology; industrial equipment and process criteria; microbial metabolite production; enzyme biotechnology; microbial biomass production; biosafety; modern microbial biotechnology methods.</p> <p><b>Practical classes:</b> Microorganisms as protein, lipid, and acid producers; amino acid fermentation technology; antibiotic synthesis; biofertilizer production; wastewater treatment and soil remediation processes.</p>
Forms of Assessment / Examination	<p>Current assessment: graphical assignments, colloquia, written work, oral quizzes.</p> <p>Final assessment: examination</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. Sangeetha J., Thangadurai D., Tanasupawat S. <i>Biotechnology of Microorganisms</i>. Apple Academic Press, 2021.</li> <li>2. Egorova T. A., Klunova S. M., Zhivukhina E. A. <i>Fundamentals of Biotechnology</i>. Moscow: Akademiya, 2011.</li> <li>3. Gazaliyev A. M., Andreeva A. P. <i>Fundamentals of Biotechnology</i>. Karaganda: KarGTU, 2011.</li> <li>4. Netrusov A. I., Kotova I. B. <i>Microbiology: Theory and Practice</i>. Vol. 1–2. Moscow: Yurayt, 2019.</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M 22.2 Industrial Microorganisms</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Usen Kudaibergenovich Akhanov PhD, associate professor Moldir Alibekovna Turaliyeva
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; practical classes – 30 hours; independent work of learners (current) – 55 hours; independent work of learners (midterm) – 12.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M21.1 Microbiology and Virology or M21.2 Sanitation and Hygiene of Biotechnological Production
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are be able to</p> <ul style="list-style-type: none"> <li>-describe technologies for producing live and inactivated microbial biomass</li> <li>-apply biopesticides and soil-improving biological products</li> <li>-explain fundamentals of immunobiotechnology and microbial synthesis with immobilized cells</li> <li>-ensure biological safety of microbiological production facilities</li> <li>-identify stages of fermentation and industrial biopreparation manufacture</li> <li>-evaluate risks and advantages of genetic engineering applications</li> <li>-organise production of vaccines, organic acids, and bioenergy products</li> <li>-apply modern analytical methods for quality control in industrial biotechnology</li> </ul>

Indicative Content	<b>Lectures:</b> Microbial biomass production; biopesticides and soil enhancers; immunobiotechnology; immobilized cell production systems; biosafety in industrial microbiology. <b>Practical classes:</b> Fermentation stages and production schemes; genetic engineering risk analysis; vaccine production; bioenergy generation; production of organic acids.
Forms of Assessment / Examination	Current assessment: tests, quizzes, feedback tasks, written and oral questioning Final assessment: written 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. Klunova S. M., Egorova T. A., Zhivukhina E. A. <i>Biotechnology</i> . Moscow, 2022. 2. Gradova N. B., Babusenko E. S., Panfilov V. I. <i>Biological Safety of Biotechnological Industries</i> . Moscow, 2022. 3. Das D., Pandit S. <i>Industrial Biotechnology</i> . CRC Press, 2021. 4. Wittmann C., Liao J. C. <i>Industrial Biotechnology: Microorganisms</i> . Wiley-VCH, 2017. 5. Verma P. (Ed.). <i>Industrial Microbiology and Biotechnology</i> . Springer, 2024. 6. Digel I., Kistaubayeva A., Savitskaya I., Akimbekov N. S. <i>Introduction to Industrial Biotechnology</i> . Barnes & Noble, 2025.
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	<b>M23.1 Ecosystem and Law</b>
Semester(s) in which the module is taught	4th semester
Module Leader / Coordinator	PhD in technical sciences, professor Sagitova G.F.; PhD in pedagogical sciences, associate professor Tleulov B.E.; Master of sciences, senior lecturer Makhatov Zh.B.; PhD in economics, associate professor Kozhamkulova I.E.; Master of sciences, lecturer Asilbekova B.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General Education Course, university component
Teaching and Learning Methods	Practical classes
Workload (including contact hours and independent study)	Total workload – 150 hours: practical classes – 60 hours; independent work of learners (current) – 55 hours; supervised independent work – 35 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M15 Philosophy, M16 Sociology and Political Science, M17 Cultural Studies and Psychology
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -demonstrate economic knowledge and understanding in the studied area; apply methods and tools of state policy for economic regulation, principles of functioning, and methods of studying economic systems; -develop a comprehensive worldview in addressing modern environmental protection and rational natural resource use; -implement measures to protect humans and their environment from hazardous and harmful factors; -analyze legal facts and phenomena, their causes and consequences; apply legislation in the process of legal regulation.
Indicative Content	<b>Practical classes:</b> Practical classes: Fundamentals of safe interaction between humans and nature, productivity of ecosystems and the biosphere; entrepreneurial activity under limited resources; enhancing business competitiveness and national economic development; regulation of ecological relations and human safety; knowledge and compliance with Kazakh law,

	rights and obligations of subjects, state regulation of social relations to ensure social progress; application of scientific research methods.
Forms of Assessment / Examination	Current assessment: Written control works; written and oral quizzes. 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. Aktachinskaya S.B. <i>Ecology and Species Diversity of Cyanobacteria in the Salgir River // Scientific Notes of the Crimean Engineering and Pedagogical University</i> . Series: Biological Sciences. 2022. No.1. pp. 4–12. 2. Amosov P.N. <i>Biology with Fundamentals of Ecology</i> . St. Petersburg, 2022. 3. Anisimov A.P., Rezvanova L.A. <i>Law and Ecology: Interaction of Scientific Fields in the Training of a Lawyer // Legal Order and Legal Values</i> . 2023. Vol.1, No.1. pp. 31–42. 4. Anchukova S.N. <i>Creativity and Cultural Ecology of Personality // Trends in Science and Education</i> . 2023. No.97-1. pp.95–98. 5. Platjouw F. <i>Environmental Law and the Ecosystem Approach</i> . 220 p., 2016. ISBN 9781138363922
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	<b>M23.2 Entrepreneurship and Financial Literacy</b>
Semester(s) in which the module is taught	4th semester
Module Leader / Coordinator	PhD in pedagogical sciences, associate professor Tleulov B.E.
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	General Education Course, university component
Teaching and Learning Methods	Practical classes
Workload (including contact hours and independent study)	Total workload – 150 hours: practical classes – 60 hours; independent work of learners (current) – 55 hours; supervised independent work – 35 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M15 Philosophy, M16 Sociology and Political Science, M17 Cultural Studies and Psychology
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -acquire comprehensive knowledge about personal finances, income sources, and expense items; -develop skills in budgeting and financial planning; -learn rational use of financial resources; -enhance critical thinking regarding savings and investments; -understand the basics of financial security and protection against fraud.
Indicative Content	<b>Practical classes:</b> Study of personal and family financial resources essential for achieving financial well-being; financial planning and consumer security; basic methods for effective spending and saving; protection and investment of personal financial resources; role and significance of personal finances for achieving financial stability; filtering misleading financial information; incentives for independent management of financial responsibilities and optimal consumer financial opportunities; making informed financial decisions in building a professional career.
Forms of Assessment / Examination	Current assessment: Colloquia, essays, written control works; written and oral quizzes. 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. Lusardi, A. <i>Financial Literacy and Education: Theory and Research</i> . Oxford University Press, 2019. 416 p. 2. Madura, J. <i>Personal Finance</i> . Pearson, 2020. 704 p.

	<p>3. Housel, M. <i>The Psychology of Money: Timeless Lessons on Wealth, Greed, and Happiness</i>. Harriman House, 2020. 252 p.</p> <p>4. O’Neill, B. <i>Financial Fitness for Life: Steps to Financial Freedom</i>. National Endowment for Financial Education, 2021. 288 p.</p> <p>5. Doyle, K.O. <i>Financial Literacy for Generation Z: A Practical Guide to Managing Your Financial Life</i>. Routledge, 2022. 300 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	<b>M24.1 Animal Physiology</b>
Semester(s) in which the module is taught	4th semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Akhanov Usen Kudaybergenovich
Language of Instruction	Kazakh, Russian, English
Relation to the Programme / Curriculum Placement	Basic discipline, 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 (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	M7.1 Fundamentals of Biotechnology or M7.2 Fundamentals of Academic Writing
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-explain the basic principles of animal physiology, including homeostasis and adaptation;</li> <li>-describe the structure and functions of the nervous, cardiovascular, and respiratory systems, as well as their interactions;</li> <li>-conduct research on reflex activity in animals and interpret the results;</li> <li>-measure heart rate, blood pressure, and respiratory parameters under various conditions;</li> <li>-analyze digestive enzyme activity and thermoregulation processes in animals;</li> <li>-evaluate the influence of physical and environmental factors on cardiovascular and respiratory functions.</li> </ul>
Indicative Content	<p><b>Lectures:</b> General characteristics of animal physiology; homeostasis and adaptation; physiological systems of animals and their interactions; nervous system and regulation of body functions; cardiovascular system – structure and functions; respiratory system and gas exchange processes.</p> <p><b>Laboratory classes:</b> Study of reflex activity in animals; measurement of heart rate and blood pressure; determination of respiratory parameters at rest and after exertion; analysis of digestive enzyme activity; measurement of body temperature and thermoregulation; investigation of the effects of physical and environmental factors on cardiovascular and respiratory systems.</p> <p><b>Practical classes:</b> Practical classes include the study of reflex activity in animals, measurement of heart rate and blood pressure, assessment of respiratory parameters at rest and after exercise, analysis of digestive enzyme activity, evaluation of body temperature and thermoregulation, and investigation of the effects of physical and environmental factors on the cardiovascular and respiratory systems.</p>
Forms of Assessment / Examination	<p>Current assessment: 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 30–60 points for current assessment and 20–40 points for the final examination.
Reading List (Essential and Recommended Literature)	1. Eckert, R., Randell, D., Augustine, J. <i>Animal Physiology: Mechanisms and Adaptation</i> . Vol. 2. Moscow: Mir, 2021.

	<p>2. Schmidt-Nielsen, K. <i>Animal Physiology: Adaptation and Environment</i>. 2 vols. Ed. E.M. Kreps. Moscow: Mir, 2022.</p> <p>3. Georgievsky, V.I. <i>Physiology of Agricultural Animals</i>. Moscow: Agropromizdat, 1990.</p> <p>4. <i>Fundamentals of Physiology</i>. Ed. P. Sterki. Moscow, 2024.</p> <p>5. <i>General Course of Human and Animal Physiology</i>. 2 vols. Ed. A.D. Nozdrahev. Moscow: Vysshaya Shkola, 2021.</p> <p>6. Hill, R.W., Wyse, G.A., Anderson, M. <i>Animal Physiology</i>. 4th ed. Sunderland, MA: Sinauer Associates, 2016.</p> <p>7. Cunningham, J.G., Klein, B.G. <i>Cunningham's Textbook of Veterinary Physiology</i>. 6th ed. St. Louis: Elsevier, 2020.</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	<b>M24.2 Modeling of Physiological Processes</b>
Semester(s) in which the module is taught	4th semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Akhanov Usen Kundaybergenovich
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	M7.1 Fundamentals of Biotechnology or M7.2 Fundamentals of Academic Writing
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-understand the key principles and methods of modeling biological and physiological systems;</li> <li>-explain the features of mathematical models, including differential equations and stochastic approaches;</li> <li>-analyze the dynamics of physiological processes, such as circulation, respiration, and metabolism;</li> <li>-work with computer software (MATLAB, Simulink) to build and simulate models;</li> <li>-predict the behavior of physiological systems under changing external and internal parameters;</li> <li>-create and validate models, comparing simulation results with experimental data;</li> <li>-apply modern modeling methods in medicine, biotechnology, and other applied fields.</li> </ul>
Indicative Content	<p><b>Lectures:</b> Introduction to modeling physiological processes; basic concepts and classification of models; biological and physiological systems – structure and dynamics; mathematical methods in physiological modeling – differential equations, stochastic models; modeling circulation and respiration; modeling the nervous system and regulatory mechanisms; modeling metabolism and energy balance; use of computer technologies and software in physiological modeling; verification and validation of physiological models; examples and applications in medicine and biotechnology; modern trends and prospects in physiological modeling.</p> <p><b>Practical classes:</b> Construction of a simple mathematical model of circulation; modeling respiratory dynamics using differential equations; analysis of parameter effects on cardiovascular system function; use of software packages (MATLAB, Simulink) for simulation of physiological</p>

	<p>processes; modeling homeostasis regulation under changing external conditions.</p> <p><b>Laboratory classes:</b> Measurement of physiological parameters (pulse, respiration, blood pressure) and data analysis; collection of experimental data for subsequent modeling; experimental investigation of organism responses to various stimuli; introduction to software for data processing and model building; analysis of modeling results and comparison with experimental data.</p>
Forms of Assessment / Examination	<p>Current assessment: tests; written and oral quizzes.</p> <p>Final assessment: state examination</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. Smith, N.P., Pullan, A.J., Hunter, P.J. <i>Modeling Physiological Systems: Principles and Applications</i>. Cambridge: Cambridge University Press, 2018.</li> <li>2. Ermentrout, G.B., Terman, D.H. <i>Mathematical Foundations of Neuroscience</i>. New York: Springer, 2010.</li> <li>3. Kappel, F., Klusmann, S., Peitz, S. (Eds.) <i>Modeling in Physiology and Medicine: Introduction and Basic Concepts</i>. Basel: Springer, 2018.</li> <li>4. Quarteroni, A., Veneziani, A., Vergara, C. <i>Geometric, Mechanical and Numerical Modeling of Physiological Systems</i>. Philadelphia: SIAM, 2017.</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M25.1 Plant Physiology</b>
Semester(s) in which the module is taught	4th semester
Module Leader / Coordinator	<p>PhD, associate professor Ermekbayeva Akbope Tontaeвна;  Master of sciences, lecturer Kudasova Dariha Eradilovna;  PhD in agricultural sciences, associate professor Dauylbai Amina Duysenhanqyzy</p>
Language of Instruction	Russian, Kazakh, English
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; midterm independent work of student – 15 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M24.1 Animal Physiology / M24.2 Modeling of Physiological Processes
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-determine transpiration intensity on the upper and lower surfaces of leaves and learn methods for detecting cytoplasmic movement and measuring its speed;</li> <li>-explain the general principles and theoretical foundations of modern plant physiology as the science of plant organism functions;</li> <li>-investigate and study the interrelation of major biological processes and their dependencies;</li> <li>-apply acquired knowledge to analyze physiological processes in plant objects, identifying and determining physicochemical properties of chlorophyll as the basis of photosynthesis.</li> </ul>
Indicative Content	<p><b>Lectures:</b> Subject, objectives, and methods of plant physiology; stages of plant physiology development; approaches to studying plant life; current problems and future perspectives of plant physiology; physiology of plant cells; root nutrition; water regime in plants; carbon nutrition; photosynthesis; plant respiration; growth and development; regulation and integration of physiological processes in plants; physiological basis of plant resilience.</p>

	<p><b>Practical classes:</b> Analyze the relationship between biotechnology and plant physiology; study main physiological processes in plants; determine water types in cells and analyze molecular water structure; evaluate soil water status and its uptake by plants; examine energetic states of chlorophyll molecules and energy expenditure pathways; assess effects of light, temperature, water supply, mineral nutrition, and plant age on photosynthesis; evaluate influence of external and internal factors on plant respiration intensity.</p> <p><b>Laboratory classes:</b> Study physiological features of plant cells; observe and analyze plasmolysis and deplasmolysis as indicators of living protoplasm; determine and calculate osmotic forces and turgor; assess photosynthesis intensity via oxygen pressure measurement; measure plant root system volume; analyze mineral nutrition; study plant respiration under various conditions; investigate glycolysis and measure associated pressure.</p>
Forms of Assessment / Examination	Current assessment: written tests; written and oral quizzes, mini-projects, and presentations. 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"> <li>1. Ajay Sojitra, Gayatri Kumari, Rajesh Chintey, Dr. Sonali, Ambadas Kabita Saiki. <i>Plant Physiology: Unraveling the Science of Plant Life</i>. First Edition, 2023. – 287 p.</li> <li>2. Kochhar, S. L., Sukhbir, K.G. <i>Plant Physiology: Theory and Applications</i>. 2nd Edition. Cambridge University Press, 2021. – 123 p.</li> <li>3. Dr. S.K. Verma, M. Verma. <i>A Textbook of Plant Physiology, Biochemistry and Biotechnology</i>. The Amazon Book Review, 2024. – 149 p.</li> <li>4. Valikhanova, G.Zh. <i>Plant Biotechnology: Textbook</i>. Almaty: New Book, 2018. – 328 p.</li> <li>5. Karipbayeva, N.Sh., et al. <i>Macromycete Fungi: Methodological Guidelines for Higher Education Institutions</i>. Almaty: Evero, 2019. – 116 p.</li> </ol>
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	<b>M31.2 Fundamentals of Plant Microclonal Propagation</b>
Semester(s) in which the module is taught	4th semester
Module Leader / Coordinator	PhD, associate professor Ermekbayeva Akbope Tontaevna; Master of sciences, lecturer Kudasova Dariha Eradilovna; PhD in agricultural sciences, associate professor Dauylbai Amina Duysenhanqzy
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory work, 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; midterm independent work of student – 15 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M24.1 Animal Physiology / M24.2 Modeling of Physiological Processes
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -know the morphological, physiological, and biochemical features of cell functioning in vitro; -possess theoretical knowledge of the mechanisms of experimental morphogenesis; -understand the mechanisms of key epigenetic and genetic processes ensuring organismal variability;

	<p>-acquire knowledge of modern biotechnological techniques in agriculture and crop production;</p> <p>-predict the consequences of introducing plants created by biotechnological methods;</p> <p>-navigate modern scientific literature on plant agricultural biotechnology;</p> <p>-apply biotechnological methods to increase yield and resilience of major crops;</p> <p>-master practical skills necessary for the work of a modern plant biotechnologist;</p> <p>-apply knowledge of cellular organization principles, biophysical and biochemical foundations, membrane processes, and molecular mechanisms of life activities.</p>
Indicative Content	<p><b>Lectures:</b> Callusogenesis; preparation and cultivation of plant cells and tissues; advantages of plant microclonal reproduction; prospects for microclonal reproduction in agricultural biotechnology; cultivation of single cells; methods for isolating single cells; in vitro cultivation methods of single cells (nanny culture, plating, microculture); conditioning factors.</p> <p><b>Laboratory classes:</b> Preparation of nutrient media for cultivation of isolated plant cells and tissues; sterilization methods for plant material and equipment; obtaining sterile explants from seeds of selected plant species; obtaining callus tissue from various explants; isolation and in vitro cultivation of selected plant species; culture of isolated embryos of selected species.</p> <p><b>Practical classes:</b> Develop understanding of plant cell and tissue culture; analyze the significance of microclonal reproduction for agriculture; master techniques for introducing and cultivating isolated plant tissues; initiate and monitor callus growth in vitro; identify and study hormone-independent plant tissues; investigate morphogenesis processes in callus tissues; perform clonal micropropagation under sterile conditions; apply cell and tissue culture techniques in plant breeding and genetics..</p>
Forms of Assessment / Examination	<p>Current assessment: written tests; written and oral quizzes, mini-projects, and presentations.</p> <p>Final assessment: examination</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. Alberts, B., et al. <i>Molecular Biology of the Cell: with problems by John Wilson and Tim Hunt</i>. Moscow; Izhevsk: NIC "Regular and Chaotic Dynamics", 2013.</li> <li>2. Timofeeva, O.A., Nevmerzhitskaya, Yu.Yu. <i>Clonal Micropropagation of Plants: Educational and Methodological Guide</i>. Kazan: Kazan University, 2012. – 56 p.</li> <li>3. Valikhanova, G.Zh. <i>Plant Biotechnology: Textbook</i>. Almaty: New Book, 2018. – 328 p.</li> <li>4. Demenko, V.I. <i>Microclonal Propagation of Garden Plants: Textbook</i>. Moscow: Timiryazev Russian State Agrarian University, 2007. – 55 p.</li> <li>5. Karipbayeva, N.Sh., et al. <i>Macromycete Fungi: Methodological Guidelines for Higher Education Institutions</i>. Almaty: Evero, 2019. – 116 p.</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M27.1 Applied Genetics</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	PhD, associate professor Ermekbayeva Akbope Tontaeвна; Master of sciences, lecturer Kudasova Dariha Eradilovna
Language of Instruction	Kazakh, English
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, laboratory classes, practical classes

Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 45 hours; laboratory classes – 30 hours; practical classes – 30 hours; independent work of learners – 60 hours; independent work of student – 15 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M21.1 Microbiology and Virology or M21.2 Sanitation and Hygiene of Biotechnological Productions
Module Aims and Intended Learning Outcomes	After completing this module, students are be able to -explain basic genetic concepts, including gene structure and function, Mendelian laws, and the nature of mutations; -apply classical genetic analysis methods for performing crosses and calculating inheritance probabilities; -perform nucleic acid isolation, electrophoresis, and PCR, and interpret the results; -analyze phenotypic manifestations of mutations and chromosomal abnormalities in model organisms; -use modern biotechnological methods (cloning, genetic engineering, gene therapy) to solve applied problems; -evaluate the application of genetics in agriculture and medicine, including genetic mapping and genetic testing.
Indicative Content	<b>Lectures:</b> Fundamentals of genetics and its applied significance; gene structure and function; Mendelian inheritance; mutations and their effects; genetic analysis and gene mapping methods; biotechnological methods in genetics – cloning, genetic engineering, gene therapy; applications of genetics in agriculture and medicine. <b>Practical classes:</b> Performing classical genetic crosses and analyzing inheritance patterns; calculating probabilities according to Mendelian laws; isolation of nucleic acids from cells; performing electrophoresis and PCR; interpreting results of genetic experiments and reporting findings. <b>Laboratory classes:</b> Studying phenotypic traits in model organisms; analyzing mutations and their manifestations; examining karyotypes and chromosomal abnormalities; isolating and analyzing DNA using molecular methods; performing genetic tests and modeling inheritance processes using software.
Forms of Assessment / Examination	Current assessment: colloquia, written assignments, written and oral quizzes, and completion of calculation tasks related to inheritance patterns. 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. Suza, W., Lee, D. <i>Genetics, Agriculture, and Biotechnology</i> . Iowa State University, 2021. Open Textbook. 2. Hartwell, L., Goldberg, M., Fischer, J., Hood, L. <i>Genetics: From Genes to Genomes, 7th Edition</i> . McGraw-Hill, 2021. – 784 p. ISBN 978-1260111348 3. Shulembayeva, K.K., Chundetova, Zh.Zh., Tokubaeva, A.A. <i>Genetics: Textbook</i> . Almaty: Kazakh University, 2018. – 268 p. (Al-Farabi Kazakh National University) <a href="http://www.elib.ukgu.kz/cgi-bin/irbis64r_01/cgiirbis_64.exe">http://www.elib.ukgu.kz/cgi-bin/irbis64r_01/cgiirbis_64.exe</a> 4. Sanders, M.F., Bowman, J.L. <i>Genetic Analysis: An Integrated Approach</i> , 3rd Edition. Pearson, 2018. – 752 p. ISBN 978-0134779506
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	<b>M27.2 Genetic Monitoring of Natural Populations</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	PhD in biology, Associate professor Akbope Tontayevna Ermekbayeva Master of science, lecturer Dariha Eradilovna Kudasova
Language of Instruction	Kazakh, English

Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, laboratory classes, practical classes
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 45 hours; laboratory classes – 30 hours. Laboratory classes – 30 hours; independent work of learners – 60 hours; independent work of students – 15 hours
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M21.1 Microbiology and Virology or M21.2 Sanitation and Hygiene of Biotechnological Production
Module Aims and Intended Learning Outcomes	After completing the course, students are able to: - understand the aims and objectives of genetic monitoring of natural populations; - collect and prepare biological material for genetic analysis; - use molecular markers (microsatellites, SNPs) for population studies; - perform DNA extraction, PCR and electrophoresis; - calculate genetic diversity and allele frequencies; - analyse genetic data using specialized software; - model genetic processes considering environmental factors; - develop recommendations for conserving genetic diversity; - prepare written reports and deliver presentations.
Indicative Content	<b>Lectures:</b> Introduction to the concept of genetic monitoring of natural populations, aims and methods. Biological sampling strategies. Molecular markers used in population genetics (microsatellites, SNPs). Genetic diversity and population structure assessment. The role of genetic monitoring in biodiversity conservation. Environmental and anthropogenic impacts on genetic variation and species resilience. <b>Practical classes:</b> Sampling biological materials and preparing specimens for analysis. DNA extraction and PCR using specific genetic markers. Electrophoresis and evaluation of amplification results. Calculation of allele frequencies and genetic diversity indices. Interpretation of genetic monitoring data considering ecological factors. <b>Laboratory classes:</b> Analysis of genotypic datasets using software tools to assess population structure and differentiation. Modelling effects of mutation, migration, genetic drift and selection. Development of conservation recommendations based on obtained genetic data. Report writing and presentation of monitoring results.
Forms of Assessment / Examination	Current assessment: colloquia, written assignments, tests. 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. Allendorf, F. W., Funk, W. C., & Aitken, S. N. <i>Conservation and the Genomics of Populations</i> (3rd ed.). Oxford University Press, 2022. 2. Altukhov, Y. P. <i>Intraspecific Genetic Diversity: Monitoring, Conservation, and Management</i> . Springer, 2006. 3. Frankham, R., Ballou, J. D., & Briscoe, D. A. <i>Introduction to Conservation Genetics</i> (2nd ed.). Cambridge University Press, 2010. 4. Galetti Jr., P. M. (Ed.). <i>Conservation Genetics in the Neotropics</i> . Springer, 2023. 5. Princée, F. P. G. <i>Exploring Studbooks for Wildlife Management and Conservation</i> . Springer, 2016.
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	<b>M47 Industrial Practice I</b>
Semester(s) in which the module is taught	4th semester
Module Leader / Coordinator	Lecturer Dariha Eradilovna Kudasova
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 – 150 hours: lectures – 30 hours; practical classes – 30 hours; independent work of learners – 55 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	M22.1 Microbial Biotechnology or M22.2 Industrial Microorganisms Required: M21.1 Microbiology and Virology or M21.2 Sanitation and Hygiene of Biotechnological Production
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -navigate the structure and activities of a biotechnological enterprise; -analyse technological schemes and principles of operation of major industrial equipment; -comply with sanitary regulations and industrial safety requirements; -conduct sampling of water, air, soil and products for physicochemical and microbiological analysis; -identify pollution sources and assess the ecological impact of the enterprise; -evaluate the efficiency of treatment facilities and environmental protection measures; -maintain production documentation and prepare an analytical internship report; -present internship results in oral and presentation format.
Indicative Content	During the industrial placement, students become familiar with the structure of a biotechnological enterprise, its production processes and quality management system. They study technological schemes, equipment and safety regulations. Special attention is given to environmental aspects, including analysis of waste streams and pollution sources. Students collect and analyse samples of water, air and soil using physicochemical and microbiological methods, assess the efficiency of treatment facilities and evaluate environmental protection measures. Upon completion of the placement, students prepare a written report and defend it before the academic supervisor.
Forms of Assessment / Examination	Current assessment protocols of completed work, safety briefing records. Final assessment: oral report defence, including questions on enterprise structure and internship activities.
Learning and Examination Requirements	Students must prepare a written internship report, complete an individual task, obtain approval and signature from the enterprise supervisor, and defend the report before a departmental examination committee.
Reading List (Essential and Recommended Literature)	1. Zhurbitsky, Z. I. <i>Biotechnology: Theory and Practice</i> . - Moscow: Academy, 2021. 2. Levenets, A. I., Kudryashov, V. A. <i>General and Applied Biotechnology</i> . - St. Petersburg: Lan, 2020. 3. Sinitsyna, O. A., Klyachko, N. L. <i>Ecological Biotechnology</i> . - Moscow: Infra-M, 2019. 4. Chernyaeva, I. G. <i>Fundamentals of Microbiological Production</i> . - Moscow: Kolos, 2022. 5. Ed. by Teplitsky, M. L. <i>Technological Equipment for Biotechnological Production</i> . - Moscow: Profession, 2020. 6. Egorova, N. S. <i>Practical Training in Biotechnology</i> . - Moscow: Academy, 2021. 7. Kuznetsov, S. I., et al. <i>Biotechnological processes: control, management, safety</i> . - Novosibirsk: SB RAS, 2020. 8. <i>Ecological monitoring and environmental protection</i> . - Textbook edited by V. I. Korovin. - Moscow: Academy, 2021. 9. <i>Cryobiotechnology: methods and application</i> . - Ed. by V. V. Gureev. - Moscow: Nauka, 2019. 10. Teterin, I. V. <i>Safety of biotechnological production</i> . - St. Petersburg: Lan, 2022.
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	<b>M28.1 Biochemistry</b>
Semester(s) in which the module is taught	5th semester
Module Leader / Coordinator	PhD in chemistry, associate professor Anar Madenovna Yesimova PhD in chemistry, associate professor Mutalieva B.Zh.
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; laboratory classes – 30 hours; independent work of learners – 67.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M6 Chemistry
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: <ul style="list-style-type: none"> <li>- understand the fundamental goals and objectives of biochemistry as the science of chemical processes in living organisms;</li> <li>- determine the structure, properties, and functions of key biomolecules: proteins, carbohydrates, lipids, and nucleic acids;</li> <li>- understand key metabolic pathways and cycles and their importance for cellular and energy metabolism;</li> <li>- measure the concentration of biomolecules in biological samples;</li> <li>- study enzymatic activity and evaluate the influence of environmental factors on reaction rates;</li> <li>- perform electrophoresis and use spectrophotometric methods to analyze biomolecules;</li> <li>- interpret the results of laboratory experiments and conduct quantitative and qualitative analysis;</li> <li>- model biochemical processes and evaluate their regulation.</li> </ul>
Indicative Content	<b>Lectures:</b> Introduction to biochemistry as the science of chemical processes in living organisms. Structure, properties and functions of biomolecules: proteins, carbohydrates, lipids, nucleic acids and low-molecular-weight compounds. Principles of metabolism: catabolism and anabolism, energy exchange and the role of ATP. Enzymes: structure, mechanism of action, kinetics and regulation. Biochemical pathways and cycles: glycolysis, Krebs cycle, photosynthesis, respiration, protein and nucleic acid synthesis. Analytical methods in biochemistry, including spectrophotometry, chromatography and electrophoresis. Physiological significance of biochemical processes in cells, tissues and organisms. <b>Laboratory classes:</b> Determination of protein, carbohydrate and lipid concentrations in biological samples. Investigation of enzyme kinetics and environmental factors (temperature, pH, substrate concentration). Electrophoresis of proteins and nucleic acids. Quantitative and qualitative analysis of biomolecules using spectrophotometry and related methods. Modelling of metabolic pathways and assessment of their regulation. Data analysis, preparation of laboratory reports, graphs and tables; adherence to safety protocols when handling chemical reagents.
Forms of Assessment / Examination	Current assessment: colloquia, written assignments, oral and written 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. Berg, J. M., Tymoczko, J. L., Gatto, G. J., & Stryer, L. <i>Biochemistry</i> (10th ed.). New York: W.H. Freeman, 2023. 2. Chakrapani, U. <i>Biochemistry</i> (5th ed.). New Delhi: Elsevier India, 2020. 3. Vasudevan, D. M., & Sreekumari, S. <i>Textbook of Biochemistry for Medical Students</i> (9th ed.). New Delhi: JayPee Brothers, 2019.

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	<b>M28.2 Inorganic Chemistry</b>
Semester(s) in which the module is taught	5th semester
Module Leader / Coordinator	PhD in chemistry, associate professor Anar Madenovna Yesimova PhD in chemistry, associate professor Mutalieva B.Zh.
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; laboratory classes – 30 hours; independent work of learners – 67.5 hours; supervised independent work – 22.5 hours здесь
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M6 Chemistry
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -explain the fundamental principles of the structure of substances and chemical reactions; -identify types of chemical bonds and properties of inorganic compounds; -perform stoichiometric calculations and prepare solutions of specified concentration; -carry out qualitative analysis of cations and anions; -interpret experimental results and follow safety rules in the laboratory.
Indicative Content	<b>Lectures:</b> Fundamental laws of inorganic chemistry: atomic structure, periodic law and periodic table of chemical elements. Types of chemical bonds: ionic, covalent, metallic and hydrogen bonds. Structure of substances and their properties. Types of chemical reactions and equations, thermochemistry and reaction kinetics. Redox processes and electrode potentials. Solutions: electrolytes, ionic strength, acid-base equilibria, hydrolysis of salts, buffer systems. Amphoteric compounds, complex compounds and coordination chemistry. Chemistry of elements and their compounds: hydrogen, alkali and alkaline earth metals, transition metals, nonmetals and their oxides, acids and bases. Application of inorganic compounds in industry, medicine and environmental protection. <b>Laboratory classes:</b> Preparation of solutions of a given concentration and titration of acids and bases. Determination of pH and hydrolysis of salts. Redox reactions and calculation of chemical equivalents. Study of the properties of metals and nonmetals, their reactions with acids and alkalis. Generation and analysis of gases (hydrogen, oxygen, carbon dioxide). Determination of ions in solutions and qualitative analysis of inorganic compounds. Study of complex compounds and their stability. Performance of qualitative analysis of cations and anions. Compliance with laboratory safety rules and chemical handling procedures.
Forms of Assessment / Examination	Current assessment: colloquia, written and oral questioning, problem solving. 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. Housecroft, C. E., Sharpe, A. G. <i>Inorganic Chemistry</i> . – 5th ed. – Harlow: Pearson Education, 2018. – 1152 p. 2. Miessler, G. L., Fischer, P. J., Tarr, D. A. <i>Inorganic Chemistry</i> . – 5th ed. – Boston: Pearson, 2021. – 1200 p.pearson.com 3. Pfennig, B. W. <i>Principles of Inorganic Chemistry</i> . – 2nd ed. – Hoboken: Wiley, 2022. – 832 p. 4. Kharkwal, M., Tyagi, S. B. <i>Concepts of Inorganic Chemistry</i> . – 1st ed. – Boca Raton: CRC Press, 2025. – 782 p.routledge.com

	5. House, J. E. <i>Inorganic Chemistry</i> . – 4th ed. – Amsterdam: Elsevier, 2025. – 600 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	<b>M29.1 Plant Biotechnology</b>
Semester(s) in which the module is taught	5th semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Zhanar Elemanova
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; laboratory classes – 30 hours; independent work of learners (current) – 60 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M25.1 Plant Physiology or M25.2 Fundamentals of Microclonal Plant Reproduction
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -explain the mechanisms of action of bioprotectors and plant growth stimulators; -classify major types of natural and microbial biopreparations; -apply biostimulants and bioprotectors to improve plant stress resistance and yield; -assess physiological and morphological effects of biopreparations on plants; -conduct biotesting and analyse experimental data in accordance with biosafety regulations.
Indicative Content	<b>Lectures:</b> Concept and classification of plant bioprotectors and growth stimulators. Mechanisms of action: regulation of physiological and biochemical processes, induction of stress resistance. Main categories of natural and synthetic stimulants: phytohormones, amino acids, humic substances, microbial preparations. Microbial-based bioprotectors: <i>Bacillus</i> , <i>Pseudomonas</i> , mycorrhizal fungi. Role of bioprotectors in plant protection from pathogens and pests. Use of stimulants to increase yield and crop quality. Modern biotechnological approaches to the development and application of biostimulants and bioprotectors. Environmental safety and regulation of biopreparation use in agriculture. <b>Laboratory classes:</b> Preparation of solutions of biostimulants and bioprotectors. Study of their effects on seed germination and plant growth. Evaluation of microbial preparations for plant protection against pathogens. Measurement of physiological parameters under treatment. Biotests for plant stress resistance. Comparative analysis of different types of stimulants and bioprotectors. Safety procedures for laboratory work involving biological agents.
Forms of Assessment / Examination	Current assessment: successful completion of practical and laboratory work, colloquia, written tests, written and oral quizzes. 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. Umesh, S. <i>Plant Biotechnology</i> . 1st ed., CRC Press / Routledge, New Delhi / London, 2019. 2. Khurana, S. M. & Kumar, N. <i>Plant Biotechnology: A Textbook</i> . 1st ed., Springer, Singapore, 2022. 3. Kamaluddin; Usha Kiran; Malik Z. A. (eds.). <i>Technologies in Plant Biotechnology and Breeding of Field Crops</i> . Springer Nature Singapore, 2022. 4. Stewart, C. Neal Jr. <i>Plant Biotechnology and Genetics: Principles, Techniques, and Applications</i> . 3rd ed., Wiley & Sons Ltd, 2025.

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Module Title	<b>M29.2 Plant Bioprotectors and Growth Stimulators</b>
Semester(s) in which the module is taught	5th semester
Module Leader / Coordinator	PhD in chemistry, associate professor Botagoz Zhaksylykovna Mutaliyeva PhD in agricultural sciences, associate professor Zhanar Rakhmanberdiyevna Elemanova PhD, associate professor Akbope Tontayevna Ermekbayeva
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; laboratory classes– 30 hours; independent work of learners (current) – 60 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M25.1 Plant Physiology or M25.2 Fundamentals of Microclonal Plant Reproduction
Module Aims and Intended Learning Outcomes	After completing this module, master’s students are able to: -explain the mechanisms of action of bioprotectors and plant growth stimulators; -classify major types of natural and microbial biopreparations; -apply biostimulants and bioprotectors to improve plant stress resistance and yield; -assess physiological and morphological effects of biopreparations on plants; -conduct biotesting and analyse experimental data in accordance with biosafety regulations.
Indicative Content	<b>Lectures:</b> Concept and classification of plant bioprotectors and growth stimulators. Mechanisms of action: regulation of physiological and biochemical processes, induction of stress resistance. Main categories of natural and synthetic stimulants: phytohormones, amino acids, humic substances, microbial preparations. Microbial-based bioprotectors: <i>Bacillus</i> , <i>Pseudomonas</i> , mycorrhizal fungi. Role of bioprotectors in plant protection from pathogens and pests. Use of stimulants to increase yield and crop quality. Modern biotechnological approaches to the development and application of biostimulants and bioprotectors. Environmental safety and regulation of biopreparation use in agriculture. <b>Laboratory classes:</b> Preparation of solutions of biostimulants and bioprotectors. Study of their effects on seed germination and plant growth. Evaluation of microbial preparations for plant protection against pathogens. Measurement of physiological parameters under treatment. Biotests for plant stress resistance. Comparative analysis of different types of stimulants and bioprotectors. Safety procedures for laboratory work involving biological agents.
Forms of Assessment / Examination	Current assessment: successful completion of practical and laboratory work, colloquia, written tests, written and oral quizzes. 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. Umesh, S. <i>Plant Biotechnology</i> . 1st ed., CRC Press / Routledge, New Delhi / London, 2019. 2. Khurana, S. M. & Kumar, N. <i>Plant Biotechnology: A Textbook</i> . 1st ed., Springer, Singapore, 2022. 3. Kamaluddin; Usha Kiran; Malik Z. A. (eds.). <i>Technologies in Plant Biotechnology and Breeding of Field Crops</i> . Springer Nature Singapore, 2022.

	4. Stewart, C. Neal Jr. <i>Plant Biotechnology and Genetics: Principles, Techniques, and Applications</i> . 3rd ed., Wiley & Sons Ltd, 2025.
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	<b>M30.1 Animal Biotechnology</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Usen Kudaybergenovich Akhanov PhD, associate professor Akbope Tontayevna Ermekbayeva
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; practical classes – 30 hours; independent work of learners (current) – 55 hours; independent work of learners (midterm) – 12.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M24.1 Animal Physiology or M24.2 Modelling of Physiological Processes
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: - identify nutrient media and cultivation systems for animal cells; -conduct hybridization and generate animal chimeras; -obtain and maintain primary cultures and cell lines; -select donor and recipient animals for cloning; -culture, evaluate and select gametes and embryos; -apply cryopreservation principles and control biomaterial freezing; -use cellular technologies and transgenic methods in animal breeding; -present laboratory work results in oral and written form.
Indicative Content	<b>Lectures:</b> Nutrient media and cultivation systems for animal cells. Hybridization and methods of chimera creation. Primary animal cell culture, subculture, and cell lines. Fundamentals of animal reproduction biology and cloning. Selection of donor animals and matching of recipients. Cellular and transgenic technologies in livestock. <b>Practical Classes:</b> <b>Practical classes:</b> Cultivation, evaluation, and selection of gametes and embryos. Cryopreservation principles. Planning and monitoring of cell, tissue, and embryo freezing. Application of cellular technologies in animal husbandry. Transgenic animals and their use.
Forms of Assessment / Examination	Current assessment: business games and simulations, case studies, colloquia, written and oral quizzes. 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. Freshney, R. I. <i>Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications</i> . – Hoboken: Wiley, 2019. 2. Stacey, G., Davis, J. (ред.). <i>Medicines from Animal Cell Culture</i> . – Chichester: Wiley, 2007. 3. Gupta, A., Rastegari, A. A. <i>Advances and Applications in Biotechnology: Volume 2 – Prospects of Transgenic Animals in Biotechnology</i> . – London: Routledge, 2026. 4. Masters, J. R. W. <i>Animal Cell Culture: A Practical Approach</i> . – Oxford: Oxford University Press, 2000. 5. Niemann, H., Wrenzycki, C. <i>Animal Biotechnology</i> . – Cham: Springer, 2018.
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	<b>M 30.2 Transgenic Animals, Plants and Methods of Their Production</b>
Semester(s) in which the module is taught	3rd semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Usen Kudaibergenovich Akhanov PhD, associate professor Yermekbayeva A.T.
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; practical classes – 30 hours; independent work of learners (current) – 55 hours; independent work of learners (midterm) – 12.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M24.1 Animal Physiology or M24.2 Modelling of Physiological Processes
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -describe the stages of embryo transplantation and in vitro fertilization technology; -select donors and obtain oocytes for cultivation; -apply methods of superovulation and biotechnological regulation of reproduction; -perform freezing and thawing of embryos; -present and document the results of practical work.
Indicative Content	<b>Lectures:</b> Technological stages of embryo transplantation; Assisted reproductive technology for oocyte fertilization; Methods of selecting donors and obtaining oocytes; Cultivation of oocytes in nutrient media; Production of embryos through in vitro fertilization. <b>Practical classes:</b> Biotechnological methods of regulating reproductive function in farm animals; Embryo transplantation technology; Superovulation methods for obtaining embryos from donors; Methods of embryo freezing and thawing.
Forms of Assessment / Examination	Current assessment: business games and simulations; case studies; colloquiums; 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.Perry, G., & Love, C. <i>Transgenic Animals and Biotechnology: Principles and Methods.</i> – 2021. – 356 p. 2.Smith, J., & Brown, L. <i>Embryo Transfer Technology in Farm Animals: Advances and Applications.</i> – 2022. – 410 p. 3.Wilson, R. <i>Assisted Reproductive Technologies in Animal Breeding.</i> – 2023. – 289 p. 4.Clark, H., & Nguyen, T. <i>Cryopreservation and In Vitro Fertilization Techniques in Livestock.</i> – 2020. – 320 p.
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Module Title	<b>M 31.1 Cell Biotechnology</b>
Semester(s) in which the module is taught	5th semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Zhanar Rakhmanberdiyevna Elemanova
Language of Instruction	Kazakh, Russian, English

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: lectures – 30 hours; practical classes – 30 hours; independent work of learners (current) – 55 hours; independent work of learners (midterm) – 12.5 hours; supervised independent work – 22.5 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M29.1 Plant Biotechnology or M29.2 Plant Bioprotectors and Growth Stimulators
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -describe the principles of cell biotechnology and methods for working with cell cultures; -obtain, maintain and cryopreserve cell lines; -apply methods of transformation, genetic modification and cell cloning; -cultivate stem cells and control their differentiation; -analyse cell state using microscopy and cytometry; -present laboratory work results in written and oral form in compliance with safety regulations.
Indicative Content	<b>Lectures:</b> Principles of cell biotechnology and methods for working with cell cultures. Techniques for obtaining and maintaining animal and plant cell lines under in vitro conditions. Methods of cell transformation and genetic modification, use of recombinant DNA and vectors. Principles of stem cell culture and differentiation control. Cloning and reproductive biotechnology including somatic cell nuclear transfer. Cell function and viability analysis using cytometric and molecular approaches. Use of bioreactors for large-scale cultivation and bioproduct production. Ethical and legal considerations in cell technology applications. <b>Practical classes:</b> Preparation and sterilization of media and equipment for cell culture work. Obtaining primary cell cultures from animal and plant tissues. Maintaining cell viability, subculturing and growth monitoring. Cryopreservation and thawing of cell lines. Application of cell transformation and genetic modification methods. Use of microscopy and cytometry to assess cell condition and structure. Cultivation of stem cells and observation of differentiation. Production of bioproducts in bioreactors and quality control. Safe handling of cell lines and biological materials.
Forms of Assessment / Examination	Current assessment: successful completion of laboratory work; colloquiums; written tests 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. Neumann, K.-H., Kumar, A., Imani, J. <i>Plant Cell and Tissue Culture – A Tool in Biotechnology: Basics and Application.</i> – 2nd ed. – Cham: Springer, 2020. 2. Gupta, S., Chaturvedi, P. (Eds.). <i>Commercial Scale Tissue Culture for Horticulture and Plantation Crops.</i> – Singapore: Springer, 2022. 3. Belwal, T., Georgiev, M. I., Al-Khayri, J. M. (Eds.). <i>Nutraceuticals Production from Plant Cell Factory.</i> – Singapore: Springer, 2022. 4. Del Villar-Martínez, A. A., Ragazzo-Sánchez, J. A., Vanegas-Espinoza, P. E., Paredes-López, O. (Eds.). <i>Advances in Plant Biotechnology: In Vitro Production of Secondary Metabolites of Industrial Interest.</i> – Boca Raton: CRC Press, 2024.
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	<b>M 31.2 Plant Cell and Tissue Culture Technology</b>
Semester(s) in which the module is taught	5th semester

Module Leader / Coordinator	PhD in agricultural sciences, associate professor Zhanar Rakhmanberdiyevna Elemanova
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; practical classes – 30 hours; independent work of learners (current) – 60 hours; independent work of learners (midterm) – 15 hours; supervised independent work – 30 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M29.1 Plant Biotechnology or M29.2 Plant Bioprotectors and Growth Stimulators
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: - describe principles of plant cell and tissue culture and methods of working with plant cultures in vitro - obtain, maintain and cryopreserve callus, meristematic and organogenic cultures - apply methods of cell transformation and genetic modification of plants - conduct induction of organogenesis and somatic embryogenesis in vitro - analyse growth, viability and differentiation of cells and tissues using microscopy and photodocumentation; - present laboratory work results in written and oral form in compliance with safety regulations.
Indicative Content	<b>Lectures:</b> Fundamental principles of plant cell and tissue culture and their significance in modern biotechnology. Methods for obtaining and maintaining callus, meristematic and organogenic cultures in vitro. Technologies of micropropagation, somatic embryogenesis and organogenesis. Methods of cell transformation and genetic modification of plants, including Agrobacterium-mediated transformation and biolistics. Use of plant bioreactors for large-scale production of cells, tissues and secondary metabolites. Methods for monitoring growth, viability and differentiation of plant cells and tissues. Ethical and regulatory aspects of plant cell technologies. <b>Practical classes:</b> Preparation and sterilization of nutrient media, instruments and laboratory ware. Establishment of primary cultures from meristems, leaves, stems and root tissues. Subculture, maintenance and growth assessment of callus and organogenic cultures. Induction of organogenesis and somatic embryogenesis in vitro. Transformation methods for plant genetic improvement. Cryopreservation and thawing of plant cells and tissues. Use of microscopy and photodocumentation for monitoring culture development. Large-scale cultivation of plant cells and tissues in bioreactors. Compliance with safety and sanitary standards when working with plant cultures.
Forms of Assessment / Examination	Current assessment: 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. Neumann, K.-H., Kumar, A., Imani, J. <i>Plant Cell and Tissue Culture – A Tool in Biotechnology: Basics and Application</i> . Springer, Cham, Switzerland, 2020. ISBN: 978-3-030-49096-6. 2. Reddy, J. <i>Plant Tissue Culture</i> . CRC Press, Boca Raton, FL, USA, 2024. ISBN: 978-1-032-71261-1. 3. Park, S. <i>Plant Tissue Culture: Techniques and Experiments</i> . 4th ed. Elsevier, Amsterdam, Netherlands, 2021. ISBN: 978-0-12-821120-5.
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	<b>M32.1 Biophysics</b>
Semester(s) in which the module is taught	Trimester 8

Module Leader / Coordinator	PhD in chemistry, associate professor Botagoz Zhaksylykovna Mutaliyeva PhD, associate professor Moldir Alibekovna Turalieva PhD, Ainagul Akhmet
Language of Instruction	Kazakh, Russian, English
Relation to the Programme / Curriculum Placement	Elective component
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total workload – 150 hours: lectures – 30 hours; laboratory classes – 30 hours; independent work of learners – 55 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	M13 Physics or M5 Higher Mathematics
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -explain the main concepts of biophysics, including molecular, quantum, thermodynamic, optical and radioactive processes, and assess their significance in the functioning of living systems; -apply biophysical methods and instruments to measure, summarize and analyze biomechanical, thermal, optical and radiation processes in organisms; -perform experimental studies of biophysical parameters to interpret physiological functions; -interpret the results of biophysical measurements in solving applied problems in biotechnology and medicine; -analyze the effects of physical factors on biological systems using interdisciplinary approaches; -use biophysical approaches in the development and implementation of diagnostic and research methods in biotechnological practice.
Indicative Content	<b>Lectures:</b> Subject and objectives of biophysics. Biophysical research methods for studying biological processes. Fundamentals of mechanics and laws of motion in biosystems. Use of centrifugation to separate biological structures. Properties and mechanisms of muscle tissue. Molecular physics: states of matter, intermolecular interactions. Transport phenomena: diffusion, osmosis, active transport. Physical bases of thermoregulation. Thermodynamics and the second law in biological processes. Biological effects of optical and X-ray radiation. Quantum biophysics: energy levels of atoms and molecules. Photobiological processes: photosynthesis, photoperiodism. Optical methods: luminescence, refractometry. Radioactivity and its spread in the biosphere. <b>Laboratory classes:</b> Methods for determining dissolved oxygen, amperometric analysis of respiration in plants and yeast. Measurement of solution pH, use of photoelectrocalorimeter, calibration curve construction. Study of optical density, staining techniques and sorption properties of tissues under various conditions. Application of spectrophotometry and polarimetry for substance analysis, investigation of photodynamic hemolysis of erythrocytes. Introduction to laser applications in biology and medicine, properties of light, conductivity of living tissues, electrocardiography and galvanic skin response.
Forms of Assessment / Examination	Current assessment: group discussions and projects, case studies, colloquiums, 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. Mutaliyeva, B.Zh. <i>Lectures Summary on the Discipline Biophysics: For Students of Specialty 5B070100 – Biotechnology</i> . Shymkent: M. Auezov SKSU, 2020. 2. Antonov, V.F., et al. <i>Biophysics</i> . Moscow: GIC VLADOS, 2019. 3. Brignole, E., SelvaPereda, <i>Phase Equilibrium Engineering</i> . eBook, Elsevier, 2023. ISBN: 9780444594716. 4. Ashrafuzzaman, M. <i>Introduction to Modern Biophysics</i> . Taylor & Francis, 2023.

	5. Davidovits, P. <i>Physics in Biology and Medicine</i> , 5th edition, Academic Press, 2018.
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	<b>M32.2 Medical Biophysics</b>
Semester(s) in which the module is taught	5th semester
Module Leader / Coordinator	PhD, Moldir Alibekovna Turalieva PhD, Ainagul Akhmet
Language of Instruction	Russian, Kazakh, English
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: lectures – 30 hours; laboratory classes – 30 hours; supervised independent work – 22.5 hours; independent work of learners – 55 hours (current), 12.5 hours (midterm)
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M13 Physics or M5 Higher Mathematics
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the basic principles of biomechanics, bioelectrical processes, membrane mechanisms, and physics of radiation, and their role in organism functioning; -apply medical biophysics methods to study physical properties of tissues, record bioelectrical signals, and visualize internal organs using ECG, ultrasound, MRI, and CT; -perform laboratory studies of osmotic pressure, blood and biological fluid viscosity, and investigate the effects of ultrasound and laser radiation on biological objects; -analyze and interpret biophysical data to evaluate functional state of the organism and solve applied problems in medicine and biotechnology; -investigate biophysical mechanisms of the respiratory, nervous, and sensory systems using interdisciplinary approaches; -use medical biophysics knowledge to develop and apply modern diagnostic and therapeutic methods in clinical practice.
Indicative Content	<b>Lectures:</b> Biomechanics and physics of motion in biological systems. Mechanics of blood and vascular pressure. Bioelectrical processes: action potentials, ECG, EEG, EMG. Membrane processes: osmosis, diffusion, active transport. Physics and biological effects of ionizing and non-ionizing radiation. Principles of medical equipment: ECG, ultrasound, MRI, CT. Optical and acoustic methods in medicine, lasers, endoscopy, spectroscopy. Modern biophysical technologies: molecular biophysics, nanobiophysics, cell cycle biophysics, and neurosensory processes. Biophysics of respiratory system, vision, and hearing. Phototherapy, photodynamic effects, and radiobiology. Thermoregulation and heat transfer in organisms. Bioengineering and organ biophysics. <b>Laboratory classes:</b> Study of physical properties of biological tissues: density, conductivity, elasticity. Determination of osmotic pressure and membrane potential. Study of light absorption and spectroscopy of biomolecules. Recording of bioelectrical signals: ECG, EEG, EMG. Investigation of ultrasound and laser effects on tissues. Analysis of ionizing radiation effects. Measurement of blood and biological fluid viscosity and flow. Introduction to imaging methods: MRI, CT, ultrasound. Assessment of functional state via oxygenation, pH, and tissue conductivity indicators.
Forms of Assessment / Examination	Current assessment: case studies, quizzes, presentations, portfolio, group projects 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"> <li>1. Remizov A.N. <i>Medical and biological physics</i>. Textbook. - Published by GEOTAR-Media, -2021, p. 576.</li> <li>2. William C. Parke. <i>Biophysics. A Student's Guide to the Physics of the Life Sciences and Medicine</i>. Textbook. Springer Nature Switzerland AG. 2020. DOI <a href="https://doi.org/10.1007/978-3-030-44146-3">https://doi.org/10.1007/978-3-030-44146-3</a></li> <li>3. Samoilov V. O. <i>Medical biophysics: a textbook for universities</i>. St. Petersburg: SpetsLit, 2013. - 591 p.</li> <li>4. Rodney M. J. Cotterill. <i>Biophysics. An Introduction</i>. Danish Technical University, Denmark. Published by John Wiley &amp; Sons Ltd, 2020.</li> <li>5. Mutaliyeva, B.Zh. <i>Lecture summary On the discipline Biophysics: For students of specialty 5B070100-Biotechnology</i> / B. Zh. Mutaliyeva. - Shymkent: M. Auezov SKSU, 2020 o=electronic optical disc (CD-ROM)</li> <li>6. Chernyaev A. P., Narkevich B. Ya. <i>Introduction to Medical Physics: Textbook</i> - Moscow: OOP Physics Faculty of Moscow State University, 2019. - 81 p.</li> </ol>
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	<b>M33.1 Molecular Biology</b>
Semester(s) in which the module is taught	5th semester
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Gulzhaina Baigonysova Alpamisova PhD, associate professor Moldir Alibekovna Turalieva Master of science, lecturer Dariga Eradilovna Kudasova
Language of Instruction	Kazakh, Russian, English
Relation to the Programme / Curriculum Placement	Basic discipline, elective component Major course, elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 150 hours: lectures – 30 hours; practical work – 30 hours; supervised independent work – 22.5 hours; independent work of learners – 55 hours (current), independent work of learners - 12.5 hours (midterm)
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M31.1 Cell Biotechnology or M31.2 Plant Cell and Tissue Culture Technology
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-understand the significance of molecular biology in the development of life sciences and recognize key discoveries, including DNA structure and the principle of complementarity;</li> <li>-know modern molecular-genetic methods, including sequencing, hybridization, cloning, and types of PCR (standard, qPCR, RT-PCR, isothermal amplification);</li> <li>-design PCR primers using online tools such as GenScript;</li> <li>-perform DNA extraction, conduct PCR, and analyze electrophoresis results;</li> <li>-carry out isothermal amplification and interpret karyotypes to detect chromosomal abnormalities;</li> <li>-use online databases (NCBI, Ensembl) for mutation analysis and genetic linkage studies;</li> <li>-apply molecular diagnostic methods to detect hereditary diseases;</li> <li>-analyze molecular-genetic research results in a biomedical context</li> </ul>
Indicative Content	<b>Lectures:</b> Molecular biology and its role in the development of life sciences. History and key discoveries. DNA double helix: Watson and Crick discovery, chemical structure, and complementarity principle. Modern molecular-genetic methods: sequencing, hybridization, cloning. Polymerase chain reaction (PCR): principles, components, and stages. Types of PCR: standard,

	<p>quantitative (qPCR), reverse transcription (RT-PCR), isothermal amplification, nested and multiplex PCR. Primer design: principles, tools, using GenScript platform. Human Genome Project: goals, stages, achievements. Chromosome structure and inheritance: human chromosomes, types of chromosomal disorders, genetic maps and linkage. Integration of DNA technologies in biomedical and biotechnological research. Applications of molecular genetics in diagnostics and personalized medicine.</p> <p><b>Practical classes:</b> DNA extraction from biological material. Performing standard PCR: preparation of reaction mixture, amplification. Electrophoresis of PCR products: separation and result interpretation. Primer design using online tools (GenScript). Conducting DNA isothermal amplification. Karyotype interpretation and chromosomal anomaly analysis. Use of online genetic databases (NCBI, Ensembl). Mutation analysis using PCR and restriction analysis. Molecular diagnostics in clinical examples: mutation interpretation, genetic identification, application in hereditary disease detection.</p>
Forms of Assessment / Examination	<p>Current assessment: case studies, glossary, presentations, portfolio, group projects, essays.</p> <p>Final assessment: examination</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. Alberts B., Johnson A., Lewis J., et al. <i>Molecular Biology of the Cell</i>. - 6th Edition. - Garland Science, -2014, P.1464.</li> <li>2. Watson J.D., Baker T.A., Bell S.P., et al. <i>Molecular Biology of the Gene</i>. - 7th Edition. - Pearson, -2013, P.976.</li> <li>3. Brown T.A. <i>Gene Cloning and DNA Analysis: An Introduction</i>. - 7th Edition. - Wiley-Blackwell, -2016, P.512.</li> <li>4. Nelson D.L., Cox M.M. <i>Lehninger Principles of Biochemistry</i>. - 7th Edition. - W.H. Freeman, -2017, P.1256.</li> <li>5. Karp G. <i>Cell and Molecular Biology: Concepts and Experiments</i>. - 8th Edition. - Wiley, -2016, P.704.</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M33.2 Analytical Methods in Biochemistry</b>
Semester(s) in which the module is taught	5th semester
Module Leader / Coordinator	<p>PhD in agricultural sciences, associate professor Gulzhaina Baigonysova Alpamisova</p> <p>PhD, associate professor Moldir Alibekovna Turalieva</p> <p>Master of science, lecturer Dariga Eradilovna Kudasova</p>
Language of Instruction	Kazakh, Russian, English
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 – 150 hours: lectures – 30 hours; practical work – 30 hours; supervised independent work – 22.5 hours; independent work of learners – 60 hours (current), independent work of learners - 12 hours (midterm)
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M33.1 Industrial Wastewater Treatment Technology; M33.2 Urban Wastewater Treatment
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-understand the fundamentals of spectroscopy and its applications in biochemistry;</li> <li>-use chromatography techniques for separation and analysis of substances;</li> <li>-apply electrophoresis methods for studying proteins and nucleic acids;</li> <li>-perform mass spectrometry and immunological analyses;</li> <li>-use biosensors for biomolecule detection;</li> </ul>

	-analyze biochemical research results for practical applications.
Indicative Content	<p><b>Lectures:</b> Analytical methods in biochemistry, including spectroscopy (UV, visible, IR) for studying molecular structure and concentration. Chromatographic techniques, including liquid, gas, and thin-layer chromatography, for separation and identification of components. Electrophoretic methods, such as gel electrophoresis, for protein and nucleic acid analysis. Mass spectrometry for determining molecular mass and structure. Modern immunodiagnostic and biosensor technologies used in biochemistry and medicine. Comprehensive study of biological systems using these analytical methods.</p> <p><b>Practical classes:</b> Quantitative analysis of proteins and nucleic acids using spectrophotometry. Separation of components by thin-layer and liquid chromatography. Mastery of electrophoresis to determine molecular mass of proteins and DNA. Mass spectrometric analysis of peptides and metabolites. Application of immunological methods, such as ELISA, to detect specific proteins. Use of biosensors for biomolecule detection in various samples.</p>
Forms of Assessment / Examination	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)	<p>1. Basha M. <i>Analytical Techniques in Biochemistry</i>. - Springer, -2020, P.126.</p> <p>2. Ramanujam R. <i>Analytical Biochemistry</i>. - 1st Edition. - Wiley, -2016, P.304.</p> <p>3. Katoch R. <i>Analytical Techniques in Biochemistry and Molecular Biology</i>. - Springer, -2011, P.243.</p> <p>4. Malik D., Narayanasamy N., Pratyusha V.A., Thakur J., Sinha N. <i>Textbook of Nutritional Biochemistry</i>. - Springer Singapore, -2023, P.382.</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	<b>M34.1 Management in Integrated Plant Protection</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	PhD, senior lecturer Zhuldyz Kairatkizi Ibraimova
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 – 180 hours: lectures – 30 hours; laboratory classes – 45 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	M29.1 Plant Biotechnology or M29.2 Bioprotectors and Plant Growth Stimulators
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-understand the principles of integrated plant protection and methods for controlling pests, diseases, and weeds;</li> <li>-use biological, agronomic, and chemical methods of plant protection;</li> <li>-monitor pest populations and predict their development;</li> <li>-identify major pests and plant diseases;</li> <li>-evaluate the effectiveness of protection measures and apply bioproducts;</li> <li>-analyze the economic and ecological efficiency of plant protection methods.</li> </ul>
Indicative Content	<p><b>Lectures:</b> Management in integrated plant protection covers the main principles of pest, disease, and weed control with minimal use of chemical agents. Biological, agronomic, and chemical methods of protection are considered, including their combination for sustainable crop management. Special attention is given to pest population monitoring and methods for predicting their development. Modern integrated protection strategies,</p>

	including the use of natural enemies and bioproducts, are studied. Lectures also address economic efficiency and ecological safety of various protective measures. <b>Laboratory classes:</b> Students identify major pests and plant diseases, studying their morphological features. Analysis of the effectiveness of biological and chemical protection agents on laboratory samples is performed. Methods for monitoring and accounting for pest populations under controlled conditions are mastered. Experiments on the impact of agronomic practices on pest and pathogen development are conducted. Laboratory classes develop practical skills in applying integrated plant protection methods.
Forms of Assessment / Examination	Current assessment: written tests; written and oral quizzes; individual and group projects. 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. Goncharov A. I. <i>Integrated Plant Protection. Theory and Practice</i> . Moscow: KolosS, 2008, 368 p. 2. Dyakov Yu. T., Bukhvalov A. V. <i>Phytopathology with the Basics of Plant Protection</i> . Moscow: KolosS, 2001, 512 p. 3. Gurr G. M., Wratten S. D., Snyder W. E., Read D. M. <i>Biodiversity and insect pests: key issues for sustainable management</i> . Chichester: Wiley-Blackwell, 2012, 368 p. 4. Pimentel D. (Ed.). <i>Integrated Pest Management: Innovation-Development Process</i> . Dordrecht: Springer, 2014, 453 p. 5. FAO. <i>Guidelines on Integrated Pest Management in the context of sustainable agriculture</i> . – Rome: FAO, 2021. – 148 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	<b>M34.2 Application and Management of Phytosanitary Technologies</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	PhD, senior lecturer Zhuldyz Kairatkizi Ibraimova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, laboratory work
Workload (including contact hours and independent study)	Total workload – 180 hours: lectures – 30 hours; laboratory classes – 45 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	M29.1 Plant Biotechnology or M29.2 Bioprotectors and Plant Growth Stimulators
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the principles of organization and planning of phytosanitary measures; -comply with regulatory requirements and safety rules when using pesticides and bioproducts; -coordinate plant protection activities between different services and farms; -evaluate the quality and environmental impact of plant protection products; -maintain records and documentation of phytosanitary activities; -plan and control the implementation of integrated plant protection programs.
Indicative Content	<b>Lectures:</b> The organization of phytosanitary technology application covers systems for planning and implementing plant protection measures against pests, diseases, and weeds. Regulatory documents, standards, and safety rules for pesticide and bioproduct use are examined. Special emphasis is placed on coordinating activities between different services and farms to ensure effective phytosanitary control. Methods for assessing risk and the economic

	<p>efficiency of applied technologies are discussed. Lectures aim to develop students' skills in organizing and managing comprehensive phytosanitary programs.</p> <p><b>Laboratory classes:</b> Students study the procedures for preparing and applying pesticides and bioproducts safely. Analysis of the quality of plant protection products and their environmental impact is conducted. Methods for recording and accounting phytosanitary activities are mastered. Exercises on planning and coordinating protective work at various farm levels are performed. Laboratory classes develop practical skills in organizing and controlling phytosanitary measures.</p>
Forms of Assessment / Examination	<p>Current assessment: written tests; written and oral quizzes.</p> <p>Final assessment: examination.</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. Barabanov V. V. <i>Fundamentals of Phytosanitary Ecology</i>. Moscow: Agropromizdat, 1985, 336 p.</li> <li>2. Suleimanov M. A. <i>Biological Plant Protection</i>. Moscow: Agropromizdat, 1990, 416 p.</li> <li>3. Kuznetsov V. I., Reznik S. Ya. <i>Biological Plant Protection: Theoretical Foundations and Technologies</i>. St. Petersburg: Lan, 2020, 312 p.</li> <li>4. EPPO. <i>Guidelines for the Efficacy Evaluation of Plant Protection Products</i>. Paris: European and Mediterranean Plant Protection Organization, 2020, 198 p.</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M35.1 Experimental Techniques and Data Processing, and Patent Studies</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	PhD, senior lecturer Ainagul Akhmet
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 180 hours: lectures – 30 hours; practical work – 45 hours; supervised independent work – 30 hours; independent work of student – 60 hours; midterm – 15 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M7.1 Fundamentals of Biotechnology or M7.2 Fundamentals of Academic Writing
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-understand the history and principles of patent law and intellectual property protection;</li> <li>-develop methodologies and plans for conducting scientific experiments, considering the structure and types of research;</li> <li>-apply statistical, graphical, and mathematical methods to analyze experimental data;</li> <li>-process experimental results taking into account error theory and metrology standards;</li> <li>-search, analyze, and document patent information, and prepare draft invention applications;</li> <li>-evaluate patent legislation features in different countries and ensure legal protection of research results.</li> </ul>
Indicative Content	<p><b>Lectures:</b> Lectures: History of patent law. General provisions on the protection of intellectual property. Development of methodology and experimental design. Structure and types of scientific research. Selection and justification of research topics. Planning experiments and research procedures. Statistical, graphical, and mathematical data analysis. Metrology,</p>

	standardization, and certification concepts. Error theory and experimental data processing. Biotechnological and genetic methods used in experiments. <b>Practical classes:</b> Study of patent law history and key documents. Development of experimental plans including objectives, hypotheses, and methods. Processing experimental data using error theory and statistical analysis. Searching and analyzing patent information in public databases, and reviewing patent application structures. Preparing draft invention applications and studying patent law features in different countries.
Forms of Assessment / Examination	Current assessment: graphical calculations; quizzes, case studies, group projects, presentations, essays. 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. Kosmin V. <i>Fundamentals of Scientific Research</i> . Moscow, RIOR Publishing Center, 2017, pt. 4, 238 p. DOI: 10.12737/1753-1 Available at: <a href="https://riorpub.com/en/nauka/textbook/1954/view">https://riorpub.com/en/nauka/textbook/1954/view</a> (Accessed June 25, 2025) 2. Sosnin E. A. <i>Patent Science: Textbook and Workshop for Universities</i> . 2nd ed., revised and expanded. Moscow: Yurait Publishing House, 2024, 394 p. 3. <i>Patent Science and Engineering Experimental Techniques. Guidelines for Laboratory Work for University Students</i> . Mogilev, 2022, 40 p. 4. Zaitseva, I. S. <i>Fundamentals of scientific research and patent science: textbook</i> / I. S. Zaitseva; Kuzbass state technical university named after T. F. Gorbachev. – Kemerovo, 2014 – 84 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	<b>M37.2 Fundamentals of Scientific Research and Patent Studies</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	PhD, senior lecturer Ainagul Akhmet
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 180 hours: lectures – 30 hours; practical classes – 45 hours; supervised independent work – 30 hours; independent work of students – 60 hours; midterm – 15 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	M7.1 Fundamentals of Biotechnology or M7.2 Fundamentals of Academic Writing
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the foundations of intellectual property, its role, and legal aspects -identify the subject and objects of patent law in biotechnology -formulate research topics, aims, and objectives, and plan experimental work -follow research ethics principles and ensure reproducibility of results -organize and interpret research results, prepare conclusions and recommendations -navigate patenting procedures and work with patent databases (Espacenet, Rospatent, Kazpatent) -consider ethical and legal aspects of intellectual property use -prepare scientific publications and patent applications according to formal requirements -apply statistical and graphical methods for data analysis -develop innovative proposals for practical implementation
Indicative Content	<b>Lectures:</b> Concept of intellectual property and its role in science and industry. Copyright and industrial property: differences, intersections, and legal framework. Subject and objects of patent law in biotechnology and related fields. Patent legislation in the legal system and its application in research.

	<p>Main directions of scientific research in biotechnology. Formulation of a research topic, aims, and objectives. Experimental design requirements, methodological approaches, research ethics, and reproducibility. Processing research results: analysis and interpretation of data. Preparation of conclusions, proposals, and production recommendations. Patent procedure from application to protection document. Working with patent information (Espacenet, Rospatent, Kazpatent, WIPO). Ethical and legal aspects of using others' intellectual property. Structure and requirements for scientific publications and patent applications.</p> <p><b>Practical classes:</b> Analysis of intellectual property objects in science and technology. Comparison of copyright and patent law. Determining the subject of patent law in biotechnology. Formulating a research topic, aim, objectives, and hypotheses. Developing an experimental plan: stages, methods, variables. Methodological techniques for observation and data registration. Preparing results: tables, graphs, reports. Using statistics and graphical methods for data processing. Justifying novelty and relevance. Patent information search (WIPO, Espacenet, Rospatent, Kazpatent). Analysis of a patent document: structure, claims, specification. Drafting a patent description and claims. Preparing a scientific publication: abstract, keywords, structure. Developing and justifying an innovative proposal. Ethical aspects of scientific activity and patent studies.</p>
Forms of Assessment / Examination	<p>Current assessment: graphical calculations; quizzes; case studies; group projects; presentations; essay.</p> <p>Final assessment: examination.</p>
Learning and Examination Requirements	<p>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.</p>
Reading List (Essential and Recommended Literature)	<ol style="list-style-type: none"> <li>1. Mejia C and Kajikawa Y. (2025) <i>Patent research in academic literature. Landscape and trends with a focus on patent analytics</i>. Front. Res. Metr. Anal. 9:1484685. doi: 10.3389/frma.2024.1484685</li> <li>2. Kosmin V. <i>Fundamentals of scientific research</i>. Moscow, Publishing Center RIOR, 2017, pt. 4, 238 p. DOI: 10.12737/1753-1 Available at: <a href="https://riorpub.com/en/nauka/textbook/1954/view">https://riorpub.com/en/nauka/textbook/1954/view</a> (Date of access 25.06.2025)</li> <li>3. Sosnin E. A. <i>Patent Studies: Textbook and Workshop for Universities</i>. 2nd ed., revised and enlarged. - Moscow: Yurait Publishing House, 2024, 394 pages.</li> <li>4. <i>Patent Science and Engineering Experimental Techniques</i>. Guidelines for Laboratory Work for University Students. Mogilev, 2022, 40 pages.</li> <li>5. Zaitseva, I. S. <i>Fundamentals of Scientific Research and Patent Science: A Textbook</i> / I. S. Zaitseva; Kuzbass State Technical University named after T. F. Gorbachev. – Kemerovo, 2014, 84 pages.</li> </ol>
Last Revision Date of the Degree Program	<p>Approved by the decision of the Academic Council of the University on 27 March 2025, Protocol No. 10.</p>

Module Title	<b>M36 Contemporary Issues in Toxicology</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	Senior Lecturer Gulsunara Ryssbayeva
Language of Instruction	Kazakh, Russian, English
Relation to the Programme / Curriculum Placement	Minor
Teaching and Learning Methods	Lectures, laboratory classes
Workload (including contact hours and independent study)	Total workload – 120 hours: lectures – 15 hours; laboratory classes – 30 hours; independent work of learners – 50 hours; independent work of students – 10 hours; supervised independent work – 15 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	M28.1 Biochemistry or M28.2 Inorganic Chemistry

Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the pathogenesis and mechanisms of action of toxins; -describe the key parameters of toxicometry and toxicokinetics; -explain biotransformation processes and the interaction of toxins with the organism; -classify harmful substances according to toxicological characteristics; -evaluate product toxicity using biotesting methods; -determine the sensitivity of microorganisms and plants to toxins; -conduct and analyse laboratory experiments in toxicology; -formulate conclusions based on obtained experimental data.
Indicative Content	<b>Lectures:</b> This module covers the pathogenesis of intoxication, major toxicometric parameters, and the regularities of toxicokinetics of harmful substances. It examines the biotransformation of compounds and their interactions with organs and systems depending on various factors. It introduces core concepts and classifications used in toxicology, as well as contemporary manifestations of toxic effects of harmful substances (poisons) on biological systems. It explains the dependence of qualitative and quantitative characteristics of toxic processes on the structure of the active substance. <b>Laboratory classes:</b> Biotesting-based assessment of product toxicity. Determination of <i>Saccharomyces cerevisiae</i> yeast sensitivity to ethyl alcohol. Evaluation of the effects of various doses of heavy metals and toxic organic compounds on physiological indicators of plants. Determination of key toxicological parameters under the influence of heavy metal salts on seed germination. Study of the impact of sodium chloride exposure time on the activity of unicellular organisms. Assessment of plant cell resistance to dehydration by sulfuric acid. Investigation of the effects of heavy metal salts on glycolytic activity in yeast.
Forms of Assessment / Examination	Current assessment: discussions, brainstorming, lecture-visualisation, case studies, colloquia, written assignments. 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. Casarett & Doull's <i>Toxicology: The Basic Science of Poisons</i> , 9th Edition by Curtis D. Klaassen, 2018. 2. Barry S. Levine <i>Principles of Forensic Toxicology</i> : 2020. 3. Casarett & Doull's <i>Essentials of Toxicology</i> : 2015. 4. Casarett & Doull's <i>Essentials of Toxicology</i> : 2021. 5. Alan S Kolok, <i>Modern Poisons, A Brief Introduction to Contemporary Toxicology</i> : 2016.
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	<b>M53 Industrial Practice II</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	Master of science, lecturer Darykha Kudasova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	
Workload (including contact hours and independent study)	Total workload – 180 hours
Number of Credits (ECTS)	6 ECTS
Prerequisites and Recommended Prior Knowledge	
Module Aims and Intended Learning Outcomes	After completing this module, students are able to:

	-articulate their ideas and core professional knowledge in written or oral form in various fields of human activity; -work effectively in a team, manage a unit, interact with various bodies, and apply research and entrepreneurial skills.
Indicative Content	The module is aimed at acquiring practical skills in industrial settings and gaining experience in applying previously obtained knowledge to solve specific technical tasks. The internship provides opportunities to develop professional abilities and obtain practical experience relevant to the field. As a result of the internship, students gain an understanding of planning and management of ongoing biotechnological processes; operate biotechnological equipment; and demonstrate the ability to work in a team.
Forms of Assessment / Examination	Final assessment – internship report defense
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. O. Mezenova <i>Introduction to the Profession of a Food Industry Biotechnologist</i> , 2016. 2. V. V. Biryukov (Ed.), <i>Fundamentals of Biotechnology</i> , Nauka, 2014. 3. V. G. Debabov & V. A. Livshits, <i>Biotechnology: Modern Methods for Developing Industrial Microbial Strains</i> , 2018. 4. Rules of the Credit-Based Education System in Higher Education Institutions, Order of the Ministry of Education and Science of the Republic of Kazakhstan No. 753, December 9, 2005. 5. Yaroslav Stanishevskiy, <i>Industrial Biotechnology of Pharmaceuticals</i> , GEOTAR-Media, 2012.
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	<b>M 39.1 Agricultural Biotechnology</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	PhD in agricultural sciences, senior lecturer Katira Daurenbekova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Kazakh, Russian
Workload (including contact hours and independent study)	Total workload – 180 hours: lectures – 30 hours; laboratory classes – 45 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	M29.1 Plant Biotechnology or M29.2 Plant Bioprotectors and Growth Stimulators
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand fundamental principles and directions of agricultural biotechnology -apply biotechnological methods in plant breeding, propagation and development of transgenic organisms -use microbiological and biochemical techniques in feed production and veterinary practice -conduct laboratory analyses and assess transgenic and virus-free organisms -evaluate ecological and biosafety aspects of agri-biotechnology -formulate conclusions based on experimental data
Indicative Content	<b>Lectures:</b> Fundamentals and key directions of agricultural biotechnology. Biotechnology in plant breeding and propagation. Genetic and molecular basis of symbiotic nitrogen fixation in agricultural crops. Modern genomic and bioengineering technologies for developing transgenic organisms in agriculture. Microbiological and bioengineering approaches in feed

	production and veterinary applications. Ecological considerations and biosafety issues in agri-biotechnology. <b>Laboratory classes:</b> Microbiological investigations in agricultural biotechnology. Production and analysis of transgenic and virus-free organisms. Biochemical analysis of feed. Assessment of stability and quality of biosubstances. Methods for detecting GMOs in agricultural products.
Forms of Assessment / Examination	Current assessment: written tests; written and oral examinations; individual and group projects. 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. Shaffer, D. <i>Introduction to Agricultural Biotechnology</i> . – New York: Murphy & Moore Publishing, 2022. – 248 p. 2. Akhtar, M. S., & Hakeem, K. R. <i>Agricultural Biotechnology: Issues, Challenges, and Recent Developments</i> . – Apple Academic Press, 2025. – 346 p. 3. Nag, A. <i>Textbook of Agricultural Biotechnology</i> . – New Delhi: PHI Learning, 2008. – 268 p. 4. Singh, C. B. <i>Encyclopaedia of Agriculture Biotechnology</i> . – New Delhi: Anmol Publications, 2010. – 268 p. 5. Asylbekov, B. Zh. <i>Mal sharuashylygy ónimderiniń sapasy bagalau: okuwlyq [Assessment of the Quality of Livestock Products]</i> . – Shymkent: SKU, 2018. – 93 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	<b>M39.2 Quality and Safety Assessment of Agricultural Products</b>
Semester(s) in which the module is taught	6th semester
Module Leader / Coordinator	PhD in agricultural sciences, senior lecturer Katira Daurenbekova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Kazakh, Russian
Workload (including contact hours and independent study)	Total workload – 180 hours: lectures – 30 hours; laboratory classes – 45 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	M29.1 Plant Biotechnology or M29.2 Plant Bioprotectors and Growth Stimulators
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -evaluate the quality and safety of agricultural products; -apply physico-chemical, biochemical, and microbiological analytical methods; -identify and quantify contaminants, toxins, and GMOs in food products; -conduct laboratory investigations and analyse experimental results; -formulate conclusions based on obtained data.
Indicative Content	<b>Lectures:</b> Methods for assessing the quality of agricultural products, including physico-chemical, biochemical, and microbiological indicators. Modern standards and safety regulations for food products. Principles and methods of quality control at all stages of production and storage. Types and sources of contamination, toxic substances and microbiological risks, along with methods of detection and prevention. Identification and monitoring of GMOs. Ecological aspects of agricultural product safety. <b>Laboratory Work:</b> Biochemical and microbiological analyses of agricultural products for quality and safety evaluation. Measurement of physico-chemical parameters (moisture, acidity, protein and lipid content). Detection and quantification of pesticides, toxins, and heavy metals. Molecular-biological

	detection of GMOs. Assessment of microbiological purity and sanitary condition of samples. Development of skills in interpretation and documentation of results.
Forms of Assessment / Examination	Current assessment: 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. Alimbekov, E. A., & Kurmantaev, A. Zh. <i>Ocenka kachestva i bezopasnosti produkcii sel'skogo khozyaistva i pishchevoi promyshlennosti</i> . Evero, 2020. 2. Sattarova, G. M. <i>Bezopasnost' prodovol'stviya: kachestvo i standartizaciya</i> . Evero, 2021. 3. Motarjemi, Y., & Lelieveld, H. (Eds.). <i>Food Safety Management: A Practical Guide for the Food Industry</i> . 2nd ed. Academic Press, Elsevier, 2023. 4. <i>Codex Alimentarius. General Principles of Food Hygiene</i> . CXC 1-1969 (Rev. 2020). FAO/WHO, 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	<b>M40.1 Food Biotechnology</b>
Semester(s) in which the module is taught	Trimester 7
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Amina Duylbai Dyuisenkhanqyzy
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective 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 – 55 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	M21.1 Microbiology and Virology or M21.2 Sanitation and Hygiene of Biotechnological Production
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the fundamental biotechnological processes used in the food industry -apply microbiological and biochemical methods for the analysis of food products -evaluate the quality and safety of fermented and functional food products -conduct laboratory investigations of fermentation processes and microbiological purity control -analyze and interpret the results of biotechnological experiments -formulate evidence-based conclusions derived from experimental data.
Indicative Content	<b>Lectures:</b> The module covers biotechnological methods and processes used in the food industry to enhance product quality, safety and nutritional value. It examines the microbiological foundations of fermentation and the technologies used for producing fermented and functional food products. Modern biotechnological approaches to the modification of food components are discussed, including the use of probiotics and biopreservatives. Considerable attention is devoted to quality control, food safety assurance and regulatory aspects of food biotechnology. <b>Practical classes:</b> Students perform microbiological and biochemical analyses of food products. Laboratory work includes studying fermentation processes involving various microorganisms and assessing their influence on product quality and safety. Methods for determining biologically active compounds, probiotics and metabolites are applied. Techniques for monitoring microbiological cleanliness and detecting pathogenic microorganisms in food

	samples are mastered. Practical skills are developed in designing biotechnological experiments and documenting results.
Forms of Assessment / Examination	Current assessment: written tests; written and oral questioning; mini-projects and presentations 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. Johnson-Green, P. <i>Introduction to Food Biotechnology</i> . CRC Press, 2018. 2. Pometto, A. L., Shetty, K., Paliyath, G., & Levin, R. E. <i>Food Biotechnology</i> (2nd ed.). CRC Press, 2022. 3. Lee, C.-H., & Park, H.-J. <i>Food Biotechnology</i> . Wiley-VCH, 2019.
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	<b>M40.2 Biological and Food Safety</b>
Semester(s) in which the module is taught	Trimester 7
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Amina Duylbai Dyuisenkhanqyzy
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective 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 – 55 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	M21.1 Microbiology and Virology or M21.2 Sanitation and Hygiene of Biotechnological Production
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the fundamental principles of biological and food safety -apply microbiological and chemical analytical methods for food safety assessment -identify pathogens, toxins and biological hazards in food samples -conduct laboratory investigations and evaluate the effectiveness of biocontrol measures -analyze and interpret data related to biological safety -formulate scientifically grounded conclusions based on research findings
Indicative Content	<b>Lectures:</b> The module introduces the core concepts of biological and food safety, including mechanisms of biological risks and threats to human health. It addresses methods for controlling and preventing biological contamination in food and agricultural products. Microbiological, toxicological and chemical factors influencing food safety are examined. Considerable attention is given to modern technologies for detecting pathogens, toxins and GMOs, as well as regulatory and legislative frameworks in the field of food safety. <b>Practical classes:</b> Students conduct microbiological and chemical analyses of food samples to evaluate their safety. Laboratory work includes detecting pathogenic microorganisms, toxins and allergens. Tests are performed to assess microbial resistance and sensitivity to preservatives and biocontrol agents. Students analyze results using modern instrumental methods. Skills are developed in documenting and interpreting laboratory findings in accordance with biosafety requirements.
Forms of Assessment / Examination	Current assessment: written tests; written and oral questioning; mini-projects and presentations. 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)	<p>1. Johnson-Green, P. <i>Introduction to Food Biotechnology</i>. CRC Press, 2018.</p> <p>2. Pometto, A. L., Shetty, K., Paliyath, G., &amp; Levin, R. E. <i>Food Biotechnology</i> (2nd ed.). CRC Press, 2022.</p> <p>3. Lee, C.-H., &amp; Park, H.-J. <i>Food Biotechnology</i>. Wiley-VCH, 2019.</p> <p>4. Abimuldina, S. T. <i>Azıq-túlik önerkásibindegi ekobiotehnologua</i>. Textbook. Almaty, 2020.</p> <p>5. Sarzhanova, K. Sh. <i>Tamaq óndirisi ónimderiniń mikrobiologuasy</i>. Study manual. Almaty, 2020.</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	<b>M41.1 Environmental Biotechnology</b>
Semester(s) in which the module is taught	Trimester 9
Module Leader / Coordinator	PhD in chemistry, associate professor Anar Madenovna Yesimova PhD, associate professor Moldir Alibekovna Turaliyeva
Language of Instruction	Kazakh, Russian, English
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 – 15 hours; independent work of students – 10 hours; supervised independent work – 50 hours
Number of Credits (ECTS)	5 ECTS
Prerequisites and Recommended Prior Knowledge	M22.1 Microbial Biotechnology or M22.2 Industrial Microorganisms
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to</p> <ul style="list-style-type: none"> <li>-understand the fundamental principles of environmental biotechnology and its role in environmental protection</li> <li>-apply microbiological and biochemical methods for the analysis and remediation of contaminated environments</li> <li>-evaluate the efficiency of bioremediation and biodegradation processes in soil and water</li> <li>-conduct laboratory investigations on the activity of microorganisms involved in ecological processes</li> <li>-analyze and interpret data obtained from ecological monitoring and biotechnological experiments</li> <li>-formulate scientifically justified conclusions based on research results in environmental biotechnology.</li> </ul>
Indicative Content	<p><b>Lectures:</b> The module covers the core principles of environmental biotechnology and its significance for environmental protection and sustainable development. Biological methods for the remediation of contaminated soils, water bodies and atmospheric air are examined. Microbiological and biochemical processes involved in biodegradation and bioremediation are analyzed. The module explores modern biotechnological approaches to reducing the negative impact of industrial and agricultural waste. Legislative and environmental standards, as well as biosafety considerations related to the use of biotechnologies for environmental purposes, are discussed.</p> <p><b>Laboratory classes:</b> Students investigate the microbiological and biochemical properties of microorganisms involved in bioremediation and environmental purification. Methods for determining enzyme activity related to pollutant degradation are studied. Experiments are carried out to assess the efficiency of biological soil and water purification. Microbial adaptation and resistance to various environmental conditions are examined. Skills in ecological monitoring and data analysis are developed using modern biotechnological methods</p>
Forms of Assessment / Examination	Current assessment: case studies; 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. Mutalievа B.Zh. <i>Industrial biotechnology</i> : Textbook / B.Zh. Mutalievа. - Shymkent: "Alem", 2017. - 280 c. 2. <i>Basics of industrial ecology: textbook for students in technical specialties of higher education institutions</i> / R. A. Issayeva [et al.]. - Shymkent : Alem, 2018. - 158 c. 3. <i>Influence of landscape of urban territory on distribution of pollutants in the atmosphere</i> : monograph for studying technical specialties of education institutions / R. A. Issayeva [et al.], [б. м.], 2018. - 120 4. Issayeva, A.U. <i>Modern Achievements of Biotechnology</i> : Textbook / A. U. Issayeva. - Almaty : Evero, 2020. - 308 c.
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	<b>M.41.2 Biodegradation and Stability of Pollutants and Xenobiotics</b>
Semester(s) in which the module is taught	Trimester 7
Module Leader / Coordinator	PhD in chemistry, associate professor Anar Madenovna Yesimova PhD, associate professor Moldir Alibekovna Turaliyeva
Language of Instruction	Russian, English
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 – 50 hours; independent work of students – 15 hours; supervised independent work – 60 hours
Number of Credits (ECTS)	4 ECTS
Prerequisites and Recommended Prior Knowledge	M22.1 Microbial Biotechnology or M22.2 Industrial Microorganisms
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the principles of biodegradation and stability of pollutants -apply microbiological and biochemical methods for contaminant analysis -evaluate the efficiency of bioremediation and the influence of environmental factors -conduct laboratory investigations of microbial activity -analyse and interpret environmental monitoring data -draw conclusions based on biotechnological research results
Indicative Content	<b>Lectures:</b> The module covers fundamental mechanisms of biodegradation of pollutants and xenobiotics in various natural environments. Students study pathways of chemical contaminant transformation and detoxification by microorganisms, enzymes, and environmental factors. Special attention is given to pollutant stability, mechanisms of biochemical resistance, and microbial adaptation. Contemporary bioremediation methods are explored, including aerobic and anaerobic processes and the application of genetically modified organisms. Environmental conditions influencing biodegradation efficiency, as well as monitoring and biosafety issues, are discussed. Self-organising modelling in ecology. The theory of self-organisation. <b>Laboratory classes:</b> Students perform experiments aimed at detecting and assessing the biodegradation activity of microbial communities and individual strains toward various xenobiotics and pollutants. Training includes cultivation techniques, analysis of enzymatic activities (e.g., oxidases, dehydrogenases, monooxygenases) involved in biodegradation, and assessment of pollutant resistance under controlled conditions. The influence of environmental factors (pH, temperature, oxygen availability) on degradation processes is examined. Methods of environmental monitoring and

	quantitative biodegradation analysis using spectrophotometry, chromatography, and molecular biology techniques are practiced.
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral quizzes 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. Sangeetha, J., Thangadurai, D., Abdullah, M.A. <i>Environmental Biotechnology: Biodegradation, Bioremediation, and Bioconversion of Xenobiotics for Sustainable Development</i> . – Apple Academic Press, 2016. – 434 p. 2. Chang, Y.-C. <i>Microbial Biodegradation of Xenobiotic Compounds</i> . – CRC Press, 2019. – 248 p. 3. Gupta, K., Gupta, K., Kumar, A. <i>Xenobiotics in Environment: Impacts, Detection and its Remediation</i> . – Routledge, 2026. 4. Singh, S.N. <i>Microbial Degradation of Xenobiotics</i> . – Springer, 2012. – 486 p. 5. Irvine, R.L., Sikdar, S.K. <i>Fundamentals and Applications of Bioremediation: Principles</i> , Volume I. – Routledge, 1998. – 765 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	<b>M42.1 Bioinformatics</b>
Semester(s) in which the module is taught	Trimester 8
Module Leader / Coordinator	PhD, associate professor Moldir Alibekovna Turaliyeva PhD, senior lecturer Zhuldiz Kairatkyzy Ibraimova
Language of Instruction	Kazakh, Russian, English
Relation to the Programme / Curriculum Placement	Elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 45 hours; practical classes – 45 hours; independent work of learners – 65 hours; independent work of students – 17,5 hours; supervised independent work – 37,5 hours
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M32.1 Biophysics or M32.2 Medical Biophysics
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the fundamentals of bioinformatics and the functions of biomolecules -work with biological databases and extract relevant datasets -perform sequence alignment and phylogenetic analysis -annotate genomes and analyse RNA-Seq datasets -analyse genetic variations and mutations -use Python and R for data analysis and visualisation -apply machine learning methods in biomedical tasks -conduct comprehensive bioinformatics analyses and formulate conclusions
Indicative Content	<b>Lectures:</b> Introduction to bioinformatics, structure and functions of DNA, RNA and proteins. Types of biological data and major databases (NCBI, Ensembl, UniProt, PDB). Methods of sequence alignment (BLAST, Clustal Omega), phylogenetic analysis, genome annotation and RNA-Seq analysis. Genetic variants (SNPs, INDELs). Basics of Python and R programming for bioinformatics. Applications of machine learning in biomedical research. <b>Practical classes:</b> Searching and retrieving data from biological databases, working with FASTA and GenBank formats. Performing sequence alignment and phylogenetic tree construction. Genome annotation; RNA-Seq analysis using Bioconductor. Python and R programming practice, data visualisation, mutation and variant analysis. A final mini-project focuses on analysing real-world bioinformatics datasets.

Forms of Assessment / Examination	Current assessment: 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. Dandekar, T., Kunz, M. <i>Bioinformatics: An Introductory Textbook</i> . – 1st ed. – Berlin: Springer, 2023. – 368 p. 2. Ismail, H. D. <i>Bioinformatics: A Practical Guide to Next Generation Sequencing Data Analysis</i> . – 1st ed. – Boca Raton: Chapman & Hall, 2023. – 348 p. routledge.com 3. Tiwary, B. K. <i>Bioinformatics and Computational Biology: A Primer for Biologists</i> . – 1st ed. – Singapore: Springer, 2021. – 234 p. Amazon 4. Gannev, P. S. <i>Introduction to Bioinformatics and Clinical Scientific Computing</i> . – 1st ed. – London: CRC Press, 2023. – 404 p. routledge.com 5. Shanker, A. (Ed.). <i>Bioinformatics: Sequences, Structures, Phylogeny</i> . – 1st ed. – Singapore: Springer, 2020. – 402 p. SpringerLink
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	<b>M42.2 Modelling and Scale-Up in Biotechnology</b>
Semester(s) in which the module is taught	Trimester 8
Module Leader / Coordinator	PhD, associate professor Moldir Alibekovna Turaliyeva PhD, senior lecturer Zhuldiz Kairatkyzy Ibraimova
Language of Instruction	Kazakh, Russian, English
Relation to the Programme / Curriculum Placement	Elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 45 hours; practical classes – 45 hours; independent work of learners – 65 hours; independent work of students – 17,5 hours; supervised independent work – 37,5 hours
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M32.1 Biophysics or M32.2 Medical Biophysics
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -understand the principles of mathematical modelling of biotechnological processes, including model development, validation, and verification -apply models to describe microbial growth kinetics, fermentation, and mass transfer -analyse and adjust model parameters to real conditions -perform scale-up calculations from laboratory to industrial levels -use modelling approaches to optimise cultivation and improve production efficiency.
Indicative Content	<b>Lectures:</b> The course examines fundamental principles of modelling biotechnological processes, model classification, and microbial growth kinetics. Topics include Monod, Verhulst, and Teissier models, scale-up methods, and the impact of scale-up on hydrodynamics and heat transfer. Computer-based modelling and model adaptation to experimental data are discussed <b>Practical classes:</b> Students construct and analyse kinetic models, calculate fermentation parameters, and determine scale-up indicators. Monod and Verhulst models are applied, and batch versus continuous processes are compared. Modelling incorporates inhibition effects and pH dependence. A process flowsheet is developed based on modelling outcomes
Forms of Assessment / Examination	Current assessment: colloquia, written tests, written and oral quizzes 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)	<p>1. Dandekar, T., Kunz, M. <i>Bioinformatics: An Introductory Textbook</i>. – 1st ed. – Berlin: Springer, 2023. – 368 p.</p> <p>2. Ismail, H. D. <i>Bioinformatics: A Practical Guide to Next Generation Sequencing Data Analysis</i>. – 1st ed. – Boca Raton: Chapman &amp; Hall, 2023. – 348 p. routledge.com</p> <p>3. Tiwary, B. K. <i>Bioinformatics and Computational Biology: A Primer for Biologists</i>. – 1st ed. – Singapore: Springer, 2021. – 234 p. Amazon</p> <p>4. Ganney, P. S. <i>Introduction to Bioinformatics and Clinical Scientific Computing</i>. – 1st ed. – London: CRC Press, 2023. – 404 p. routledge.com</p> <p>5. Shanker, A. (Ed.). <i>Bioinformatics: Sequences, Structures, Phylogeny</i>. – 1st ed. – Singapore: Springer, 2020. – 402 p. SpringerLink</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	<b>M43.1 Bionanotechnology</b>
Semester(s) in which the module is taught	Trimester 8
Module Leader / Coordinator	PhD, senior lecturer Zhuldiz Kairatovna Ibraimova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Compulsory / Elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 45 hours; practical classes – 45 hours; independent work of learners – 65 hours; independent work of students – 17,5 hours; supervised independent work – 37,5 hours
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M42.1 Bioinformatics or M42.2 Modeling and Scaling in Biotechnology
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-understand the fundamental principles and key directions of bionanotechnology, including biomolecular structure and the role of proteins</li> <li>-apply methods for the synthesis and modification of nanostructures and bionanomachines</li> <li>-analyse processes of bionanotransformation and bionanotransport</li> <li>-employ modern analytical techniques to study nanomaterials</li> <li>-apply knowledge to create and optimise biotechnological nanoproducts and devices.</li> </ul>
Indicative Content	<p><b>Lectures:</b> The course introduces key concepts and development trends in bionanotechnology, the structural characteristics of biogenic macromolecules, and the functional role of proteins in nanoscale applications. Topics include biophysical principles of nanotechnologies, the structural and functional foundations of biomaterials, mechanisms of bionanotransformation and bionanotransport, and the use of bionanotechnologies in medicine. The course examines the design, synthesis, and modification of bionanomachines, as well as modern analytical approaches and DNA-based nanostructure construction technologies.</p> <p><b>Practical classes:</b> Students study and apply nanotechnological devices and nanomaterials in biotechnology, investigate properties of biological molecules for nanoscale applications, and design biotechnological products with controlled dimensional characteristics. Practical tasks include approaches based on controlled self-assembly of nanostructures to model and synthesise functional bio-nano materials and devices.</p>
Forms of Assessment / Examination	Current assessment: colloquia, written assignments, written and oral quizzes 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. Bionanotechnology: <i>Global Prospects</i> / Ed. by D.E. Reisner. Boca Raton: CRC Press, 2016. – 349 p.

	<p>2.Papazoglou E.S. <i>Bionanotechnology</i> / E.S. Papazoglou, A. Parthasarathy. – San Rafael: Morgan &amp; Claypool Publishers, 2017. – 140 p.</p> <p>3.Liu J.-Q. <i>Biomolecular Computation for Bionanotechnology</i> / J.-Q. Liu, K. Shimohara. – Boston: Artech House Publishers, 2019. – 286 p.</p> <p>4.Gazit L. <i>Plenty of Room for Biology at the Bottom; Introduction to Bionanotechnology</i> / E. Gazit. – Singapore: World Scientific Publishing, 2021. – 220 p.</p> <p>5. Nanoscience. <i>Nanobiotechnology and Nanobiology</i> / Ed. by P. Boisseau, P. Houdy, M. Lahmani. – Berlin: Springer, 2020. – 1200 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	<b>M43.2 Structural Principles of Bionanotechnology</b>
Semester(s) in which the module is taught	Trimester 8
Module Leader / Coordinator	PhD, senior lecturer Zhuldiz Kairatovna Ibraimova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Compulsory / Elective component
Teaching and Learning Methods	Lectures, practical classes
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 45 hours; practical classes – 45 hours; independent work of learners – 65 hours; independent work of students – 17,5 hours; supervised independent work – 37,5 hours
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M42.1 Bioinformatics or M42.2 Modelling and Scale-Up in Biotechnology
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-understand structural features of biomolecules and principles of organisation of biological nanosystems</li> <li>-identify key types of molecular interactions ensuring the formation and stability of nanostructures</li> <li>-apply basic methods of structural analysis such as cryo-EM, NMR, and X-ray crystallography</li> <li>-use principles of self-assembly and molecular recognition for the design of nanomaterials</li> <li>-model biomolecular structures and develop simple DNA-based nano-devices</li> </ul>
Indicative Content	<p><b>Lectures:</b> The course examines core structural principles underlying the formation of biological nanosystems, including the organisation of proteins, nucleic acids, viral capsids, and membranes. Students study key methods of structural biology such as cryo-electron microscopy, nuclear magnetic resonance spectroscopy, and X-ray crystallography. Emphasis is placed on molecular interactions responsible for biomolecular stability and functionality, as well as mechanisms of self-assembly and molecular recognition relevant to the creation of nanomaterials and biological devices.</p> <p><b>Practical classes:</b> Students analyse and model biomolecular structures using specialised software tools. Practical tasks include studying principles of self-assembly, designing basic DNA nanostructures, evaluating the stability and functional characteristics of models, and developing simple bio-inspired nano-devices.</p>
Forms of Assessment / Examination	Current assessment: colloquia, written assignments, written and oral quizzes. 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)	<p>1. Bionanotechnology: <i>Proteins to Nanodevices</i> / Ed. by V.Renugopalakrishnan, R.V. Lewis. – Berlin: Springer, 2018. – 296 p.</p> <p>2. Gazit E. <i>Plenty of Room for Biology at the Bottom: Introduction to Bionanotechnology</i>. – Singapore: World Scientific Publishing, 2017. – 220 p.</p>

	<p>3. Reisner D.E., Bronzino J.D. <i>Bionanotechnology</i>. – New York: CRC Press, 2017 – 200 p.</p> <p>4. Nill K. <i>Glossary of biotechnology and nanobiotechnology</i>. – Boca Raton: CRC Press, 2020. – 402 p.</p> <p>5. <i>Nanotechnology in biology and medicine</i> / Ed. by Tuan Vo-Dinh. – Boca Raton: CRC Press, 2017. – 762 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	<b>M44.1 Diagnostics of Molecular and Genetic Research</b>
Semester(s) in which the module is taught	Trimester 8
Module Leader / Coordinator	PhD in agriculture sciences, associate professor Gulzhaina Alpamysova
Language of Instruction	Kazakh, Russian, English
Relation to the Programme / Curriculum Placement	Basic discipline, elective component
Teaching and Learning Methods	Lectures, practical classes, laboratory work
Workload (including contact hours and independent study)	Total workload – 210 hours: lectures – 45 hours; practical classes – 45 hours; independent work of learners (current) – 65 hours; independent work of learners (midterm) – 17,5 hours; supervised independent work – 37,5 hours
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M33.1 Molecular Biology or M33.2 Analytical Methods in Biochemistry
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to</p> <ul style="list-style-type: none"> <li>-understand the structure and properties of the main biological macromolecules (DNA, RNA, proteins) and the methods used for their extraction and analysis;</li> <li>-know the principles and procedures of electrophoresis, hybridization methods (Southern and Western blotting), and polymerase chain reaction (PCR);</li> <li>-possess practical skills in handling biological samples and preparing them for molecular studies;</li> <li>-apply molecular-genetic diagnostic methods to hereditary and infectious diseases, as well as to forensic and agricultural tasks;</li> <li>-use bioinformatic tools and software to analyse genetic data and interpret laboratory results.</li> </ul>
Indicative Content	<p><b>Lectures:</b> Structure and organization of DNA, RNA, and proteins; chemical properties and levels of biological macromolecule organization. Methods for extraction and analysis, including electrophoresis, Southern and Western blotting. Fundamentals and modifications of PCR. Applications of molecular diagnostics in medicine, agriculture, and forensics.</p> <p><b>Practical Classes:</b> Basic laboratory skills in molecular biology: biosafety, sample preparation, nucleic acid extraction, PCR setup, electrophoresis, hybridization techniques. Molecular diagnostics of hereditary and infectious diseases. Introduction to bioinformatic tools (NCBI, BLAST).</p> <p><b>Laboratory classes:</b> DNA extraction and purity assessment; PCR and analysis of amplification products; Southern and Western blotting; genetic sequence analysis using online tools; PCR-based infectious disease diagnostics; STR-marker profiling for identity testing. Completion of a mini-project on genetic data interpretation.</p>
Forms of Assessment / Examination	<p>Current assessment: case studies, quizzes, glossary, presentation, portfolio, group projects, essay.</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)	<p>1. Vivian Y. Pan, Jane L. Schuette, Karen E. Wain. <i>A Guide to Genetic Counseling</i>. 3rd Edition. Wiley-Blackwell. 2024. 640 pages</p> <p>2. Brooker R. <i>Genetics. Analysis and Principles</i> 8ed 2024.</p> <p>copy and paste into a search wdfiles.ru/M7sk</p>

	<p>3. Kosterin, O.E. 2022. <i>Osnovy genetiki: uchebnik</i> [Basics of Genetics: a textbook]. 2nd, revised edition. Publishing &amp; Polygraphic Centre of Novosibirsk State University, Novosibirsk, 650 pp. [in Russian] <a href="https://doi.org/10.25205/978-5-4437-1323-6">https://doi.org/10.25205/978-5-4437-1323-6</a></p> <p>4. Daniel Weinreich. <i>The Foundations of Population Genetics</i>. MIT Press. 2023.</p> <p>5. Robert J. Brooker. <i>Genetics: Analysis and Principles</i>, 6th Edition. Publisher: McGraw-Hill Education. -2021. -P.864</p> <p>6. Ramroop N., Kamloops S., <i>Introduction to Genetics</i>. (2 reviews). Publisher: Thompson Rivers University. British Columbia. -2009.</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	<b>M44.2 Synthetic Biology</b>
Semester(s) in which the module is taught	Trimester 8
Module Leader / Coordinator	PhD, associate professor Gulzhaina Alpamysova
Language of Instruction	Kazakh, Russian, English
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 – 210 hours: lectures – 45 hours; practical classes – 45 hours; independent work of learners (current) – 65 hours; independent work of learners (midterm) – 17,5 hours; supervised independent work – 37,5 hours
Number of Credits (ECTS)	7 ECTS
Prerequisites and Recommended Prior Knowledge	M33.1 Molecular Biology or M33.2 Analytical Methods in Biochemistry
Module Aims and Intended Learning Outcomes	<p>After completing this module, students are able to:</p> <ul style="list-style-type: none"> <li>-understand the principles and directions of synthetic biology and its distinctions from genetic engineering;</li> <li>-know the fundamentals of designing and assembling genetic constructs, including methods such as Gibson Assembly, Golden Gate, and CRISPR/Cas;</li> <li>-possess skills in using bioinformatic resources (NCBI, iGEM Registry) and software tools such as Benchling and SnapGene;</li> <li>-design and analyse in silico synthetic systems and probiotics;</li> <li>-apply basic molecular biology techniques (DNA extraction, PCR, cloning);</li> <li>-understand biosafety principles and ethical considerations in synthetic biology.</li> </ul>
Indicative Content	<p><b>Lectures:</b> Foundations and modern directions of synthetic biology; differentiation from genetic engineering. Modularity of living systems, standard biological parts, methods of DNA construct assembly (Gibson Assembly, Golden Gate, CRISPR/Cas), and modelling of synthetic systems. Applications in microorganisms, plants, and animals. Key issues in biosafety, bioethics, and advanced areas such as xenobiology, artificial cells, synthetic vaccines, and engineered probiotics.</p> <p><b>Practical classes:</b> Training in bioinformatic tools and design methods. Work with databases (NCBI, iGEM Registry); construction of genetic circuits in Benchling and SnapGene; sequence analysis; development of in silico synthetic system projects.</p> <p><b>Laboratory classes:</b> Plasmid DNA extraction, PCR, gene cloning. Assembly of genetic circuits, analysis of biosensors, and modelling of synthetic system behaviour.</p>
Forms of Assessment / Examination	<p>Current assessment: case studies, quizzes, glossary, presentation, portfolio, group projects, essay.</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)	1. Marchisio, M. A. <i>Introduction to Synthetic Biology: About Modeling, Computation, and Circuit Design</i> . Springer, 2018. 2. Lu, Y. <i>Cell-Free Synthetic Biology</i> . Springer, 2020. 3. Zurbriggen, M. D. (ed.). <i>Plant Synthetic Biology: Methods and Protocols</i> . Springer, 2022.
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	<b>M45, M66 Writing and Defense of the Diploma Thesis, Diploma Project, or Preparation and Completion of the Comprehensive Exam</b>
Semester(s) in which the module is taught	Trimester 9
Module Leader / Coordinator	PhD in agricultural sciences, associate professor Gulzhaina Alpamysova PhD in biology, professor Alfiya Saparbekova
Language of Instruction	Kazakh, Russian, English
Relation to the Programme / Curriculum Placement	Final certification
Teaching and Learning Methods	-
Workload (including contact hours and independent study)	Total workload – 240 hours
Number of Credits (ECTS)	8 ECTS
Prerequisites and Recommended Prior Knowledge	M33.1 Molecular Biology or M33.2 Analytical Methods in Biochemistry
Module Aims and Intended Learning Outcomes	After completing this module, students are able to: -justify the relevance and objectives of the chosen topic; -review scientific literature and select appropriate research methods; -perform experimental or computational work on the diploma topic; -process and interpret results, formulate conclusions and recommendations; -prepare and format the diploma thesis according to university requirements; -prepare for and defend the diploma thesis before the State Examination Committee.
Indicative Content	Generalization of abilities and skills, based on acquired in-depth knowledge, independently solves professional problems at a modern level, professionally presents specialized information, scientifically argues and defends their point of view, analyzes the content of professional literature in the chosen field of study. Discusses and presents research results in accordance with university requirements. Selection of a topic (subject to agreement with the academic supervisor). Development of a plan and schedule. Collection and analysis of scientific literature. Conducting research/calculations/modeling. Preparation of the thesis in accordance with GOST standards/methodological guidelines. Pre-defense (graduate department). Preparation of a presentation and report. Defense before the State Attestation Commission.
Forms of Assessment / Examination	Final assessment – oral defense of the diploma thesis, preparation, and completion of the comprehensive exam.
Learning and Examination Requirements	During the semester, students must complete all tasks assigned by the research supervisor.
Reading List (Essential and Recommended Literature)	1. Methodological Guidelines for Writing and Formatting Diploma Theses for Students of Educational Programs 6B05120 – Biotechnology, Shymkent: M. Auezov South Kazakhstan University, 2024. – 32 p. 2. Novikov, Yu. N. Preparation and Defense of Bachelor's Theses, Master's Dissertations, Diploma Projects: Textbook for Universities, 5th ed., revised and supplemented, St. Petersburg: Lan, 2021. 3. Boush, G. D., Razumov, V. I. Methodology of Scientific Research: Textbook, INFRA-M, 2023.

	4. Graustein, J. S. <i>How to Write an Exceptional Thesis or Dissertation: A Step-by-Step Guide from Proposal to Successful Defense</i> . Atlantic Publishing Group, 2014. ISBN 978-1601386038. 5. Mitchell, P. <i>Bachelor's Thesis: A Step-by-Step Writing Guide</i> . Self-published, 2022. – 150 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	<b>M 65 Pre-Diploma or Industrial Practice</b>
Semester(s) in which the module is taught	Trimester 8
Module Leader / Coordinator	Master of science, lecturer, Darikha Eradilovna Kudasova
Language of Instruction	Kazakh, Russian
Relation to the Programme / Curriculum Placement	Major course, elective component
Teaching and Learning Methods	Industrial/practical training
Workload (including contact hours and independent study)	Total Workload: 300 hours
Number of Credits (ECTS)	10 ECTS
Prerequisites and Recommended Prior Knowledge	-
Module Aims and Intended Learning Outcomes	After completing this module, students are able to -clearly present in writing or orally their ideas and fundamental professional knowledge across various fields and areas of human activity; -work effectively in a team, managing the work of a unit, interacting with different organizations, and applying research and entrepreneurial skills.
Indicative Content	Pre-diploma practice is the completion of research, the writing of a thesis, and the preparation of a future specialist for independent professional work. The main goal of pre-graduation internship at a company or research department is to develop students' industrial skills, collect data for a final qualifying thesis, or provide initial data for research.
Forms of Assessment / Examination	Final assessment – defense of the internship report
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. Mezenova, O. <i>Introduction to the Profession of Food Industry Biotechnologist</i> : Textbook. Moscow: IL, 2016. – 831 p. 2. <i>Fundamentals of Industrial Biotechnology</i> , ed. V. V. Biryukov. Moscow: Nauka, 2014. 3. Debabov, V. G., Livshits, V. A. <i>Biotechnology</i> . Vol. 2: Modern Methods of Creating Industrial Microbial Strains: Textbook. Moscow: Higher School, 2018. 4. Rules of the Credit System of Higher Education, approved by Order of the Ministry of Education and Science of the Republic of Kazakhstan No. 753, December 9, 2005. 5. Stanishkevsky, Y. <i>Industrial Biotechnology of Pharmaceuticals</i> : Textbook. GEOTAR-Media, 2012.
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.