AL-FARABI KAZAKH NATIONAL UNIVERSITY

Faculty of biology and biotechnology

Department of Biology and Biotechnology

Department of Molecular biology and genetics

APPROVED

Dean of Faculty

_____ Kurmanbaeva M.S.

"23" 05 2025 №10

EDUCATIONAL-METHODICAL COMPLEX OF DISCIPLINE

«68001 Genetic engineering»

Educational program "Biotechnology"

Course – 3
Semester – 6
Number of credits – 6
Lecture – 3,0
Laboratory classes – 3,0
IWST - 6

Almaty

Educational-methodical complex of the discipline is made by associated professor, PhD Amirova A.K.

Considered and recommended at the meeting of the Department of Molecular Biology and Genetics

from «21» 05 2025, protocol № 22

Head of the Department of Molecular Biology and Genetics _____ Zhunusbayeva Zh.K.

SYLLABUS
Spring semester 2025 – 2026 academic year
Educational program "6B05105 - Genetics", 3 course

ID and name of course	Independent work of the student (IWS)	Number of credits			General number of credits	Independent work of the student under the guidance of a teacher (IWST)
		Lectures (L)	Practical classes (PC)	Lab. classes (LC)		
68001 Genetic engineering	5	3,0	-	3.0	6	6.

ACADEMIC INFORMATION ABOUT THE COURSE

Learning Format	Cycle, component	Lecture types	Types of practical classes	Form and platform final control
Offline	P, UC	problematic, analytical lecture	problem solving, situational tasks	Traditional written exam, Univer, offline of the exam
Lecturer - (s)	associate professor Aigul Kuzembayevna Amirova			
e-mail :	aigul_amir@mail.ru			
Phone:	+7(708)8047195			
Assistant	Sanzhar Dosanovich Alibayev			

ACADEMIC COURSE PRESENTATION

Purpose of the course	Expected Learning Outcomes (LO) *	Indicators of LO achievement (ID)
To develop the ability to apply molecular genetic methods of genetic engineering in practice. The following will be considered: general principles of gene cloning; methods for constructing hybrid (recombinant) DNA molecules (reDNA); vector DNA molecules; expression of cloned genes in pro- and eukaryotic cells; the genetic engineering system of the yeast Saccharomyces cerevisiae; vector systems of animal and plant cells.	1. Evaluate the achievements of genetic engineering in biotechnology and the methodologies used. Establish the relationships and differences between the main methods of genetic engineering research for producing GMO products, master methods of food quality control and safety, and understand new forms of plants and animals.	1.1 Explains the relationship of modern biotechnology with other disciplines and establishes the achievements of modern biotechnology in the field of genetic engineering.
		1.2 Understands the basic methods of genetic engineering and their possible practical application.
	2. Explain various genetic engineering techniques and methods. Assess the potential application of these methods to produce GMO organisms and products.	2.1 Classifies genetic engineering methods and identifies their advantages.
		2.2 Establishes the relationship between methods and the goals of using these methods in practice.
	3. To exploit the potential of using newly engineered genomes to obtain useful substances and properties of organisms in biotechnology.	3.1 Determines the efficiency of creating new genetically modified products.
		3.2 Explains the principles of operation of the methods and justifies the practical application of genetic engineering methods;
	4. Apply knowledge from various fields of biotechnology to genetic engineering to create genetically modified organisms with beneficial properties.	4.1 Apply acquired knowledge to understand the principles underlying genetic engineering techniques.
		4.2 Explains the application of genetic engineering to solving problems in pharmacological research.
	5. Plan projects, establish methods and manage them; be able to find and make decisions to solve problems in the field of genetic engineering.	5.1 Determines the potential of each method for generating project ideas.
		5.2 Evaluates current methods and models the potential of genetic engineering in the modern world to address future challenges.
	Molecular biology and gender diagnostics	
Postrequisites	Medical and Forensic Genetics	

Learning Resources	**Literature:** main, additional. 1. Шулембаева К.К., Токубаева А.А. Реконструкция генома мягкой пшеницы на основе хромосомной инженерии и отделенной гибридизации: монография. КазНУ им. аль-Фараби. - Алматы: Қазақ ун-ті, 2019. - 240 с. 2. Огурцов А.Н., Близнюк О.Н., Масалитина Н.Ю. Основы генной инженерии и биоинженерии. Учебное пособие. Часть 1.: Молекулярные основы генных технологий. Харьков: НТУ "ХПИ", 2018. - 288 с. 3. Муминов Т.А., Куандыков Е.У. Основы молекулярной биологии : курс лекций. - Алматы : ССК, 2017. – 222 с. 4.Varshney Rajeev K. Plant Genetics and Molecular Biology. - London: Springer, 2018. - 298 p. 5. Halford Nigel G. Crop Biotechnology: Genetic Modification And Genome Editing. - London: World Scientific, 2018. - 218 p. **Internet resources** 1. http://elibrary.kaznu.kz/ru 2. https://www.isaaa.org/resources/publications/pocketk/16/ 3. https://vc.ru/future/109057-gennaya-inzheneriya-sostoyanie-na-2020 4. https://sites.google.com/site/anogurtsov/lectures/ge **Internet resources** 1 . http://elibrary.kaznu.kz/ru 2. MOOC / video lectures, etc. 3. https://www.coursera.org/ 4. https://www.edx.org/
Academic course policy	The academic policy of the course is determined by the Academic Policy and the Policy of Academic Integrity of Al-Farabi Kazakh National University . Documents are available on the main page of IS Univer . **Integration of science and education.** The research work of students, undergraduates and doctoral students is a deepening of the educational process. It is organized directly at the departments, laboratories, scientific and design departments of the university, in student scientific and technical associations. Independent work of students at all levels of education is aimed at developing research skills and competencies based on obtaining new knowledge using modern research and information technologies. A research university teacher integrates the results of scientific activities into the topics of lectures and seminars (practical) classes, laboratory classes and into the tasks of the IWST, IWS, which are reflected in the syllabus and are responsible for the relevance of the topics of training sessions and assignments. **Attendance.** The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course. Failure to meet deadlines results in loss of points. **Academic honesty.** Practical/laboratory classes, IWS develop the student's independence, critical thinking, and creativity. Plagiarism, forgery, the use of cheat sheets, cheating at all stages of completing tasks are unacceptable. Compliance with academic honesty during the period of theoretical training and at exams, in addition to the main policies, is regulated by the "Rules for the final control" , "Instructions for the final control of the autumn / spring semester of the current academic year" , "Regulations on checking students' text documents for borrowings". Documents are available on the main page of IS Univer . **Basic principles of inclusive education.** The educational environment of the university is conceived as a safe place where there is always support and equal attitude from the teacher to all students and students to each other, regardless of gender, race / ethnicity, religious beliefs, socio-economic status, physical health of the student, etc. All people need the support and friendship of peers and fellow students. For all students, progress is more about what they can do than what they can't. Diversity enhances all aspects of life. All students, especially those with disabilities, can receive counseling assistance by phone / e- mail aigul_amir@mail.ru or via video link in ZOOM: https://us05web.zoom.us/j/88254829221?pwd=mIjuOjokfnvcjeA41Z1O0kDDQ3EG3N.1 *to the meeting.* **Integration MOOC (massive open online course).** In the case of integrating MOOC into the course, all students need to register for MOOC. The deadlines for passing MOOC modules must be strictly observed in accordance with the course study schedule. **ATTENTION!** The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course, as well as in the MOOC. Failure to meet deadlines results in loss of points.

INFORMATION ABOUT TEACHING, LEARNING AND ASSESSMENT

Score-rating letter system of assessment of accounting for educational achievements				Assessment Methods
Grade	**Digital equivalent points**	**points, % content**	**Assessment according to the traditional system**	**Criteria-based assessment** is the process of correlating actual learning outcomes with expected learning outcomes based on clearly defined criteria. Based on formative and summative assessment. **Formative assessment is** a type of assessment that is carried out in the course of daily learning activities. It is the current measure of progress. Provides an
A	4.0 _	95-100	Excellent	

A-	3.67	90-94	
B+	3.33	85-89	Good
B	3.0	80-84	
B-	2.67	75-79	
C+	2.33	70-74	
C	2.0	65-69	Satisfactorily
C-	1.67	60-64	
D+	1.33	55-59	
D	1.0	50-54	
Fx	0,5	25-49	Unsatisfactory
F	0	0-24	

operational relationship between the student and the teacher. It allows you to determine the capabilities of the student, identify difficulties, help achieve the best results, timely correct the educational process for the teacher. The performance of tasks, the activity of work in the classroom during lectures, seminars, practical exercises (discussions, quizzes, debates, round tables, laboratory work, etc.) are evaluated. Acquired knowledge and competencies are assessed.

Summative assessment - type of assessment, which is carried out upon completion of the study of the section in accordance with the program of the course. Conducted 3-4 times per semester when performing IWS. This is the assessment of mastering the expected learning outcomes in relation to the descriptors. Allows you to determine and fix the level of mastering the course for a certain period. Learning outcomes are evaluated.

Formative and summative assessment	**Points % content**
Activity at lectures	5
Work in practical classes	20
Independent work	25
Design and creative activity	10
Final control (exam)	40
TOTAL	100

Calendar (schedule) for the implementation of the content of the course. Methods of teaching and learning.

A week	**Topic name**	**Number of hours**	**Max. ball**
	Module 1. Genetic engineering. The structure of nucleic acids. The structure and function of genes.		
1	**Lecture 1.** Introduction. The purpose and objectives of genetic engineering. The history of the development of genetic engineering technologies.	1	
	Laboratory work 1. Introduction to laboratory tools and alternative equipment.	2	6
2	**L 2.** Vectors are special devices designed to deliver foreign genes to various organisms.	1	
	LW. 2 Fire safety rules in laboratories.	2	7
	IWST P 1. Consultations on the implementation of IWS 1	1	
3	**L 3.** Enzymes used in genetic engineering. Restriction enzymes and DNA ligase.	1	
	LW. 3. Solving problems using restriction enzyme sequences.	2	7
4	**L 4.** Marker genes: selective genes, reporter genes.	1	
	LW. 4. Safety signs in the laboratory. Rules for the proper use of dispensers.	2	7
	IWS 1. Phage and cosmid vectors. Enzymes used in genetic engineering.	2	20
5	**L 5.** Recombinant DNA technology.	1	
	LW. 5. Plant DNA extraction and precipitation methods.	2	7
	IWST 2. Consultations on the implementation of IWS 2		
	Module 2. Genetic engineering methods.		
6	**L 6.** Methods of gene cloning. Creation of a genomic library.	1	
	LW. 6. Recombinant DNA synthesis. Problem solving.	2	7
	IWS 2. Transgenic industrial products. Industrial production of insulin and other valuable medicines. Preparation and defense of a presentation.		25
7	**L 7.** Methods of genetic transformation of plant protoplasts, cells and tissues.	1	
	LW. 7. The main chemical reagents used in laboratory research. Their classification.	2	7
	IWST 3. Test work on the above topics was completed.	2	
8	**L 8.** Construction of the *Agrobacterium tumefaciens* Ti plasmid.	1	
	LW. 8. Introduction to the PCR method.	2	7
	IWST 4. Consultation on the implementation of IWS 3	1	
Midterm control 1			**100**
9	**L 9.** Plant transformation method using *Agrobacterium tumefaciens*.	1	
	LW. 9. Methods for determining gene amplification. Gel documentation	2	7
	IWS 3. Regulation of the production of genetically modified organisms. Myths about the dangers of transgenics. Preparation and defense of a presentation.		25
10	**L 10.** Biolistic transformation of plants. The principle of operation of the gene gun.	1	
	LW. 10. Methods for detecting GMOs in foods. Methods and tools.	2	6
	IWST 5. Consultation on the implementation of IWS 4	1	
11	**L 11.** Methods of genetic transformation of animals.	1	
	PC 11. Making an agarose gel. Horizontal gel electrophoresis.	2	7
	IWS 4 Legislation in the field of GMOs (domestic, foreign), patenting (legal regulation of the creation and use of GMOs).	1	25
	Module 3. Genetic engineering: the future and biosafety.		
12	**L12.** Recombinant DNA and hereditary diseases.	1	

	IWS 12. Preparation of reagents and buffers required for PAGE electrophoresis.	2	8
13	**L 13.** RNA interference: mechanism of action and prospects for use in medicine.	1	
	PC 13. PAGE electrophoresis.	2	7
	IWST 5. Test work on the topics covered above.		
14	**L 14.** Mechanisms of gene expression regulation in prokaryotes and eukaryotes.	1	
	PC 14. Molecular genetic analysis in medicine and forensics	2	7
15	**L 15.** Gene therapy. Personalized medicine.	1	
	PC 15. Modern genome editing technologies such as CRISPR/Cas9 and new opportunities for treating hereditary diseases.	2	7
	IWST 6. Consultation on the final exam	1	
Midterm control 2			**100**
Final control (exam)			**100**
TOTAL for course			**100**

Dean _____ **Kurmanbaeva M.S.**

Chair of the Academic Committee
on the Quality of Teaching and Learning _____ **Baktybaeva L.K.**

Head of Department _____ **Zhunusbayeva Zh.K.**

Lecturer _____ **Amirova A.K.**

RUBRICATOR OF THE SUMMATIVE ASSESSMENT

CRITERIA EVALUATION OF LEARNING OUTCOMES

Example 1. Group presentation on the topics IWS 1. " Phage and cosmid vectors. Enzymes used in genetic engineering." (25% of 100% MC)

Criterion	"Excellent" 20-25%	"Good" 15-20%	"Satisfactory" 10-15%	"Unsatisfactory" 0-10%
Understanding of the theories, concepts and technologies used in the field of genetic engineering.	Deep understanding of theories, concepts and technologies used in the field of genetic engineering.	Understanding theories, concepts and technologies in the field of genetic engineering. Links (citations) to key sources are provided.	Limited understanding of theories, concepts of professional identity and teacher professionalism. Limited references (citations) to key sources are provided.	Superficial understanding / lack of understanding of theories, concepts of professional identity and professionalism of the teacher. Relevant references (citations) to key sources are not provided.
Awareness of modern methods of genome analysis and recombinant DNA construction.	Has a good understanding of theories, principles and methods, key concepts and the role of genetic engineering in improving living organisms, the relationship between chromosomal engineering and genetic engineering and other modern technologies of human genome editing and gene therapy.	Limited awareness of genetic transformation techniques. Limited analysis of the topic, poorly supported by theoretical and empirical research.	Little awareness of genetic engineering methods. Little theoretical or practical research.	There is little or no connection between the concepts of a teacher's professional identity and the context of Kazakhstan. Little or no use of empirical research.
Definition of the area of practical application/recommendation	Offers sound policy and/or practical recommendations, proposals for improving the professional identity and professionalism of teachers in Kazakhstan.	Limited knowledge of genetic engineering techniques used in practice.	Limited policy and practical recommendations. Recommendations are non-essential, not based on rigorous analysis, and are shallow.	Little or no policy and practice advice, or advice of very low quality.
Presentation, teamwork	Excellent, attractive presentation, excellent quality of visuals, slides, materials, excellent teamwork.	Good engagement, good quality of visuals, slides or other materials, good level of teamwork.	Low level of engagement, low quality of materials, poor level of teamwork.	Lack of presentation and speech.

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