Al-Farabi Kazakh National University
Faculty of Biology and Biotechnology
Department of Molecular Biology and Genetics

Final Assessment Program
for Course ID 68001 «Chromosomal and genetic engineering»

"7M05109 – Biotechnology"

Almaty 2025

The final assessment program for discipline ID 68001 «Chromosomal and genetic engineering» under the educational program "7M05109 – Biotechnology" was compiled by Amirova A.K., position of associate professor (associate prof.), PhD in biology.

Reviewed and approved at a meeting of the Department of Molecular Biology and Genetics

From "29" 08 2025, protocol No. 1

Head of the Department _____ Zh.K. Zhunusbayeva

Introduction

Exam format: standard written, Univer, offline.

The exam will consist of three questions:

Question 1 includes cognitive competence questions that assess knowledge and understanding of the subject matter and is worth 30 points.

Question 2 includes functional competence questions that assess the ability to apply and analyze information and is worth 30 points.

Question 3 includes systems competence questions that reveal the ability to synthesize and evaluate information and solve problems in medical genetics and is worth 40 points.

The exam is conducted according to the summer session schedule of the Faculty of Biology and Biotechnology. The exam schedule is posted in the Univer system. The exam format is a traditional standard offline format, according to the classroom schedule. Students take the exam "here and now" in real time.

The written exam process involves the automatic generation of an exam question, to which they must provide a written answer. Proctoring is mandatory for the written exam. Video recordings of the exam are stored for three months after the end of the session.

The exam schedule (date, time, and room) is posted in advance in the Univer system. Exam duration: 2 hours.

Exam proctoring is used.

Exam Procedure. 1. The student enters the classroom 20 minutes before the exam, presents identification, and signs the attendance sheet. They take their assigned seat and are seated. At the beginning of the exam, the student receives a ticket from the instructor on duty and answers the questions on the ticket on the provided sheets. Bringing anything into the classroom except identification and a pen is prohibited.

Attention! Students are not allowed to open their ticket before the exam begins. After completing their answer, they hand in their answer and leave the classroom. The instructor on duty forwards all answers to the dean's office, where they are coded and submitted to the examination committee for review. Before the exam begins, the instructor on duty greets the participants and warns them against using additional sources of information. They periodically remind them of the remaining time remaining.

Guidelines for completing the assignment

Block I

1. Goals and objectives of chromosome engineering.
2. History of the development of chromosome engineering technologies.
3. Chromosome structure and organization of DNA sequences in viruses, bacteria, and cellular organelles: chloroplasts and mitochondria.
4. DNA packaging in chromosomes. Karyotype and idiogram. Euchromatin and heterochromatin.
5. Chromosomal abnormalities. Chromosomal mutations: quantitative and structural variability. Chromosomal translocation, chromosomal inversion, and chromosomal deletion for the identification of essential genes.
6. Chromosomes of viruses and bacteria, mitochondria, and chloroplasts.
7. Lampbrush chromosomes. Polythenia as a phenomenon. Polytene chromosomes.
8. Quantitative chromosome changes: autopolyploidy, allopolyploidy. Duplications, translocations, deletions, and inversions.
9. Plant and animal husbandry. Genetic foundations of evolution, the possibility of restoring the genetic base for breeding ancient cultivated species with depleted gene pools.

Block II

1. Using monosomic and nullisomic wheat genetic lines for gene mapping and genome research.
2. Genomic projects and projected developments.
3. Modern gene mapping methods and the creation of genomic libraries.
4. The chromosome walking method.
5. Basic principles of genetic engineering. Implementation of genetic information.
6. Molecular vectors used in genetic engineering and their applications.
7. Genetic elements regulating prokaryotic gene expression.
8. Characterization of repressors as elements controlling the synthesis of inducible enzymes.
9. Operonic organization of bacterial genes. The Jacob F. and Monod J. model using the lactose (lac) operon as an example.
10. Creation of recombinant DNA and gene cloning methods.

Block III

1. Plant genetic transformation technology using crown gall plasmids.
2. Ti plasmid structure. Integration of T-DNA with the plant chromosome.
3. Plasmids. Vector types. Enzymes: restriction enzymes and ligase.
4. Plant viruses as vectors for genetic engineering.
5. Methods for transforming protoplasts, cells, and plant tissues.
6. Crown galls are tumors induced by certain soil bacteria.
7. Agrobacterium-mediated transformation of plants.
8. Structure and mechanism of insertion of the A. tumefaciens Ti plasmid. Integration of T-DNA with the plant chromosome.
9. Biolistic transformation of organisms. Gene gun.
10. Methods for genetic transformation of animals.

Thematic program of final assessment

The first block includes questions on cognitive (knowledge) competence, assessing knowledge and understanding of the subject matter. This task allows students to demonstrate knowledge of chromosomal and genetic engineering, the history of chromosomal engineering technologies, chromosome structure, and the organization of DNA sequences in viruses, bacteria, and cellular organelles (chloroplasts and mitochondria), DNA packaging in chromosomes, chromosomal mutations, quantitative chromosome changes (autopolyploidy, allopolyploidy), duplications, translocations, deletions, and inversions. Students must also demonstrate knowledge of the prospects for the development of biotechnology and genetic engineering, including their practical significance in various fields of science, production, and industry, drawing on modern, advanced textbooks, teaching aids, and other literary sources. This assignment is worth **30 points.**

The second block includes questions on functional competence, assessing the ability to apply and analyze information and systematize scientific research results by processing literary data. This task is designed to demonstrate students' knowledge of monosomic and nullisomic wheat genetic lines for gene mapping and genome research, genomic projects, modern gene mapping methods, genomic library construction, basic principles of genetic engineering, recombinant DNA production methods, and gene extraction and cloning methods. It is worth **30 points.**

The third block includes systems competency questions that test students' ability to synthesize and evaluate information. This question, a task related to the use of biotechnological methods, is designed to test students' knowledge of recombinant DNA technology, methods for transforming protoplasts, cells, and plant tissues, basic DNA sequencing methods, and important discoveries in genetic engineering and their applications. It is worth **40 points.**

FINAL TEST ASSESSMENT GUIDE

Course: "Ethics and Biosafety in Genetics." Format: standard, written, Univer, offline.

Score / Criteria	DESCRIPTORS				
	Excellent	**Good**	**Satisfactory**	**Unsatisfactory**	
	90–100 points	**70–89 points**	**50–69 points**	**25–49 points**	**0–24 points**
1. Knowledge and understanding of the theory and concept of the course	The student has fully mastered the topic as outlined in the curriculum and has mastered it well enough; independently answers assigned tasks logically and comprehensively, highlights key points, and is able to analyze, compare, classify, supplement, clarify, and systematize the material read; identifies key points and establishes cause-and-effect relationships; writes answers clearly, supporting them with necessary examples; writes answers in competent scientific language, correctly uses and explains all scientific terms and concepts. Has a good knowledge of primary and secondary literature.	The student has mastered the topic almost completely in accordance with the syllabus (there are gaps in knowledge in certain, particularly complex, sections); cannot consistently highlight the most important ones, and does not make significant errors in the answer; can write situational problems of easy to medium difficulty; answers are not fully expressed in literate scientific language and cannot be completely specific when providing examples; arguments in the main points are abbreviated, and the logic and consistency of the explanation of the material are not observed.	The student has mastered the basic knowledge of the subject; however, he or she struggles with independent writing and formulates answers inaccurately. He or she is capable of completing only simple tasks and is attentive to the general course material, but has difficulty solving specific problems. Correct conclusions are interspersed with incorrect ones. The presentation of material lacks logic and consistency, and makes errors in answering questions.	The answers do not correspond to the content of the questions. Key concepts in the course questions are formulated incorrectly. The questions are incorrectly explained, the reasoning is flawed, there are factual and verbal errors, and the conclusion is incorrect.	The student does not have answers to the questions posed; it has been established that they do not know or do not understand a significant portion of the course material. The student has not mastered the required minimum knowledge of the subject. They lack knowledge of the basic concepts and theories. They are unable to develop principles for conducting the final assessment.
2. Application of the selected methodology to specific applied problems	The chosen methodology and technology are applied in a profound way to specific practical problems; they freely apply scientific concepts to the problem, logically and convincingly addressing the underlying issue. They fully complete	There are shortcomings in the full application of the selected methodology and technology to specific practical problems. The course methodology and the student's acquired knowledge are not fully integrated and not adapted	The chosen methodology and technology cannot be fully applied to solving specific practical problems. The course's theoretical knowledge and tools are applied superficially, the content is sparse, the answers	Unable to apply the chosen methodology and technology to specific practical assignments. Incorrectly applies important parts of the course material, makes significant, specific errors that cannot be corrected	Unable to use knowledge and algorithms to solve problems; unable to draw conclusions and draw results. Makes serious errors when writing answers and

	the course assignment, write a detailed, well-reasoned answer to the question, and are then able to solve practical course problems.	to the specific practical problems presented. The answers are unclear, and there are minor errors. The assignment is not fully completed, the practical problems of the course are not fully solved, and the student does not provide a reasoned answer to the question posed.	contain inaccuracies, the material presented is illogical, and interdisciplinary connections are not explained. The material is fragmented, lacks logical consistency, and contains factual and semantic inaccuracies.	independently, and does not write correct answers to additional questions related to the assignment content. Unable to write solutions to assignments, and has errors and deficiencies that exceed the norm in overall assignment performance.	has not mastered the material. Unable to formulate principles for conducting final assessments.
3. Evaluation and analysis of the applicability of the selected methodology to the proposed practical task, justification of the obtained result	Integrate, justify, and analyze methods and technologies on a given topic, and structure the answer. High-level integration and analysis of information and communication technologies and theory. Ability to analyze concepts and illustrate answers with examples and visual aids, including from personal experience. Fluently present the results of analyses and other research, and solve complex situational problems. Consistently, logically, and competently justify the scientific principle and the methodology and technology applied. Can demonstrate the ability to conduct laboratory and instrumental research at a high scientific and methodological level.	Allows minor errors when applying knowledge in practical and laboratory assignments, as well as inaccuracies in the use of scientific and technical terminology. Inaccuracies in the integration and analysis of information and communication technologies and theory. Allows minor errors when conducting instrumental research at a high scientific and methodological level.	A superficial justification of the laws and principles of the scientific phenomena under consideration, poor use of the bulk of the material in accordance with the curriculum, difficulties in independently reproducing it and meeting the requirements of leading questions. Weak integration and analysis of information and communication technologies and theory. Weak implementation of practical and instrumental research at a high scientific and methodological level.	The integration and analysis of information and communication technologies and theory are extremely weak and unclear. The execution of laboratory and instrumental research at a high scientific and methodological level is also extremely weak and unclear. The assignment was completed with serious errors, the answers to the questions were incorrect, and the conceptual materials and arguments were used ineffectively.	When providing examples and using visual aids, lack of integration of information and communication technologies and theory, inability to apply them; inability to complete assignments, lack of answers to questions, inability to use analytical materials and tools. inability to develop principles for conducting final assessments.

Example of calculating the final exam score

Letter grading system	Numbers equivalent to points	% content	Assessment according to the traditional system
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	Satisfactory
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	

Formula for calculating the final grade:

Final assessment $FO = \frac{\sum Б1}{\sum к} \times КВ1 + \frac{\sum Б2}{\sum к} \times КВ2 + \frac{\sum Б3}{\sum к} \times КВ3$

Where **Б** is the score for each criterion, **К** is the total number of criteria, and **КВ** is the question block coefficient. Based on the score obtained during the calculation, we can compare the assessment with the grading scale.

Thus, with this calculation, the project will be assessed at **87 points - "Good" - B+** in accordance with the point-rating letter system for assessing the academic achievements of students with their translation into the traditional grading scale and ECTS.

List of recommended sources

References: primary and secondary.

1. Reconstruction of the common wheat genome based on chromosome engineering and isolated hybridization [Text]: monograph / K. K. Shulembaeva, A. A. Tokubaeva; Al-Farabi Kazakh National University. - Almaty: Kazakh University, 2019. - 240 p.: ill., table. - Bibliography: pp. 223-240. - 500 (circulation) copies. - ISBN 978-601-04-3860-6
2. Ogurtsov A. N., Bliznyuk O. N., Masalitina N. Yu. Fundamentals of genetic engineering and bioengineering. Textbook. Part 1: Molecular basis of gene technologies. Kharkov: NTU "KhPI", 2018. 288 p.
3. Nefedova L.N., Application of Molecular Research Methods in Genetics: A Textbook / L.N. Nefedova. - M.: NITs Infra-M, 2012. - 104 p.: 60x88 1/16. - (Higher education: Bachelor's degree). (cover) ISBN 978-5-16-005494-0, http://znanium.com/bookread.php?book=302262
4. Theory of Laboratory Biochemical Research. Fundamentals of Biochemistry [Text]: a textbook for secondary specialized schools / [responsible V. Kuznetsov]; Ministry of Defense of the Russian Federation. - 6th ed., revised. - Rostov n / D: Phoenix, 2014. - 397, [2] p.: table. - (Secondary vocational education). - Bibliography: pp. 381-382. - ISBN 978-5-222-22003-0
5. Fundamentals of Molecular Biology [Text]: lecture course / T. A. Muminov, E. U. Kuandykov; [Kaz. National Medical University named after S. D. Asfendiyarov]. - Almaty: SSK, 2017. - 222, [1] p.: ill. - ISBN 978-601-310-323-5

Internet resources:

1. http://elibrary.kaznu.kz/ru
2. https://www.coursera.org/
3. https://www.edx.org/
4. http://elibrary.kaznu.kz/ru
5. https://www.isaaa.org/resources/publications/pocketk/16/
6. https://vc.ru/future/109057-gennaya-inzheneriya-sostoyanie-na-2020
7. https://sites.google.com/site/anogurtsov/lectures/ge

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