Малик В.

AL-FARABI KAZAKH NATIONAL UNIVERSITY
Faculty of Biology and Biotechnology
Department of Biotechnology

AFFIRM
Dean of the Faculty
_____ Kurmanbayeva M.S.
"05" September 2024 Protocol No.1

EDUCATIONAL AND METHODOLOGICAL COMPLEX OF DISCIPLINE

102108 «MICROBIAL GENETICS AND ENGINEERING»

«8D05111 – Microbiology»

Course - 1
Semester -1
Number of credits -5
Lecture-15 h.
Practical classes -30 h.
IWST -5

Almaty 2024

Educational and methodological complex of discipline was compiled by Dr. Azhar Malik, PhD.
Based on the educational program «8D05111 – Microbiology»

Considered and recommended at a meeting of the biotechnology department from

September 05, 2024, Protocol No. 1

Head of the Department _____ Kistaubayeva A.S.
(signature)

SYLLABUS
Fall semester 2024-2025 academic year
Educational program "8D05111 – Microbiology"

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)		
102108 Microbial Genetics and Engineering	4	15	30	-	5	5

ACADEMIC INFORMATION ABOUT THE COURSE

Learning Format	Cycle, component	Lecture types	Types of practical classes	Form and platform final control
Offline	Elective disciplines	Presentations	Seminars, discussions,	Writing exam (Offline)
Lecturer - (s)	Malik Azhar Malikkyzy, PhD			
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Phone :	+7 702 385 94 84			

ACADEMIC COURSE PRESENTATION

Purpose of the course	Expected Learning Outcomes (LO) *	Indicators of LO achievement (ID)
To develop in-depth knowledge of microbial genetics and engineering in doctoral students, including inheritance, replication, mutation, recombination, and regulation of gene expression in microorganisms. To study modern methods of genetic engineering and their application to the creation of strains with useful properties. To introduce the main tools of genetic engineering, including CRISPR-Cas, recombination and cloning technologies.	1. Doctoral students will identify and describe Get a basic understanding of molecular mechanisms in development of disease. Gain knowledge on methods of cloning, gene amplification and sequencing. To study different types of sequencing methods and their significance. To understand the importance and different techniques used in gene expression analysis. Gain insights of the various techniques used for Gene silencing.	1.1 demonstrate ability to reproduce the main principles of genetics, find essential information, analyze it, classify, and synthesize any scientific conclusions.
	2. Doctoral students will understand how molecular/cellular biology may be used to characterise cellular processes	2.1 explain the obtained results of experiments, process properly any experimental data.
	3. Master the methods and approaches to manipulation of genetic systems of microorganisms. Develop skills in designing and conducting scientific experiments in the field of genetic engineering.	3.1 analyze obtained data according to current information, prognose any possible variants of the results.
		3.2. plan the experiment considering available information, and modify the experiment if it is necessary, use modern methods and tools for the experiment.
	4. Develop skills in critical analysis of scientific literature and effective scientific work.	4.1 create a presentation, a scientific report, or a thesis as a conclusion of the experiment.
		4.2 be able to discuss the main advantages and disadvantages of the selected method of research.
Prerequisites	Biotechnology, Microbiology, Virology, Biochemistry	
Postrequisites	Bioengineering	
Learning Resources	**Literature:** 1. Maloy, S. R., Cronan, J. E., & Freifelder, D. (1994). *Microbial Genetics*. Jones & Bartlett Learning. 2. Madigan, M., Martinko, J., Bender, K., Buckley, D., & Stahl, D. (2015). *Brock Biology of Microorganisms*. Pearson. 3. Lander, E. S. et al. (2016). *CRISPR-Cas: A Laboratory Manual*. Cold Spring Harbor Laboratory Press.	

4. Buckingham and Flaw's, "Molecular Diagnostics: Fundamentals, Methods and Clinical Applications", F.A. DavisCompany; Firstedition, 2007.
5. Jens Kurreck, Cy Aaron Stein, Molecular Medicine: An Introduction, 2016
6. Doudna, J. A., & Sternberg, S. H. (2017). A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution. Houghton Mifflin Harcourt.
7. Green, M. R., & Sambrook, J. (2012). Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press.
8. Gasser, R. B., & von Samson-Himmelstjerna, G. (2016). Genomics and Molecular Genetics of Parasites. Springer.

Additional materials:
Scientific articles from the journals Nature Microbiology, Journal of Bacteriology, Applied and Environmental Microbiology.

Research infrastructure

1. Classes of Biology and Biotechnology department of KazNU
2. Research Institute of Sustainability of Ecology of Bioresources
3.

Internet resources

1. http://elibrary.kaznu.kz/ru
2. MOOC / video lectures, etc.
3. Google Scholar
4. Sciencedirect.com
5. academia.edu
6. researchgate

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 azhar.malikkyzy@gmail.com **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
A	4.0	95-100	Great
A-	3.67	90-94	
B+	3.33	85-89	Fine
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	Unsatisfactory
D	1.0	50-54	

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 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 **FUNDAMENTALS OF GENETICS AND MICROBIAL ENGINEERING**		
1	**L 1.** Introduction to Microbial Genetics and Engineering	1	
	PC 1. Structure and Properties of Nucleic Acids,Nucleosome assembly, DNA replication in prokaryotes, DNA replication in eukaryotes, DNA Repair Mechanisms, Homologous Recombination, Site-specific recombination	2	10
2	**L 2.** Transcription in prokaryotes, Transcription in eukaryotes, Post-Transcriptional Modifications, RNA editing	1	
	PC 2. Regulation of Transcription in Prokaryotes, Regulation of Transcription in Eukaryotes, Protein synthesis in prokaryotes, Protein synthesis in eukaryotes	2	10
3	**L 3.** Nucleosome remodeling, DNA methylation and gene regulation	1	
	PC 3. Mechanisms of Gene Silencing: RNA interference- RISC-mediated silencing	2	10
4	**L 4.** Mechanisms of RNA interference, Role of heterochromatin in gene silencing	1	
	PC 4. Epigenetic Regulation	2	10
5	**L 5.** Polymerase Chain Reaction, Quantitative Real Time PCR, Gel Electrophoresis, Blotting Techniques: Southern, Western & Northern	1	
	PC 5. Construction of Genomic and cDNA Libraries, Applications of DNA microarray, DNA Sequencing: sanger's method, shotgun and clone contig approach, next generation sequencing	2	10
	IWST 1 consultation		
	MODULE 2 **MICROBIAL BIOFACTORIES: PRODUCTION OF ENZYMES, BIOACTIVE SUBSTANCES**		
6	**L 6.** Enzymes in molecular genetics	1	
	PC 6. DNA polymerases: role in PCR and DNA synthesis. Restriction enzymes: types of restriction enzymes and their use in molecular cloning. Ligases: cross-linking of DNA fragments, role in recombinant DNA technology. Ribonucleases and deoxyribonucleases: application in nucleic acid research	2	10
	IWST 1: Molecular methods in microbial genetics (presentation)		30
7	**L 7.** Enzymes in Genetic Engineering	1	
	PC 7. Transcriptases: Reverse Transcriptase and Its Use in Creating cDNA. Recombinant Enzymes: Obtaining and Using Enzymes from Genetically Modified Organism. Enzyme Engineering to Increase Specificity and Activit. Biocatalysis and the Use of Microbial Enzymes in Synthetic Biology	2	10
Midterm control 1			**100**
8	**L 8.** Enzymes in Industrial Biotechnology	1	
	PC 8. Microbial Enzymes in Environmental Biotechnology: Biodegradation and Environmental Cleaning. Use of Enzymes in Medical Applications (Diagnostics, Therapy)	2	5
9	**L 9.** Ethical and environmental aspects of using microbial enzymes	1	

	PC 9. Impact of using microbial enzymes on the environment. Biosafety and control of genetically modified organisms. Prospects for development and challenges in the use of enzymes in bioengineering	2	
	IWST 2 consultation		
10	**L 10.** DNA manipulative enzymes, Principles of Gene Cloning, Desirable properties of vectors, Prokaryotic and Eukaryotic Expression Systems (Constitutive & Inducible).	1	
	PC 10. Plasmid Vectors, Phage Vectors, Cosmids, Phagemids, Artificial chromosomes, Lentiviral Vectors, Adenoviral Vectors, Plant Vectors, Insect Vectors.	2	
	IWST 2: Genome editing using CRISPRCAS (make a review article)		
	MODULE 3		
	MODERN METHODS AND TECHNOLOGIES OF MICROBIAL GENETICS AND ENGINEERING		
11	**L 11.** Methods of gene transfer in Plants and Animals: Chemical, Physical and biological methods, Protein Engineering, Site Directed Mutagenesis, Reporter Gene Assays, DNA-Protein Interactions, Protein-Protein Interactions, Targeted Genome Editing: ZFNs, TALENs, CRISPRs	1	
	PC 11. Gene Targeting: Knock-ins & Knock-outs, miRNA and siRNA induced silencing, Application of miRNA and siRNA, Transgenic plants and transgenic animals, Gene therapy, Somatic cell nuclear transfer	2	
	IWST 3 consultation		
12	**L12.** Sequencing methods: Enzymatic DNA sequencing; chemical sequencing of DNA; automated DNA sequencing; RNA sequencing; chemical synthesis of oligonucleotides; mutation detection: SSCP, DGGE, RFLP	1	
	PC 12. Next-generation sequencing methods: Illumina (Solexa) sequencing, 454 Pyrosequencing, SMRT, SOLiD, Oxford Nanopore.	2	5
	IWST 3: Metagenomics and microbial community analysis (make a review article)		20
13	**L 13.** Phage engineering: using viruses for gene therapy and fighting bacteria	1	
	PC 13. Comparative genomics and evolutionary analysis of microorganisms	2	5
14	**L 14.** Bioinformatic approaches for genomic data analysis	1	
	PC 14. Ethics and biodiversity in the context of microbial engineering	2	5
15	**L 15.** Development of genetic constructs for microbes: project work	1	
	PC 15. Presentation of projects and summing up	2	5
Midterm control 2			**100**
Final control (exam)			**100**
TOTAL for course			**100**

Dean of the Faculty of Biology and Biotechnology — **Kurmanbaeva M.S.**

Chair of the Academic Committee on the Quality of Teaching and Learning — **Baktybayeva L.K.**

Head of Biotechnology Department — **Kistaubaeva A.S.**

Lecturer — **Malik A.M.**

RUBRICATOR OF THE SUMMATIVE ASSESSMENT
CRITERIA EVALUATION OF LEARNING OUTCOMES

of course: Microbial Genetics and Engineering (25% of 100% MC)

Criterion	"Excellent" 20-25%	"Good" 15-20%	"Satisfactory" 10-15%	"Unsatisfactory" 0-10%
erstanding Theories concepts of professional tity and professionalism of a her	Demonstrates deep understanding of theories and concepts related to professional identity and teacher professionalism. Provides relevant citations from key sources.	Demonstrates understanding of theories and concepts related to professional identity and teacher professionalism. Provides appropriate citations from key sources.	Demonstrates understanding of theories and concepts related to professional identity and teacher professionalism. Provides appropriate citations from key sources.	Demonstrates understanding of theories and concepts related to professional identity and teacher professionalism. Provides appropriate citations from key sources.
wareness of key issues of rofessional identity and rofessionalism of teachers in Kazakhstan	Makes excellent connections between the concepts of professional identity and professionalism with the context of Kazakhstan. Strong use of empirical evidence (e.g., interviews, statistical data).	Makes connections between the concepts and the context of Kazakhstan. Supports arguments with empirical research.	Demonstrates limited connection between concepts and the context of Kazakhstan. Limited use of empirical evidence.	Shows little or no connection between the concepts and the context of Kazakhstan. Little or no use of empirical research.
Policy proposal or practical recommendations/suggestions	Provides well-developed, relevant policy or practical recommendations to enhance teacher professionalism and identity in Kazakhstan.	Offers some policy or practical recommendations to improve teacher identity and professionalism.	Offers limited recommendations that are shallow or lack depth. Recommendations are not supported by thorough analysis.	Offers little to no policy or practical recommendations, or the recommendations are of poor quality.
Letter, APA style	Writing is clear, concise, and accurate. Fully adheres to APA style.	Writing is generally clear and concise with minor errors. Mostly follows APA style.	Writing contains some clarity issues and key errors. Several mistakes in APA style.	Writing lacks clarity and coherence. Multiple APA style mistakes.