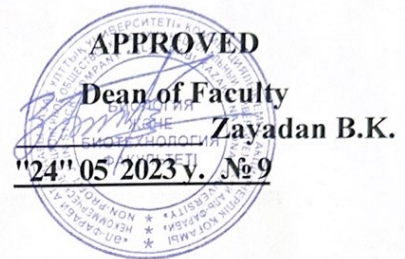


AL-FARABI KAZAKH NATIONAL UNIVERSITY
Faculty of Biology and Biotechnology
Department of Biotechnology



EDUCATIONAL COMPLEX OF DISCIPLINE

100645 Microbial Engineering
Educational program on specialty «6B05101 Biological Engineering»

Course – 2
Semester - 4
Number of credits -9


Almaty, 2023

The educational-methodical complex of the discipline is compiled by
Senior Lecturer of the Department of Biotechnology, PhD Musralina L.Z.

Based on the curriculum for the specialty "6B05101 Biological Engineering"

Considered and recommended at the meeting of the Department of Biotechnology from

"23" 05 2023, protocol № 14

Head of the Department of Biotechnology  Kistaubaeva A.S.

SYLLABUS
Spring semester 2023-2024 academic year
Educational program "6B05101 Biological Engineering"

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)		
100645 Microbial Engineering	7	3	6	0	9	7

ACADEMIC INFORMATION ABOUT THE COURSE

Learning Format	Cycle, component	Lecture types	Types of practical classes	Form and platform final control
<i>Offline</i>	AP. Elective component. M6- Commercial Biotechnology	Problem-based, analytical	situational assignments, analyzing scientific articles, discussions	Written exam (Univer)
Lecturer - (s)	Musralina Lyazzat Zenurainovna			
e-mail :	musralinal@gmail.com, lyazke@mail.ru			
Phone :	+77052108741			
Assistant - (s)				
e-mail :				
Phone :				

ACADEMIC COURSE PRESENTATION

Purpose of the course	Expected Learning Outcomes (LO) *	Indicators of LO achievement (ID)
The aim of the discipline is the formation of students' professional competencies in production, monitoring and research activities, as well as the analysis of fundamental knowledge aimed at expanding the understanding of the basic methods and capabilities of genetic engineering on the example of prokaryotes. The features of the structural and functional organization of the genomes of prokaryotes and phages will be considered; genetic methods of constructing bacterial strains with specified	1. Understanding of Microbial Physiology and Genetics: Students should be able to explain the fundamental principles of microbial physiology and genetics.	1.1. Successful completion of assessments demonstrating knowledge of key microbial pathways;
		1.2. Knowledge of genetic engineering techniques, and the ability to analyze and interpret genetic information
	2. Proficiency in Genetic Manipulation Techniques: Students should be proficient in various genetic manipulation techniques used in microbial engineering	2.1. Demonstration of the ability to design and perform genetic modifications in microorganisms;
		2.2. Successful execution of laboratory experiments involving gene cloning, gene knockout, or gene overexpression;
	3. Understanding of Metabolic Engineering Principles: Students should understand the principles of metabolic engineering and how to optimize microbial metabolism for specific applications;	3.1. Successful completion of projects or assignments that involve the design;
		3.2. Implementation of metabolic engineering strategies to enhance the production of a desired product

properties; the prospects of using genetic methods in various fields of human activity (industry, agriculture, scientific research, etc.) are shown.	4. Knowledge of Microbial Bioprocess Engineering: Students should be familiar with the principles of microbial bioprocess engineering and the factors influencing the scale-up of microbial cultures;	4.1. Demonstrated ability to design and optimize microbial fermentation processes
		4.2 Selection of appropriate growth media, bioreactor parameters, and downstream processing techniques;
	5. Ability to Analyze and Optimize Microbial Systems: Students should be able to analyze microbial systems and optimize them for specific industrial application	5.1 Completion of projects or case studies where students identify bottlenecks, troubleshoot issues, and propose solutions to optimize microbial systems for improved productivity;
		5.2 Successful completion of presentations, reports, or written assignments that demonstrate the ability to convey scientific information and ideas clearly and concisely.
Prerequisites	General and molecular genetics, Microbiology, Biochemistry	
Postrequisites	Medicine biotechnology, Programming	
Learning Resources	<p>Literature:</p> <ol style="list-style-type: none"> 1. Z. Sterbacek Microbial Engineering First International Symposium on Advances in Microbial Engineering/ Elsevier Science, 2016, - 134 p. - ISBN 9781483155647, 1483155641; 2. Lucy Phillip Microbial Engineering: Principles, Methods and Applications / Syrawood Publishing House, 2017. - 244 p. - ISBN 9781682864098, 168286409X; 3. Chandravanu Dash, Mrutyunjay Suar, Namrata Misra Microbial Engineering for Therapeutics / Springer Nature Singapore, 2022, - 374 p. - ISBN 9789811939792, 9811939799 4. Vijai G. Gupta, Anita Pandey New and Future Developments in Microbial Biotechnology and Bioengineering, Elsevier Science, 2019, - 462 p. - ISBN 9780444635044, 0444635041 5. Ajay Kumar Singh, Chaitanya G. Joshi, Madhvi Joshi, Poonam Bhargava, Vijai Singh, Engineering of Microbial Biosynthetic Pathways / Springer Nature Singapore, 2020, - 318 p. - ISBN 9789811526046, 9811526044; 6. Y. Kang and J. D. Keasling. 2006. "Increasing mevalonate production by engineering the metabolism of Escherichia coli." Lake Arrowhead Conference, Lake Arrowhead, CA, September 2006; 7. L. d'Espaux, A. Reider Apel, M. Wehrs, A. Ghosh, R. A. Li, D. Sachs, M. Garber, W. Zhuang, J. Gin, L. J. G. Chan, O. Nnadi, C. J. Petzold, N. Hillson, H. Garcia Martin, A. Mukhopadhyay, and J. D. Keasling. 2016. "A Cas9-based toolkit to program gene expression in Saccharomyces cerevisiae." 5th Int'l Conf on Biomolecular Engineering, Austin TX. 8. S. Curran and J. D. Keasling. 2018. "In vitro investigations into a type I modular/iterative polyketide synthase module." John Innes/Rudjer Bošković Summer Schools in Applied Molecular Microbiology, Dubrovnik, Croatia <p>Research infrastructure</p>	

<p>1. laboratories of the Faculty of Biology and Biotechnology</p> <p>Professional scientific databases</p> <p>1. https://scopus.com</p> <p>2. https://pubmed.ncbi.nlm.nih.gov/</p> <p>Software (optionally)</p> <p>1. 1. http://elibrary.kaznu.kz/ru</p> <p>2. https://biglibrary.ru/category47/book144/part66/</p> <p>3. http://cbio.ru/</p>

<p>Academic course policy</p>	<p>The academic policy of the course is determined by <u>the Academic Policy and the Policy of Academic Integrity of Al-Farabi Kazakh National University</u>.</p> <p>Documents are available on the main page of IS Univer .</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Compliance with academic honesty during the period of theoretical training and at exams, in addition to the main policies, is regulated by <u>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"</u>.</p> <p>Documents are available on the main page of IS Univer .</p> <p>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.</p> <p>All students, especially those with disabilities, can receive counseling assistance by phone / e- mail: lyazke@mail.ru</p> <p>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.</p> <p>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.</p>
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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	<p>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.</p> <p>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.</p> <p>Summative assessment -type of assessment, which is carried out upon completion of the study of the section in accordance</p>
A	4.0	95-100	
A-	3.67	90-94	
B+	3.33	85-89	

				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.
B	3.0	80-84		Formative and summative assessment
B-	2.67	75-79		Activity at lectures
C+	2.33	70-74		Work in practical classes
C	2.0	65-69	Satisfactorily	Independent work
C-	1.67	60-64		
D+	1.33	55-59	Unsatisfactory	Final control (exam)
D	1.0	50-54		TOTAL
				Points % content
				5
				30
				25
				40
				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 Title			
Number of modules, title of topics, number of IWS, the distribution of components by week is determined by the teacher, the assessment of knowledge is determined by compiler of the syllabus.			
1	L1. Introduction to Microbial Engineering	1	
	LC1. Standards of medical equipment in medical institutions	1	10
2	L2. Classification of biomedical and environmental equipment.	1	
	LC2. Historical Perspectives and Milestones in Microbial Engineering	1	10
	IWSP1. Consultations on the implementation of IWST1		
3	L3. Fundamentals of Microbial Physiology	1	
	LC3. Genetic Manipulation Techniques in Microbial Engineering	1	10
4	L4. Introduction to Metabolic Engineering	1	
	LC4. Case Studies in Metabolic Engineering Successes and Challenges	1	10
	IWST1. Bioengineering methods	1	30
5	L5. Algorithm, analyse data in biomedicine.	1	
	LC5. Analysis on R Studio	1	10
6	L6. Applications of Microbial Engineering in Biotechnology	1	
	LC6. Ethical and Safety Considerations in Microbial Biotechnology	1	10
	IWSP2. Consultations on the implementation of IWST2		
	IWSP3. Consultations on the implementation Midterm control		
7	L7. Introduction to Synthetic Biology	1	
	LC7. Designing Microbial Systems for Specific Applications	1	10
Midterm control 1			100
8	L8. Basics of Bioprocess Engineering	1	
	LC8. Scale-Up and Optimization of Microbial Cultures	1	5
	IWST2. Microbial Physiology and Genetics		20
9	L9. Plan, design, develop, install, operate, and maintain devices, equipment, and complexes for prevention, diagnosis, and treatment.	1	
	LC9. Planning the maintenance of medical equipment.	1	5
	IWSP4. Consultation on the implementation of IWST3		
10	L10. Environmental Microbial Engineering	1	
	LC10. Cutting-Edge Technologies in Microbial Engineering		
11	L11. Conduct research and observations on the interaction of biological, natural and artificial systems.	1	
	LC11. Emerging Trends and Future Directions in the Field	1	5
	IWST3. Metabolic Engineering Principles		20
12	L12. Laboratory Techniques in Microbial Engineering	1	
	LC12. Experimental Design and Data Analysis in Microbial Engineering	1	5
	IWSP5. Consultation on the implementation of IWST4		20
13	L13. Interpret the results of biomedical experiments, assessing the relationship between the structure of biomolecules and their functions at the molecular level	1	
	LC13. Example using Engineering Molecular Cell Biology	1	
14	L14. Biochemical processes in medical biotechnology.	1	

	LC14. Biomedical engineering	1	5
	IWST 4. Microbial Biotechnology Applications		20
15	L15. Industry Applications of Microbial Engineering	1	
	LC15. Q&A Session with Industry Professionals	1	5
	IWSP6. Consultation on preparation for the exam		
Midterm control 2			100
Final control (exam)			100
TOTAL for course			100

RUBRICATOR OF THE SUMMATIVE ASSESSMENT
CRITERIA EVALUATION OF LEARNING OUTCOMES

Issued at the request of the teacher for each planned summative assessment (IWST)

TEMPLATE

Task name (points, % content from 100% MC, copy from the calendar (graphics) implementation of the content of the training course, methods of teaching and learning

Criterion	"Excellent" Max. weight in %	"Good" Max. weight in %	"Satisfactory" Max. weight in %	"Unsatisfactory" Max. weight in %

Written assignment "My professional history" (25% of 100% MC)

Criterion	"Excellent" 20-25%	"Good" 15-20%	"Satisfactory" 10-15%	"Unsatisfactory" 0-10%
Understanding Theories and concepts of professional identity and professionalism of a teacher	Deep understanding of theories, concepts of professional identity and teacher professionalism. Relevant and relevant links (citations) to key sources are provided.	Understanding theories, concepts of professional identity and teacher professionalism. 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 key issues of professional identity and professionalism of teachers in Kazakhstan	Links well the key concepts of professional identity and teacher professionalism with the context of Kazakhstan. Excellent substantiation of arguments with evidence from empirical research (for example, based on interviews or statistical analysis).	Links the concepts of professional identity and teacher professionalism with the context of Kazakhstan. Supports arguments with evidence from empirical research.	Limited connection of the concepts of professional identity and professionalism of teachers with the context of Kazakhstan. Limited use of evidence from empirical 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.
Policy proposal or practical recommendations/suggestions	Offers sound policy and/or practical recommendations, proposals for improving the professional identity and professionalism of teachers in Kazakhstan.	Offers some policy and/or practical recommendations, proposals for enhancing the professional identity and professionalism of teachers in Kazakhstan	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.
Letter, APA style	The writing demonstrates clarity, conciseness and correctness. Strictly follows the APA style.	The letter demonstrates clarity, conciseness and correctness. Basically follows the APA style.	The letter has some key errors and clarity needs to be improved. There are mistakes in following the APA style.	The writing is unclear, it is difficult to follow the content. Lots of mistakes in following the APA style.

Group presentation "Teaching profession in Kazakhstan" (30% of 100% RK)

Criterion	"Excellent" 25-30%	"Good" 20-20%	"Satisfactory" 15-20%	"Unsatisfactory" 0 - 15%
Understanding theories and concepts of the professional identity of the teacher and the teaching profession	Deep understanding of theories, concepts of the professional identity of the teacher and the teaching profession.	Understanding theories, concepts of the professional identity of the teacher and the teaching profession.	Limited understanding of theories, concepts of the professional identity of the teacher and the teaching profession.	Superficial understanding / lack of understanding of theories, concepts of the professional identity of the teacher and the teaching profession.
Awareness of key issues of the professional identity of the teacher and the teaching profession in Kazakhstan	Competent correlation of the key concepts of the professional identity of the teacher and the teaching profession with the context of Kazakhstan. Excellent substantiation of arguments with evidence from empirical research (for example, based on interviews or statistical analysis).	There is a connection between the concepts of professional identity of a teacher and the teaching profession with the context of Kazakhstan. The arguments are backed by evidence from empirical research.	Limited correlation of the professional identity of the teacher and the concepts of the teaching profession with the context of Kazakhstan. Limited use of evidence from empirical research	Insignificant connection / lack of connection between the concepts of the teacher's professional identity and the context of Kazakhstan. Little or no empirical research is used.
Pilot Study	Excellent use of the results of pilot studies (interviews or surveys) in the presentation	Good use of the results of pilot studies (interviews or surveys) in the presentation.	Satisfactory use of the results of pilot studies (interviews or surveys) in the presentation.	Poor use of the results of pilot studies (interviews or surveys) in the presentation.
Suggestion of policy or practical recommendations/suggestions	Offers very good policy and/or practical advice or suggestions for improving the professional identity and teaching profession in Kazakhstan.	Offers some policy and/or practical recommendations or suggestions for improving the professional identity and teaching profession in Kazakhstan.	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 visuals, slides or other materials, good teamwork.	Satisfactory level of involvement, satisfactory quality of materials, satisfactory level of teamwork.	Low engagement, low quality content, poor teamwork.

Dean of the Faculty of Biology and Biotechnology

Head Department of Biotechnology

Lecturer

Zayadan B.K.

Kistaubayeva A.S.

Musralina L.Z.

