# SYLLABUS

**Spring semester 2022-2023 academic years**

# on the educational program “Biological Engineering”

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| **Discipline’s code** | **Discipline’s title** | **Indepen dent work of students (IWS)** | **No. of hours per week** | | | | | **Numb er of credits** | **Independen t work of student with**  **teacher (IWST)** |
| **Lect ures (L)** | **Practical training (PT)** | | **Labor atory (Lab)** | |
| OB 2212 | Basic of  Biotechnology | 98 | 15 | 15 | | 15 | | 6 | 8 |
| **Academic course information** | | | | | | | | | |
| **Form of education** | **Type of course** | **Types of lectures** | | | **Types of practical training** | | **Number of IWS** | | **Form of final control** |
|  | Theoretical | Problematic, analytical | | | Problem solving, situational tasks,  video analysis | | 6 | | Written traditional  Univer |
| Lecturer and practical  trainer | Akimbekov S. Nuraly, Ph.D., Post.Doc., Assistant Professor. | | | | | | According to the class timetable | | |
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**Academic presentation of the course**

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| **Aim of course** | **Expected Learning Outcomes (LO)**  As a result of studying the discipline the undergraduate will be able to: | **Indicators of LO achievement (ID)**  (for each LO at least 2 indicators) |
| To provide the basic knowledge and practical aspects of microorganisms, plant and animal cell culture and their applications in biosecurity, biotechnology, molecular biology, and environmental sciences. | **1.** To apply scientific method and good experimental design in scientific experiments, to understand and demonstrate good laboratory practice (GLP) and good manufacture practice (GMP). | * 1. Gain the basic knowledge in the field of biotechnology and related areas.   2. Ability to apply knowledge in practice.   3. Ability to compete, to be psychologically ready to change the type of their professional activity.   4. Ready for the act rationally and independently, guided by evidence scientific- based conclusions.   5. Describe observations/experience received from cognitive professional activities in the field of biotechnology. |
| **2.** To characterize new discoveries in biotechnology, which have led to the outcome in the form of fundamental and applied research, to cover the foundation platform of microorganisms, plant and animal cell culture and their applications. | * 1. Gain the basic knowledge of research techniques that used in biology.   2. Characterize the skills to use the equipment applying in the biotechnology.   3. Name the modern requirements for biotechnology products.   4. Create a strategy for the analysis of work processes and phenomena in the modern biotech industry.   5. Ability to evaluate in all aspects of modern industrial and application microbiology.   6. Ability to evaluate in all aspects of modern |

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|  |  | plant biotechnology and animal biotechnology |
|  | **3.** To involve multidisciplinary areas, such as microbiology, biochemistry, genetic engineering, immunology, tissue culture and physiology, and many more along with engineering, which make biotechnology very challenging. | * 1. Demonstrate effective interviewing skills to obtain employment in the biotechnology industry.   2. Maintain a lab notebook; describe correct standard operating procedures, good lab practice and other documentation required in a biotechnological lab.   3. Demonstrate standard lab techniques such as pipetting and measurements (mass/ volume).   4. Demonstrate proper use of lab equipment.   5. Understand and apply techniques to conduct a self-directed job search. |
| **4.** Synthesize, interpret and evaluate results and  know the modern requirements for biotechnology of prokaryote and eukaryote; | * 1. Be able to use modern information   technologies for the search, collection, storage and processing of information.   * 1. Be able to demonstrate knowledge of the main objects, methods and principles used in biotechnology of prokaryote and eukaryote.   2. Be able to work in a team |
|  | **5.** To form the skills related to the basic methods  and technologies used in plant and animal biotechnology | 1. **1** Be able to demonstrate ability to own   methods and techniques for studying biotechnological objects.   * 1. Be able to demonstrate knowledge of the main objects, methods and principles used in biotechnology   2. Be able to demonstrate knowledge about approaches and achievements of biotechnology; |
| **Prerequisites** | Low molecular biological substances, Microorganisms and viruses are the objects of biotechnology | |
| **Post requisites** | Environmental biotechnology, Food biotechnology, Industrial biotechnology. | |
| **Information resources** | **Literature:**   1. Moo-Young Murray (ed.) Comprehensive Biotechnology. 3rd edition. Pergamon, 2019. -4912 p. 2. Sangeetha J., Thangadurai D., Tanasupawat S., Kanekar P.P. (Eds.) Biotechnology of Microorganisms. Apple Academic Press, 2020. - 372 p. 3. Zayadan B.L., Dzhansugurova L.B., Turasheva S.K. Basics of Biotechnology. Textbook. - Almaty: Kazakh University, 2018. - 354 p. 4. Turasheva S.K. Basics of Biotechnology: Plant Biotechnology. Textbook. Almaty. 2016. -198 p. 5. Turasheva S.K. Applied aspects of plant biotechnology: a monograph. Almaty. 2019 (in English) 6. Gordon I.R.Reproductive Technologies in Farm Animals. 2004. DOI 10.1079/9780851998626.0000 7. Animal Biotechnology. Technologies, Markets & Companies – Edited by Prof. K.K. Jain. Jain PharmaBiotech. A Jain Pharma Biotech Report. 2013. 215 p.   **Internet sources:**  <http://elibrary.kaznu.kz/ru/>  <https://study.com/academy/lesson/what-is-biotechnology-definition-history-examples.html> [https://www.edx.org/course/the-science-and-business-of-](https://www.edx.org/course/the-science-and-business-of-biotechnology?index=product&queryID=00f7bdcd41964882a27dbd2a9f8dadcf&position=1)  [biotechnology?index=product&queryID=00f7bdcd41964882a27dbd2a9f8dadcf&position=1](https://www.edx.org/course/the-science-and-business-of-biotechnology?index=product&queryID=00f7bdcd41964882a27dbd2a9f8dadcf&position=1) <https://www.coursera.org/learn/industrial-biotech>  <https://bmcmicrobiol.biomedcentral.com/> | |

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| **Academic policy of the course in the context of university moral and ethical values** | **Academic Behavior Rules:**  All students have to register at the MOOC. The deadlines for completing the modules of the online course must be strictly observed in accordance with the discipline study schedule.  ATTENTION! Non-compliance with deadlines leads to loss of points! The deadline of each task is indicated in the calendar (schedule) of implementation of the content of the curriculum, as well as in the MOOC.  **Academic values:**   * Practical trainings/laboratories, IWS should be independent, creative. * Plagiarism, forgery, cheating at all stages of control are unacceptable. * Students with disabilities can receive counseling at e-mail [kaznu.nur@gmail.com](mailto:kaznu.nur@gmail.com) |
| **Evaluation and attestation policy** | **Criteria-based evaluation:**  assessment of learning outcomes in relation to descriptors (verification of the formation of competencies  in midterm control and exams). |

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|  | **Summative evaluation:** assessment of work activity in an audience (at a webinar); assessment of the  completed task. |

**CALENDAR (SCHEDULE) THE IMPLEMENTATION OF THE COURSE CONTENT:**

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| Week s | | Topic name | LO | ID | Unt of hours | Maxi mum score | Form of knowledge assessment | The form of the lesson  / platform |
| **Module 1: The fundamentals of microbial biotechnology** | | | | | | | | |
| 1 | **L.1.** Microbial Biotechnology: fundamentals of | | LО-1 | ID-1.1. | 1 |  |  | Online |
|  | applied microbiology. | |  |  |  | [https://teams.microsoft.com/l/channel/19](https://teams.microsoft.com/l/channel/19%3aEYMDJwfPEbgO7ZbSq3lC5aZL4qbkClMjzOEm_ZzxGPk1%40thread.tacv2/General?groupId=3fc85724-ce65-45f6-8ef7-3efdfcb547cd&tenantId=b0ab71a5-75b1-4d65-81f7-f479b4978d7b)  [%3aEYMDJwfPEbgO7ZbSq3lC5aZL4q](https://teams.microsoft.com/l/channel/19%3aEYMDJwfPEbgO7ZbSq3lC5aZL4qbkClMjzOEm_ZzxGPk1%40thread.tacv2/General?groupId=3fc85724-ce65-45f6-8ef7-3efdfcb547cd&tenantId=b0ab71a5-75b1-4d65-81f7-f479b4978d7b) [bkClMjzOEm\_ZzxGPk1%40thread.tacv2](https://teams.microsoft.com/l/channel/19%3aEYMDJwfPEbgO7ZbSq3lC5aZL4qbkClMjzOEm_ZzxGPk1%40thread.tacv2/General?groupId=3fc85724-ce65-45f6-8ef7-3efdfcb547cd&tenantId=b0ab71a5-75b1-4d65-81f7-f479b4978d7b) |
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|  | **P.1.** Inoculum, production media and biomass | | LО-1 | ID-1.1. | 1 | 6 | Task- | Online |
|  | production in microbial biotechnology. | |  | ID-1.2. |  |  | oriented |  |
|  | **Lab.1.** Biochemistry and physiology of growth | | LО-1 | ID-1.3. | 2 | 10 |  | Online |
|  | and metabolism of microorganisms. | |  | ID-1.1. |  |  |  |
|  | **IWS 1.** | | LО-2 | ID-1.2. |  | 10 | Logic task | Online |
|  |  | |  | ID-1.4. |  |  |  |
| 2 | **L.2.** Introduction to Concepts and Technologies | | LО-2 | ID-1.2. | 1 |  |  | Online |
|  | in Microbial Biotechnology. | |  | ID-1.3. |  |  |
|  | **P.2.** Scientific, technical, and economic aspects of | | LО-1 | ID-1.3. | 1 | 6 | Task- | Online |
|  | microbial products. | |  | ID-1.4. |  |  | oriented |  |
|  | **Lab.2.** Sterilization in Biotechnology. Types of | | LО-2 | ID-1.3. | 2 | 10 |  | Online |
|  | sterilization. Aseptic techniques. | |  | ID-2.1. |  |  |  |
| 3 | **L.3.** Prokaryotic cells in biotech production. | | LО-2 | ID-1.3. | 1 |  |  | Offline |
|  |  | |  | ID-2.1. |  | (according to |
|  |  | |  |  |  | class schedule) |
|  | **P.3.** Investigation the potentials of isolated | | LО-2 | ID 1.3. | 1 | 6 | Task- | Offline |
|  | cultures from soil. | |  |  |  |  | oriented | (according to |
|  |  | |  |  |  |  |  | class schedule) |
|  | **Lab.3.** Isolation the perspective cultures from | | LО-2 | ID-1.3. | 2 | 10 |  | Offline |
|  | soil. | |  | ID-2.1. |  |  | (according to |
|  |  | |  |  |  |  | class schedule) |
| 4 | **L.4.** Fermentation Biotechnology: principles, | | LО-2 | ID-2.1. | 1 |  |  | Offline |
|  | processes, and products. | |  |  |  | (according to |
|  |  | |  |  |  | class schedule) |
|  | **P.4.** Isolation of end masses as fermentation | | LО-3 | ID-2.1. | 1 | 6 | Task- | Offline |
|  | products. | |  | ID-2.2. |  |  | oriented | (according to |
|  |  | |  |  |  |  |  | class schedule) |
|  | **Lab.4.** Isolation the microbial cultures from | | LО-3 | ID-3.3. | 2 | 10 |  | Offline |
|  | fermented beverages. | |  | ID-2.1. |  |  | (according to |
|  |  | |  |  |  |  | class schedule) |
|  | **IWS 2.** | | LО-2 | ID-2.3. |  | 10 | Logic task | Offline |
|  |  | |  | ID-2.5. |  |  | (according to |
|  |  | |  |  |  |  | class schedule) |
| 5 | **L.5.** Bioreactors, fermentation systems and | | LО-3 | ID-3.1. | 1 |  |  | Offline |
|  | metabolic pathways. | |  | ID-3.2. |  | (according to |
|  |  | |  |  |  | class schedule) |
|  | **P.5.** Investigation the potentials of isolated | | LО-2 | ID-3.1. | 1 | 6 | Task- | Offline |
|  | cultures from fermented products. | |  | ID-2.4. |  |  | oriented | (according to |
|  |  | |  |  |  |  |  | class schedule) |
|  | **Lab.5.** Isolation the cultures from fermented | | LО-3 | ID-3.3. | 2 | 10 |  | Offline |
|  | products. | |  | ID-3.1. |  |  | (according to |
|  |  | |  |  |  |  | class schedule) |
|  | **IC 1.** | |  |  |  | 100 |  |  |
| Module 2: Plant Biotech | | | | | | | | |
| 6 | **L.6.** The aim of Plant biotechnology. Basic direction in Plant biotechnology | | LО-2 | ID-2.1.  ID-2.2. | 1 |  |  | Offline  (according to class schedule) |
| **P.6.** Plant cell culture as a subject of the | | LО-3 | ID-3.1. | 1 | 6 | Task- | Offline |

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|  | Biotechnology | | |  | ID-2.4. |  |  | oriented | (according to |
|  | | |  |  | class schedule) |
| **Lab.6.** Instruction of safety technique. Laboratory | | | LО-3 | ID-3.3. | 2 | 10 |  | Offline |
| Manual/rules of lab work in laminar box, with | | |  | ID-3.1. |  |  | (according to |
| autoclaves, PCR-thermocycler, shaker, light setup | | |  |  |  |  | class schedule) |
| 7 | **L.7.** Biology of cultivated plant cells. Principles | | | LО-3 | ID-3.1. | 1 |  |  | Offline |
|  | and methods of cultivation plant cells | | |  | ID-3.2. |  | (according to |
|  |  | | |  |  |  | class schedule) |
|  | **P.7.** Morphogenesis and regeneration in plant cell | | | LО-4 | ID-4.1. | 1 | 6 | Task- | Offline |
|  | culture. Cell technologies for receiving important | | |  | ID-4.2. |  |  | oriented | (according to |
|  | BAS derived from plant material. | | |  |  |  |  |  | class schedule) |
|  | **Lab.7.** Prepare solution | of | macro-, | LО-4 | ID-4.1. | 2 | 10 |  | Offline |
|  | microelements, growth regulators |  |  |  | ID-4.3. |  |  | (according to |
|  |  |  |  |  |  |  |  | class schedule) |
|  | **IWS 3** | | |  |  |  | 10 | Logic task | Offline  (according to class schedule) |
| 8 | **L.8** Technologies, used for saving biodiversity | | | LО-3 | ID-3.1. | 1 |  |  | Offline |
|  | and plant propagation in vitro | | |  | ID-2.6. |  | (according to |
|  |  | | |  |  |  | class schedule) |
|  | **P.8** Clonal propagation of rare and endangered | | | LО-2 | ID-2.1. | 1 | 6 | Task- | Offline |
|  | plants. Cryopreservation | | |  | ID-3.5. |  |  | oriented | (according to |
|  |  | | |  |  |  |  |  | class schedule) |
|  | **Lab.8.** Calculation of stock solutions | | | LО-4 | ID-4.1. | 2 | 10 |  | Offline |
|  | concentration. Prepare of solid Murashige-Skoog | | |  | ID-4.3. |  |  | (according to |
|  | (MS) medium | | |  |  |  |  | class schedule) |
| 9 | **L.9.** Technologies used in | plant | breeding | LО-3 | ID-3.1. | 1 |  |  | Offline |
|  | programs |  |  |  | ID-3.3. |  | (according to |
|  |  |  |  |  |  |  | class schedule) |
|  | **P.9.** Cell selection. Embryoculture. Methods of | | | LО-4 | ID-4.2. | 1 | 6 | Task- | Offline |
|  | Fertilization in vitro. Haploid technology. | | |  | ID-3.5. |  |  | oriented | (according to |
|  |  | | |  |  |  |  |  | class schedule) |
|  | **Lab.9.** Cultivation of carrot parenchyma tissue on | | | LО-2 | ID-2.1. | 2 | 10 |  | Offline |
|  | MS medium in vitro | | |  | ID-2.3. |  |  | (according to |
|  |  | | |  |  |  |  | class schedule) |
|  | **IWS 4** | | |  |  |  | 10 | Logic task | Offline  (according to class schedule) |
| 10 | **L.10.** Bioengineering methods in plant | | | LО-3 | ID-3.4. | 1 |  |  | Offline |
|  | biotechnology | | |  | ID-2.6. |  | (according to |
|  |  | | |  |  |  | class schedule) |
|  | **P.10.** Cell and genetic engineering of plants | | | LО-4 | ID-3.3. | 1 | 6 | Task- | Offline |
|  |  | | |  | ID-4.1. |  |  | oriented | (according to |
|  |  | | |  |  |  |  |  | class schedule) |
|  | **Lab.10.** Cultivation of mature wheat embryos in | | | LО-2 | ID-2.1. | 2 | 10 |  | Offline |
|  | vitro on MS medium with different phytohormons | | |  | ID-2.6. |  |  | (according to |
|  |  | | |  |  |  |  | class schedule) |
|  | **MT** | | |  |  |  | 100 |  |  |
| Module 3: Animal Biotech | | | | | | | | | |
| 11 | **L.11.** The main directions and tasks of modern | | | LО-2 | ID-2.1. | 1 |  |  | Offline |
|  | Animal biotechnology. Bioethics issues in Animal | | |  | ID-2.2. |  | (according to |
|  | biotechnology. | | |  |  |  | class schedule) |
|  | **P.11.** Objects used in Animal biotechnology. | | | LО-3 | ID-3.1. | 1 | 6 | Task- | Offline |
|  |  | | |  | ID-2.4. |  |  | oriented | (according to |
|  |  | | |  |  |  |  |  | class schedule) |
|  | **Lab.11.** Safety rules in Animal biotechnology | | | LО-3 | ID-3.3. | 2 | 10 |  | Offline |
|  | laboratory. | | |  | ID-3.1. |  |  | (according to |
|  |  | | |  |  |  |  | class schedule) |
| 12 | **L.12.** Animal cell culture technology. Primary | | | LО-3 | ID-3.1. | 1 |  |  | Offline |

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|  | Culture. Subculturing. Cell line. Maintenance. |  | ID-3.2. |  |  |  | (according to  class schedule) |
| **P.12.** Cell potency. Totipotency, multipotency,  pluripotency of animal cells. | LО-4 | ID-4.1.  ID-4.2. | 1 | 6 | Task-  oriented | Offline  (according to class schedule) |
| **Lab.12.** Artificial insemination, In vitro  fertilization, and embryo transfer in animals. | LО-4 | ID-4.1.  ID-4.3. | 2 | 10 |  | Offline  (according to class schedule) |
|  | **IWS 3** |  |  |  | 10 | Logic task | Offline  (according to class schedule) |
| 13 | **L.13.** Cryopreservation of gametes and embryos.  Guidelines for Cryopreservation. Freezing Medium. Cryopreservation Medium. | LО-3 | ID-3.1.  ID-2.6. | 1 |  |  | Offline  (according to class schedule) |
| **P.13.** Methods for assessment of the of the  somatic cells, gametes and embryos viability**.** | LО-2 | ID-2.1.  ID-3.5. | 1 | 6 | Task-  oriented | Offline  (according to class schedule) |
| **Lab.13.** Protocol for Cryopreserving Cultured  Cells. | LО-4 | ID-4.1.  ID-4.3. | 2 | 10 |  | Offline  (according to class schedule) |
| 14 | **L.14.** Animal cloning. Stem cells and the  perspectives of practical application. | LО-3 | ID-3.1.  ID-3.3. | 1 |  |  | Offline  (according to class schedule) |
| **P.14.** Cloning method using the somatic cell  nuclear transplantation. | LО-4 | ID-4.2.  ID-3.5. | 1 | 6 | Task-  oriented | Offline  (according to class schedule) |
| **Lab.14.** Method of embryonic cloning. | LО-2 | ID-2.1.  ID-2.3. | 2 | 10 |  | Offline (according to  class schedule) |
|  | **IWS 4** |  |  |  | 10 | Logic task | Offline  (according to class schedule) |
| 15 | **L.15.** Genetic transformation of animal somatic  cells. | LО-3 | ID-3.4.  ID-2.6. | 1 |  |  | Offline  (according to class schedule) |
| **P.15.** The principles of genetic engineering in Animal biotechnology. | LО-4 | ID-3.3.  ID-4.1. | 1 | 6 | Task- oriented | Offline (according to  class schedule) |
| **Lab.15** Methods of introducing the foreign DNAs  into animal cells. | LО-2 | ID-2.1.  ID-2.6. | 2 | 10 |  | Offline  (according to class schedule) |
|  | **IC 2.** |  |  |  | 100 |  |  |

Abbreviations: L – lecture; P – practice, Lab. – laboratory, IWS – individual work of students; IWST – individual work of students with teacher; IC – intermediate control.

Dean of the faculty Zayadan B.K.

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