**Sillabus**

**Fall semester 2020-2021 academic years**

**on the educational program**   
«*8D05105* - Biotechnology **»**

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| **Discipline’s code** | **Discipline’s title** | **Independent work of students (IWS)** | **No. of hours per week** | | | | | **Number of credits** | **Independent work of student with teacher (IWST)** |
| **Lectures (L)** | **Practical training (PT)** | | **Labora-tory (Lab)** | |
|  | Molecular methods in Biotechnology |  | 2 | 0 | | 2 | | 3 |  |
| **Academic course information** | | | | | | | | | |
| **Form of education** | **Type of course** | **Types of lectures** | | | **Types of practical training** | | **Number of IWS** | | **Form of final control** |
| Full-time | Professional  disciplines elective component |  | | | Laboratory works | | In writing form | | tests |
| Lecturer | Kenzhebaeva Saule Sagindikovna | | | | | |  | | |
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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 acquaint students with the peculiarities of the essence and applications of the main methods in studying nucleic acids and proteins to show their relationship with the purpose of research.  to form PhD students' ability to know, objects and applications of modern methods, scientific terminology of the subject of molecular diagnostics.  to develop analytical skills to work with various information. | 1. demonstrate knowledge for the essence and applications of the main methods of molecular approaches in biotechnology including nucleic acids and proteins, to analyze information obtained when deciding practical tasks, | 1.1. know the features of the essence for extraction, modification, purification and analysis of nucleic acids and proteins technologies;  1.2. analyze major principles, steps and applications of molecular methods in biotechnology;  1.3. finds a correspondence between different types of analysis of results obtained by using molecular methods  1.4. demonstrates knowledge about the advantages and dis advantages of molecular methods, analysis and interpretation;  1.5. based on lecture material and information sources, can write the main steps of modification of molecular methods and interpretation . |
| 2. to select and apply in practice modern methods in biotechnology, including molecular cloning research for the qualitative and quantitative analysis and applications, | 2.1. conducts information search for solving research problems;  2.2. formulates research objectives and plans the process of its implementation; prepares equipment (instruments, apparatus) for conducting experiments;  2.3. selects and prepares samples (biological material) for the experiment;  2.4. conducts a qualitative and quantitative analysis of biological products, in accordance with methodological recommendations in accordance with safety regulations; |
| 3. to interpret the results of applications of molecular methods, using experiments for research purpose, assessing the relationship between their advantages, choice for decision of practical objectives and applications; | 3.1. records and formalizes the results of experimental work in the required format (tables, graphs, diagrams, etc.)  3.2. assesses the correctness of practical work;  3.3. analyzes the data obtained during the experiment;  3.4. compares the obtained data with the expected results, confirming the correctness of the experiment performed;  3.5. makes analysis and final conclusions from the received data; |
| 4. Demonstrate knowledge of the limitations, modification of molecular methods for different areasareas; | 4.1. based on molecular methods in biotechnology apply knowledge for practival applications and research purpose,  4.2 use techniques biotechnology to obtain bioactive compounds for medical and pharmaceuticals.  4.3 understand the basics of the limitations, modification of molecular methods for medical areas. |
| 5. to analyze the significant applications of molecular methods in agriculture, industry, health and molecular biology research,  to analyze information obtained when deciding practical tasks. | -5.1. to be able to correctly represent and evaluate applications of molecular methods in agriculture, industry health,  5.2 to be able to choose an approach and method depending on the task. |
| **Prerequisites** | **Cell biology, molecular biology, microbiology, Plant biochemistry and physiology,** | |
| **Post requisites** | different area of biotechnology and molecular Biology | |
| **Information resources** | **Main:** John M. Walker. Methods in molecular biology.  Santos SS, Nielsen TK, Hansen LH, Winding A. Comparison of three DNA extraction methods for recovery of soil protist DNA. J Microbiol Methods. 2015;115:13-9. Li M, Ishiguro Y, Kageyama K., Zhu Z. A simple method for normalization of DNA extraction to improve the quantitative detection of soil-borne plant pathogenic oomycetes by real-time PCR. Lett ApplMicrobiol[.](https://www.ncbi.nlm.nih.gov/pubmed/25970140) 2015 Aug;61(2):179-85. Dilhari A, Sampath A, Gunasekara C., Fernando N, Weerasekara D., Sissons C.  McBain A, WeerasekeraM, . Evaluation of the impact of six diffent DNA extraction methods for the representation of the microbial community associated with human chronic wound infections using a gel-based DNA profiling method. AMB Express. 2017 Sep 19;7(1):179. Maroney, P. A., Chamnongpol, S., Souret, F., Nilsen, T. W. (2008) Direct detection of small RNAs using splinted ligation. Nat. Protoc. 3, 279–87.  Curr Protoc Mol Biol. Author manuscript; available in PMC 2014 May 6.  Published in final edited form as: Curr Protoc Mol Biol. 2013 Jan; 0 22: Unit–22.1.   1. Glik, B., Pasternak J. Molecular biotechnology. Principles and applications.- M.: “Mir”, 2002. - 589 p.   **Additional:**   1. J. Schnell, M. Steele, J. Bean, M. Neuspiel, N. Dormann, C. Pearson, A. Savoie L. Bourbonnie`re, P. Macdonald. A comparative analysis of insertional effects in genetically engineered plants: considerations for pre-market assessments. Rev. Transgenic Res (2015) 24:1–17. 2. Nathan S. Mosier, Michael R. Ladisch. Modern biotechnology: connecting innovations in microbiology and biochemistry to engineering fundamentals [2009]. ISBN 978-0-470-11485-8 3. Tortora, Gerard J. Microbiology: an introduction [2010]. ISBN-13: 978-0- 321-55007- 4. Madsen, Eugene L. Environmental microbiology [2008].ISBN-13: 978-1- 4051-3647- 5. T.A. Egorova, S.M. Klunova, E.A. Zhivukhin. Fundamentals of biotechnology: a tutorial. - Moscow: "Academy", 2003. - 208 р.   Pershina L.A. Cultivation of isolated cells and tissues of higher plants: a textbook. Part 1. - Novosibirsk: NSU, 2000. – 46 р. | |
| **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 \*\*\*\*\*\*\*@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).  **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 | Topic name | | LO | ID | | amount of hours | | Maximum score | | Form of Knowledge Assessment | | The  Form of the lesson  / platform |
| **Module 1** Structure, feature and functions of nucleic acids | | | | | | | | | | | |  |
| 1 | **Lecture 1.** Introduction to methods of molecular biotechnology. Extraction of nucleic acids | **LO** 1 | | **ID** 1.2  **ID** 1.3  **ID** 1.1 | | 1 | |  | | ВС 1 | Off line | |
| **Seminar 1.** Main approaches of extraction of nucleic acids from different biological materials | **LO** 2 | | **ID** 2.1.  **ID** 2.2 | | 2 | | 10 | | Analysis of the written report | Off line | |
| 2 | **Lecture 2** Main principes of RNA extraction»  ” | **LO** 1  **LO** 2  **LO** 3 | | **ID** 1.3.  **ID** 2.1.  **ID** 2.3  **ID** 2.4..  **ID** 3.1  **ID** 3.2  **ID** 3.3 | | 1 | |  | | ВС 2 | Off line | |
| **Seminar 2** Methods of extraction of RNA from different biological materials | **LO** 1 | | **ID** 1.3 | | 2 | | 10 | | Analysis of the written report | Off line | |
|  | SIWT 1. Consultation and admission of PhD dtudent Independent work with Teacher. Student Independent work (SIW). MicroRNA. 3. Home tasks 1 titles in the UNIVER system.  The written decision. |  | |  | |  | | 15 | |  | Off line | |
|  | \*\* Consultation on the implementation of CPC on the ZOOM platform. Completed SIW task  students send to the section "Distance learning" of the UNIVER system. | | | | | | | | | | | |
| 3 | **Lecture 3.** Hybridization conditions and melting temperature in nuclear acids analysis | **LO** 1 | | **ID** 1.3 | | 1 | |  | | ВС 3 | Off line | |
| **Seminar 3** Analysis and characterization of nucleic acids. | **LO** 2 | | ИД 2.2 | | 2 | | 10 | | ТЗ 3 | Off line | |
| 4 | **Lecture 4.** Main principles of electrophoresis for analysis of nucleic acids. Types of electrophoresis for nuclear acids and proteins analysis. | **LO** 2  **LO** 3 | | **ID** 2.1.  **ID** 2.3  **ID** 2.4..  **ID** 3.1  **ID** 3.2  **ID** 3.3  **ID** 3.5. | | 1 | |  | | ВС 4 | Off line | |
| **Seminar 4.** Nucleic Acid detection and modification | **LO** 2  **LO** 3 | | **ID** 2.1.  **ID** 2.3  **ID** 2.4..  **ID** 3.1  **ID** 3.2  **ID** 3.3  **ID** 3.5. | | 2 | | 10 | | Analysis of the written report | Off line | |
| 5 | **Lecture 5**. Molecular cloning techniques, main steps and applications. | **LO** 1 | | **ID** 1.1.  **ID**.1.2. | | 1 | |  | | ВС 5 | Off line | |
| **Seminar 5.** MicroRNA Cloning from Cells of the Immune System. Use of nucleases, exonuclease, restrictase in molecular biotechnology | **LO** 2  **LO** 3 | | **ID** 2.1.  **ID** 2.3  **ID** 2.4..  **ID** 3.1  **ID** 3.2  **ID** 3.3  **ID** 3.5. | | 2 | | 10 | | Analysis of the written report | Off line | |
| SIWT. Consultation and admission of Student Independent work with Teacher. Student independent work (SIW 2) 3. Home tasks 2 titles in the UNIVER system. | | | | | | | | | | | |
| **MC 1 100** | | | | | | | | | | | | |
| **Module II** Structural analysis of nucleic acids. | | | | | | | | | | | | |
| 6 | **Lecture 6.** FISH (Fluorescence In-Situ Hybridization) method |  | |  | | 1 | |  | |  | Off line | |
|  | **Seminar 6.** Preparation cDNA, main steps |  | |  | | 2 | | 10 | |  | Off line | |
| 7 | L. 6. DNA library. PCR principles. | **LO** 1 | | **ID** 4.1 | | 1 | |  | |  | Off line | |
|  | **Seminar 6.** Design of primers. DNA Separation Techniques for different types of DNA | **LO** 2 | | **ID** 3.2 | | 2 | | 10 | | Analysis of the written report | Off line | |
|  | **Lecture 7.** Different types of PCR and their applications.  **Seminar 10.** Applications of microarrays in biotechnology | **LO** 1 | | **ID** 1.2 | | 1 | |  | |  | Off line | |
| **Seminar 7.** Genome mapping, genetic mapping, physical mapping, mapping distance | **LO** 2 | | **ID** 1.1,  1.2 | | 2 | | 10 | | Analysis of the written report | Off line | |
| SIWT 3. Consultation and admission of Student Independent work with Teacher. Student independent work (SIW 2) 3. Home tasks 3 titles in the UNIVER system. The task is carried out by a student (report, presentation). | **LO** 1 | | **ID** 1.2  **ID** 1.5 | |  | | 20 | | Written assignment | Off line | |
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| 8 | **Lecture 8.** DNASequencing techniques. | **LO** 1 | | **ID** 4.1 | | | 1 | |  |  | Off line | |
| **Seminar** 8. Interpretation of DNA **s**equencing results. | **LO 1** | | **ID** 1.3,  4.1 | | | 2 | | 10 | Analysis of the written report | Off line | |
| 9 | **Lecture 9.** Protein sequencing techniques | **LO** 1 | | **ID** 1.3 | | | 1 | |  |  | Off line | |
| Seminar 9. Preparation samples for protein sequencing | **LO** 2 | | **ID** 1.3 | | | 2 | | 10 | Analysis of the written report | Off line | |
| SIWT 4. Consultation and admission of Student Independent work with Teacher. Student independent work (SIW 4) 3. Home tasks 4 titles in the UNIVER system. The task is carried out by 1 student (report, presentation). | **LO** 1 | | **ID** 1.2  **ID** 1.5 | | |  | | 20 | Written assignment | Off line | |
| 10 | Lecture 10. Gene expression analysis | **LO** 1  **LO 2** | | **ID** 1.3 | | | 1 | |  |  | Off line | |
| **Seminar 10.** Mass analysis of proteolytic peptides is a popular method of protein characterization, as cheaper instrument designs used for characterization. | **LO** 2 | | **ID** 1.3 | | | 2 | | 10 | Analysis of the written report | Off line | |
| **Midterm 100** | | | | | | | | | | | | |
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| 11  12 | **Lecture 11.** Molecular markers to identify polymorphism. Applications | **LO** 1 | | | **ID** 1.3,  4.1 | | 1 | |  |  | Off line | |
| **Seminar 11.** Applications of different types of moleculaer markes in practical biotechnology.. | **LO** 4 | | | **ID** 4.1,  5.1 | | 2 | | 10 | Analysis of the written report | Off line | |
| **L.12.** Strategies for SNP detections strategies for arrays. | **LO** 1 | | | **ID** 1.3  **ID** 4.1 | | 1 | |  |  | Off line | |
| **Seminar 12.** Protocol of SNP marker. | **LO** 4 | | | **ID** 1.2,  2.1 | | 2 | | 10 | Analysis of the written report | Off line | |
| **SIWT 5.** Consultation and admission of Student Independent work with Teacher. Student Independent work (SIW) 5. Topics:. The task is carried out by 1 student (report, presentation). | **LO** 1 | | | **ID** 1.2  **ID** 1.5 | |  | | 20 |  | Off line | |
| 13 | Lecture 13. The use of DNA markers in molecular breeding | **LO** 1 | | | **ID** 1.3  **ID** 4.1 | | 1 | |  |  | Off line | |
| Seminar 13. Types of DNA microarrays The Future of DNA arrays. Data standards and data exchange. DNA microarrays for transcription factor binding analysis.. | **LO** 4 | | | **ID** 1.2,  2.1 | | 2 | | 10 | Analysis of the written report | Off line | |
| 14 | **Lecture. 14.** QTL analysis***.*** | **LO** 1 | | | ИД 4.2 | | 1 | |  |  | Off line | |
| **Seminar 14.** QTL applications in breeding | **LO** 1  **LO** 2 | | | **ID** 3.2,  5.1 | | 2 | | 10 | Analysis of the written report | Off line | |
| **SIWT 6.** Consultation and admission of Student Independent work with Teacher. Student Independent work (SIW) 6. Topics: Research on animal cloning, achievements. Methods of embryo transplantation farm animals and their application. Gene transfer by using yeast artificial chromosomes. Home tasks 6 titles in the UNIVER system. The task is carried out by student (report, presentation). | **LO** 4,5 | | | **ID** 4.3, 5.1 | |  | | 20 |  | Off line | |
| 15 | Lec. 15. Genome editing, or genome engineering, CRISPR gene editing. | **LO** 1 | | | **ID** 1.1 | | 1 | |  |  | Off line | |
| Seminar 15. CRISPR gene editing process | **LO** 1**LO** 4 | | | **ID** 4.2, 5.1 | | 2 | | 10 | Analysis of the written report | Off line | |
| **SIWT 7.** Consultation and admission of Student Independent work with Teacher. Student Independent work (SIW) 5. Topics: Research on animal cloning, achievements. Methods of embryo transplantation farm animals and their application. Gene transfer by using yeast artificial chromosomes. Home tasks 7 titles in the UNIVER system. The task is carried out by a 1 student (report, presentation). | **LO** 1, 4 | | | **ID** 1.3,  3.2 | |  | | 15 |  | Off line | |
| **MC 2 100** | | | | | | | | | | | | |

Dean of the Faculty \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ B.K.Zzayadan

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Head of department \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ A.S. Kustaubayeva

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