**Sillabus**

**Fall semester 2021-2022 academic years**

**on the educational program**   
**«MBMR 6308-** 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)** | |
|  | Moleсular biochemical markers of plants resistance to disease |  | 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 undergraduate with the peculiarities of the essence and applications of the main moleсular and biochemical markers of plants resistance to disease, to show their relationship with genotype characteristics and environmental conditions.  To form undergraduate ability to know, objectives of plant pathology, disease and disorder caused by plant pathogens, classification of diseases and modern methods, scientific terminology of the subject of molecular diagnostics.  Develop analytical thinking skills to work with various information. | 1. demonstrate knowledge for the essence and applications of the main moleсular and biochemical markers of plants resistance to disease, used  in modern plant pathology including methods of creation of resistant plants to patogens, to analyze information obtained when deciding practical tasks, | 1.1. know the features of the essence for the main moleсular and biochemical markers of plants resistance to disease their types and techniques of use;  1.2. analyze major steps of relationship with genotype characteristics and environmental conditions;  1.3. finds a correspondence between different types of biochemical markers and mechanism for disease resistant in plants  1.4. demonstrates knowledge about methods of study of biochemical and molecular markers;  1.5. based on lecture material and information sources, can write the main steps of choice the type of markers to evaluate plants responses to patogens. |
| 2. to select and apply in practice moleсular and biochemical markers of plants resistance to disease, including different substances such as phytoalexins, lignin cellulose, differenct classes of cell wall proteins and enzymes, genetic modification research for the qualitative and quantitative analysis of plant resistance; | 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 types of biochemical markers including phenolic compounds, sugars, total free amino acid, oxidative enzymes and protein DNA markers in plant improvement to desease, use of molecular markers in marker-assisted selection to develop new resistant genotypes and assessing the relationship between their advantages, choice for decision of practical purpose 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 the laboratory test;  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 final conclusions from the received data; |
| 4. Demonstrate knowledge of the identification of genes for resistance to different pathogenic fungous, microorganisms | 4.1. based on biotechnology of microorganisms apply knowledge about production of enzymes and bioactive compounds for medical and pharmaceuticals s;  4.2 use techniques the identification of genes for resistance to different pathogenic fungous, microorganisms.  4.3 understand the basics of the application of markers for agricultural plants with improved characteristics. |
| 5. to analyze the significant applications of new disease resistant crops in agriculture, health and environmental,  to analyze information obtained when deciding practical tasks. | -5.1. to be able to correctly represent and evaluate applications of new disease resistant crops in agriculture, sustainable production  5.2 to be able to choose an approach and method depending on the task. |
| **Prerequisites** | **Cell biology, Plant biochemistry and physiology, Botany** | |
| **Post requisites** | Agricultural Biotechnology, Molecular Biology | |
| **Information resources** | 1. **Main:** Reinhard Renneberg. *Biotechnology for Beginners [2007]. ISBN:*   9780123735812   1. Shakoor Ahmad Plant basal resistance: genetics, biochemistry and impacts on   plant-biotic interactions. Biology: An Illustrated Guide to Science [2012]. ISBN-10: 0- 8160-6162-9, P. 151   1. Talaro-Talaro: Foundations in Microbiology, Fourth Edition [2011]. ISBN: 978-0072320428 2. Fahmi AI, El-Shehawi AM and El-Orabey WM. Leaf rust resistance and molecular identification of *Lr* 34 Gene in egyptian wheat. J. Microb Biochem Technol 2015, 7:6 3. Glik, B., Pasternak J. Molecular biotechnology. Principles and applications.- M.: “Mir”, 2002. - 589 p.   **Additional:**   1. Eugene W. Nester and etc. Microbiology: a human perspective, sixth edition [2011]. ISBN 978–0–07–299543–5 2. Prescott, Harley, and Klein’s microbiology, seventh edition [2008]. ISBN 978–0–07–299291–5 3. Nathan S. Mosier, Michael R. Ladisch. Modern biotechnology: connecting innovations in microbiology and biochemistry to engineering fundamentals [2009]. ISBN 978-0-470-11485-8 4. Tortora, Gerard J. Microbiology: an introduction [2010]. ISBN-13: 978-0- 321-55007- 5. Madsen, Eugene L. Environmental microbiology [2008].ISBN-13: 978-1- 4051-3647- 6. 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.** Introduction to biochemical markers of plants resistance to disease. Main approaches of study**”** | | | | | | | | | | | |  |
| 1 | **Lecture** 1**.** Principles of plant pathology. An introduction to Plant Pathology | **LO** 1 | | **ID** 1.2  **ID** 1.3  **ID** 1.1 | | 2 | |  | | ВС 1 | Video lecture | |
| *Seminar* 1. Biochemical markers of disease resistance | **LO** 2 | | **ID** 2.1.  **ID** 2.2 | | 2 | | 7 | | Analysis of the written report | Webinar  in MS Teams | |
| 2 | **Lecture** **2.** Signal transduction pathways of pathogen | **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 | |  | | ВС 2 | Video lecture | |
| *Seminar 2.* Cyclic adenosine monophosphate (cAMP). Mitogen-activated protein kinases (MAPKs | **LO** 1 | | **ID** 1.3 | | 2 | | 7 | | Analysis of the written report | Webinar  in MS Teams | |
|  | SIWT 1. Consultation and admission of Student Independent work with Teacher. Student Independent work (SIW) 3. Home tasks 1 titles in the UNIVER system. HW CDS Methods of extraction and determination of biochemical markers of plants resistance to disease including sugars, phenols |  | |  | |  | | 15 | |  | Distance learning" of the UNIVER system. | |
|  | \*\* Consultation on the implementation of CPC on the offline platform. Completed SIW task  Ms students send to the section | | | | | | | | | | | |
| 3 | **Lecture** 3. Gene for Gene Concept | **LO** 1 | | **ID** 1.3 | | 2 | |  | | ВС 3 | Video lecture | |
| *Seminar* 3. Biochemical markers related to disease resistance. Choice and application. | РО 2 | | ИД 2.2 | | 2 | | 7 | | ТЗ 3 | in MS Teams | |
| HW 3. CDS Genetic and physiological evidences elicitor-receptor models. | | | | | | | | | | | |
| 4 | **Lecture** 4. The practical use of gene to gene relationships | **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 | |  | | ВС 4 | Video lecture  in MS Teams | |
| Seminar 4. Biochemical markers of disease resistance 4. Extraction DNA. Main principles. | **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 | | 7 | | Analysis of the written report | Webinar  in MS Teams \* | |
| 5 | Lecture 5 Biochemical relationship in resistant and susceptible cultivars | **LO** 1 | | **ID** 1.1.  **ID**.1.2. | | 2 | |  | | ВС 5 | Video lecture  in MS Teams | |
| *Seminar* 5. Signal responses - massive changes in gene expression. Structural Defenses. Biochemical relationship in resistant and susceptible cultivars | **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 | | 7 | | Analysis of the written report | Webinar  in MS Teams \* | |
| SIWT. Consultation and admission of Student Independent work with Teacher. Student independent work (SIW 2) 3. Home tasks 2 Protein- Protein interaction) in the UNIVER system. | | | | | | | | | | | |
| **MC 1 100** | | | | | | | | | | | | |
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| 6 | Lecture 6. Examples of isozyme systems routinely used in plant breeding for disease resistance | **LO** 1 | | **ID** 1.1.  **ID**.1.2. | | 2 | |  | | ВС 5 | Video lecture  in MS Teams | |
|  | Seminar 6. Utilization of pigmented cells and phytoalexins as biochemical markers for screening resistance . | **LO** 1 | | **ID** 1.1.  **ID**.1.2. | | 2 | | 5 | | ВС 5 | Video lecture  in MS Teams | |
| **Module 2. “**Molecular markers for plants resistance | | | | | | | | | | | | |
| 7 | **Lecture** 7. RFLP markers. Application for  determination of plants resistance. | **LO** 1 | | **ID** 4.1 | | 2 | |  | |  | Video lecture  in MS Teams | |
| 7 | *Seminar.*7. Optimization and use of RFLP markers for comparative and synteny mapping | **LO** 1 | | **ID** 1.2 | | 2 | |  | |  | Video lecture  in MS Teams | |
|  | SIWT 3. Consultation and admission of Student Independent work with Teacher. Student independent work (SIW 2) 3. Home tasks 3titles in the UNIVER system. The task is carried out by a group of 2 students (report, presentation). | **LO** 1 | | **ID** 1.2  **ID** 1.5 | |  | | 7 | | Written assignment | Webinar  in MS Teams | |
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| 8 | **Lecture** 8. Random Amplified Polymorphic DNA (RAPD) | **LO** 1 | | **ID** 4.1 | | | 2 | |  |  | Video lecture  in MS Teams | |
| *Seminar* 8. To know and learn: application of Random Amplified Polymorphic DNA (RAPD) in plants breeding for disease resistance | **LO 1** | | **ID** 1.3,  4.1 | | | 2 | | 5 | Analysis of the written report | Webinar  in MS Teams \* | |
| 9 | **Lecture** 9. Process management in microbial Biotechnology: genome management and analysis in microbial Biotechnology. Microbial process kinetics | **LO** 1 | | **ID** 1.3 | | | 2 | |  |  | Video lecture  in MS Teams | |
| *Seminar* 9. Role of secondary metabolites in defense mechanisms of plants | **LO** 2 | | **ID** 1.3 | | | 2 | | 5 | Analysis of the written report | Webinar  in MS Teams \* | |
| 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 a group of 2 students (report, presentation). | **LO** 1 | | **ID** 1.2  **ID** 1.5 | | |  | | 7 | Written assignment | Webinar  in MS Teams | |
| 10 | **Lecture** 10. Retrotransposons molecular markers. | **LO** 1 | | **ID** 1.3 | | | 2 | |  |  | Video lecture  in MS Teams | |
| *Seminar* 10. DNA Separation Techniques for different types of DNA | **LO** 2 | | **ID** 1.3 | | | 2 | | 5 | Analysis of the written report | Webinar  in MS Teams \* | |
| **Midterm 100** | | | | | | | | | | | | |
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| 11  12 | **Lecture** **11.** Inter simple sequence repeat (ISSR). | **LO** 1 | | | **ID** 1.3,  4.1 | | 2 | |  |  | Video lecture  in MS Teams | |
| *Seminar* 11. Types of DNA microarrays The Future of DNA arrays. Data standards and data exchange. DNA microarrays for transcription factor binding analysis.  . | **LO** 4 | | | **ID** 4.1,  5.1 | | 2 | | 5 | Analysis of the written report | Webinar  in MS Teams \* | |
| **Lecture** **12.** Inter simple sequence repeat (ISSR). Cleaved amplified polymorphic sequences (CAPS) - molecular markers***.*** | **LO** 1 | | | **ID** 1.3  **ID** 4.1 | | 2 | |  |  | Video lecture  in MS Teams | |
| *Seminar* **12.** Strategies for SNP detections strategies for arrays | **LO** 4 | | | **ID** 1.2,  2.1 | | 2 | | 5 | Analysis of the written report | Webinar  in MS Teams \* | |
| **Module 3. “** Animal biotechnology | | | | | | | | | | | |
| **SIWT 5.** 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 5 titles in the UNIVER system. The task is carried out by a group of 2 students (report, presentation). | **LO** 1 | | | **ID** 1.2  **ID** 1.5 | |  | | 7 | Written assignment | Webinar  in MS Teams | |
| 13 | **Lecture** **13.** High-Throughput Marker Systems. Single Nucleotide Polymorphisms (SNPs)  . | **LO** 1 | | | **ID** 1.3  **ID** 4.1 | | 2 | |  |  | Video lecture  in MS Teams | |
| *Seminar* **13.** Preparation of DNA chip and the experiment. | **LO** 4 | | | **ID** 1.2,  2.1 | | 2 | | 5 | Analysis of the written report | Webinar  in MS Teams \* | |
| 14 | **Lecture** **14.**  Marker-assisted Selection for Disease Resistance: Applications in Breeding. | **LO** 1 | | | ИД 4.2 | | 2 | |  |  | Video lecture  in MS Teams | |
| *Seminar* **14.** Marker-assisted backcrossing (MABC). Marker assisted pyramiding. | **LO** 2 | | | **ID** 3.2,  5.1 | | 2 | | 5 | Analysis of the written report | Webinar  in MS Teams \* | |
| **SIWT 6.** 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 6 titles in the UNIVER system. The task is carried out by a group of 2 students (report, presentation). | **LO** 4,5 | | | **ID** 4.3, 5.1 | |  | | 7 | ТЗ 13 | ZOOM\*\* | |
| 15 | **Lecture** **15.** Combined Marker Assisted Selection (MAS): The development. | **LO** 1 | | | **ID** 1.1 | | 2 | |  |  | Video lecture  in MS Teams | |
| *Seminar* **15.** Advantages of MAS over conventional methods. | **LO** 4 | | | **ID** 4.2, 5.1 | | 2 | | 5 | Analysis of the written report | Webinar  in MS Teams \* | |
| **MC 2** Questions |  | | |  | |  | | 15 |  |  | |
| **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 group of 2 students (report, presentation). | **LO** 1, 4 | | | **ID** 1.3,  3.2 | |  | | 7 |  | ZOOM\*\* | |
| **MC 2 100** | | | | | | | | | | | | |

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