**AL-FARABI KAZAKH NATIONAL UNIVERSITY**

**Biology and Biotechnology Faculty**

**Department of Biotechnology**

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|  | APPROVED byDean of Faculty **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ B.K. Zayadan**  **"\_27\_"\_\_08\_\_ 2022** |

# EDUCATIONAL-METHODICAL COMPLEX OF THE DISCIPLINE

# Environmental Biotechnology

«6B05103 – Biotechnology»

Course – 4

Semester – 1

Number of credits – 5

Lecture - 15 hour

Seminar – 30 hour

IWSP - 4

**Almaty 2022**

Educational-methodical complex of the discipline is made by Yernazarova A.K., PhD, senior teacher

Based on the working curriculum on the specialty «6B05103 – Biotechnology»

Considered and recommended at the meeting of the Biotechnology department

From «29» \_\_06\_\_ 2022, Protocol № 39

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

### Recommended by the methodological council of the faculty

On «20» 08\_ 2022, Protocol №1

Chairman of the methodological council of the faculty \_\_\_\_Nazarbekova S.T.

**Sillabus**

**Fall semester 2022-2023**

**on “Biotechnology” educational program**

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| **Course code** | | **Course name** | **Independent student work (ISW)** | **Number of hours** | | | | | | **Number of credits** | **Independent work of a student under the guidance of a teacher (IWST)** |
| **Lectures (L)** | **Seminars (S)** | | | **Laboratory work (LW)** | |
|  | | **Environmental Biotechnology** | 4 | 15 |  | | | 30 | | 5 | 4 |
| **Academic Course Information** | | | | | | | | | | | |
| **Type of education** | | **Type of the course** | **Types of lectures** | | | **Types of practice sessions** | | | **Number of ISW** | | **Final control form** |
| Offline | | Basic discipline University component | Presentations | | | Seminars | | | 4 | | Oral Exam |
| **Lecturer** | | Yernazarova Aliya Kulakhmetovna | | | | | | |  | | Scheduled |
| **e-mail** | | Aliya.Yernazarova@kaznu.edu.kz | | | | | | |
| **Telephone** | | --- | | | | | | |
| **Academic presentation of the course** | | | | | | | | | | | |
| **Objective of the course** | **Expected Learning Outcomes (ELO)**  **As a result of studying the discipline, the student will be able to:** | | | | | | **Indicators of achievement ELO (IA) (for each ELO at least 2 indicators) As a result of studying the discipline, the student will be able to:** | | | | |
| to introduce the students to various regional and global concerns regarding the environment, including the natural challenges, various types of environmental pollutants and their effects, the changing environment, and the developments of diverse technologies to detect, study and address these concerns; to introduce specific examples and cases, and explain how chemical, biological and molecular sciences can be applied to identify and address issues of environmental concerns. | ELO 1 Acquire detailed knowledge and understanding of the ecological foundations that explain the participation of microorganisms, plants in ecosystems and the great power that exists in their biotechnological use. | | | | | | IA 1.1 Classify microbes according to energy source and carbon source and evaluate energy outcome of the energy metabolism according to electron acceptor and electron donor usage  IA 1.2 Recognize the various global and regional environmental concerns due to natural causes and/or human activities, and the impact of these on various forms of life including native biodiversity  IA 1.3 Describe the role of plants and microorganisms in processes such as biodegradation, biofilm formation, biocorrosion, mineral leaching, composting, clean drinking water. | | | | |
| ELO 2 Demonstrate an understanding of the processes involved in small-scale and industrial scale bacterial fermentations | | | | | | IA 2.1 Outline the principles of methods for quantification of organic carbon in wastewater  IA 2.2 Describe the most commonly applied disinfection methods, and the steps typically involved in drinking water treatment process train  IA 2.3 Explain the microbial processes and growth requirements undelaying the activated sludge process, nitrification, denitrification, enhanced phosphorus removal, and anaerobic digestion. | | | | |
| ELO 3 Understand the topics and be able to formulate biodegradation kinetics and remediate organic and inorganic compounds through case studies, laboratory demonstrations, and field studies. | | | | | | IA 3.1 Apply kinetics and basic chemostat theory to determine microbial growth rates, biomass yield, and substrate concentration and removal rate  IA 3.2 Evaluate the potential for biodegradation of organic pollutants, taking microbial and physical/chemical environments, as well as the chemical structure of the compound itself, into consideration  IA 3.3 Demonstrate the ability to use various instruments used in microbial biotechnology, their operating principles and application. | | | | |
|  | ELO 4 Demonstrate advanced skills in performing literature searches in undertaking an in-depth case study of an environmental issue, and presenting a critical appraisal. | | | | | | IA 4.1 Critically analyze relevant journal articles and investigate industrial application of the above concepts.  IA 4.2 Appreciate the scientific, ethical and/or social issues associated with certain applications of biotechnology for alleviating the environmental concerns.  IA 4.3 Introduce the wide range of professional activities linked to biotechnological knowledge and provide the foundations of intimate interrelation between this scientific field and the sustainable development of human society. | | | | |
| **Prerequisites** | Microbiology, The basics of Biotechnology, Physiology of Plants, Biochemistry | | | | | | | | | | |
| **Post requisites** | Modern methods in biotechnology | | | | | | | | | | |
| **Literature and Resources** | Main:   1. Environmental Biotechnology [2008]. ISBN 9788122425444 2. Eugene L. Madsen. Environmental Microbiology, From genomes to biogeochemistry [2008]. ISBN-13: 978-1-4051-3647-1. 3. Environmental biotechnology : biodegradation, bioremediation, and bioconversion of xenobiotics for sustainable development [2016]. Edited by Jeyabalan Sangeetha, Devarajan Thangadurai, Muniswamy David, Mohd Azmuddin Abdullah. ISBN 978-1-77188-362-7. 4. Environmental Microbiology and Biotechnology: Volume 1: Biovalorization of Solid Wastes and Wastewater Treatment [2020] / [Anoop Singh](https://ru.b-ok.asia/author/Anoop%20Singh), [Shaili Srivastava](https://ru.b-ok.asia/author/Shaili%20Srivastava" \o "Найти все книги автора), [Dheeraj Rathore](https://ru.b-ok.asia/author/Dheeraj%20Rathore), [Deepak Pant](https://ru.b-ok.asia/author/Deepak%20Pant). ISBN 9789811560217 5. Environmental Microbiology and Biotechnology Volume 2: Bioenergy and Environmental Health [2021]. Edited by Anoop Singh, Shaili Srivastava, Dheeraj Rathore, Deepak Pant. ISBN 9789811574931 6. Gareth Price. Biology: An Illustrated Guide to Science [2006]. ISBN-10: 0-8160-6162-9. 7. Environmental Biotechnology: For Sustainable Future [2019] / [Ranbir Chander Sobti](https://ru.b-ok.asia/author/Ranbir%20Chander%20Sobti), [Naveen Kumar Arora](https://ru.b-ok.asia/author/Naveen%20Kumar%20Arora), [Richa Kothari](https://ru.b-ok.asia/author/Richa%20Kothari). ISBN 9789811072840. 8. Principles and Applications of Environmental Biotechnology for a Sustainable Future [2017]. ISBN 811018669.   Additional:   1. Nathan S. Mosier, Michael R. Ladisch. Modern biotechnology: connecting innovations in microbiology and biochemistry to engineering fundamentals [2009]. ISBN 978-0-470-11485-8. 2. Tortora, Gerard J. Microbiology: an introduction [2010]. ISBN-13: 978-0-321-550071. 3. Madsen, Eugene L. Environmental microbiology [2008].ISBN-13: 978-1-4051-3647-1. 4. Talaro, Kathleen P. Foundations in microbiology. 8th edition [2012]. ISBN 978-0-07-337529-8.   **Internet resources:**  <https://www.goodreads.com/>  <https://www.coursera.org/>  <https://www.edx.org/>  <https://ed.ted.com/> | | | | | | | | | | |
| **Academic policy of the course in the context of university moral and ethical values** | Rules of Academic Conduct:  The deadlines for completing the modules of the course must be strictly observed in accordance with the schedule for studying the discipline.  ATTENTION! Failure to meet deadlines results in loss of points! The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the training course.  Academic values:  - Practical / laboratory studies, ISW should be independent, creative.  - Plagiarism, forgery, use of cheat sheets, cheating at all stages of control are unacceptable.  Students with disabilities can receive consulting assistance at e-address [Almagul.Baubekova@kaznu.edu.kz](mailto:Almagul.Baubekova@kaznu.edu.kz) | | | | | | | | | | |
| **Assessment and attestation policy** | Criteria assessment: assessment of learning outcomes in relation to descriptors (checking the formation of competencies at midterm control and exams).  Summative assessment: assessment of the activity of work in the audience (at the webinar); assessment of the completed assignment. | | | | | | | | | | |

**Calendar for the implementation of the content of the training course:**

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Week | Topic name | ELO | IA | Number of hours | Maximum score | Knowledge Assessment Form | The form of the lesson  /platform |
| **1** | Lecture 1. Introduction to Environmental Biotechnology | ELO 1 | IA1.1  IA1.2 | 1 | **0** |  | Lecture |
| **1** | Laboratory work 1. (LW 1) General safety rules. Equipment and technique | ELO 1 | IA1.1 | 2 | 10 | Discussion | Seminar |
| **2** | Lecture 2. The Role of Plants in Environmental Biotech - Phytoremediation | ELO 1 | IA1.3 | 1 | 0 |  | Lecture |
| **2** | LW 2 Isolation and Characterization of Bacteria from Crude Petroleum Oil Contaminated Soil (Virtual lab, Manuscript) | ELO 1 | IA1.3 | 2 | 10 | Discussion | Online class lecture on MS Teams |
| **3** | Lecture 3. Phytoremediation of air pollutants | ELO 1 | IA1.2  IA1.3 | 2 | 0 |  | Lecture |
| **3** | LW 3. Isolation and Characterization of Bacteria from Crude Petroleum Oil Contaminated Soil (Virtual lab) | ELO 1 | IA1.3 | 2 | 10 | Discussion | Seminar |
| **3** | ISWT Consultation and reception  ISWT 1 Local Environmental Problem of my hometown (Project) | ELO 1 | IA1.1  IA1.2  IA1.3 | 4 | 15 | Presentation, discussion | Online class lecture on MS Teams |
| **4** | Lecture 4. Wastewater treatment | ELO 2 | IA2.1  IA2.2 | 2 | 0 |  | Lecture |
| **4** | LW 4. Growth Response of Bacteria on Petroleum Fuel (Diesel) | ELO 2 | IA2.1 | 2 | 10 | Discussion | Seminar |
| **5** | Lecture 5. Bioremediation of Heavy Metals | ELO 2 | IA2.2  IA2.3 | 1 | **0** |  | Lecture |
| **5** | LW 5. Growth Response of Bacteria on Petroleum Fuel (Diesel) | ELO 2 | IA2.3 | 2 | 10 | Discussion | Seminar |
| **6** | Lecture 6. Microbial destruction of toxics: Bioremediation of Radioactive Waste | ELO 2 | IA2.2  IA2.3 | 1 | 0 |  | Lecture |
| **6** | LW 6. Enrichment for Uric Acid Utilizing Bacteria (Virtual lab) | ELO 2 | IA2.2 | 2 | 10 | Discussion | Seminar |
| **7** | Lecture 7. Microbial leaching | ELO 2 | IA2.2  IA2.3 | 1 | **0** |  | Lecture |
| **7** | LW 7. Enrichment for Uric Acid Utilizing Bacteria (Virtual lab) | ELO 2 | IA2.3 | 2 | 10 | Discussion | Seminar |
| **7** | ISWT 2. Microbial remediation of contaminated lands | ELO 2 | IA2.2  IA2.3 | 1 | 15 | Presentation, discussion | Online class lecture on MS Teams |
| **7** | МТ 1 (Midterm Exam) |  |  |  | 100 |  |  |
| **8** | Lecture 8. Biotransformation of pesticides | ELO 3 | IA3.1 | 1 | 0 |  | Lecture |
| **8** | LW 8. Environmental Detection of Streptomycin-Producing Streptomyces spp. by Using strb1 and 16S rDNA-Targeted PCR (Virtual lab) | ELO 3 | IA3.1 | 2 | 10 | Discussion | Seminar |
| **9** | Lecture 9. Immobilization of Cells Application in Environmental Biotech | ELO 3 | IA3.1  IA3.2 | 1 | 0 |  | Lecture |
| **9** | LW 9. Environmental Detection of Streptomycin-Producing Streptomyces spp. by Using strb1 and 16S rDNA-Targeted PCR (Virtual lab) | ELO 3 | IA3.2 | 2 | 10 | Discussion | Seminar |
| **9** | ISWT 3. Biosorption and bioaccumulation | ELO 3 | IA3.1  IA3.2  IA3.3 | 1 | 15 | Test | Online class lecture on MS Teams |
| **10** | Lecture 10. Biopesticides | ELO 3 | IA3.3 | 1 | 0 |  | Lecture |
| **10** | LW 10 Report. | ELO 3 | IA3.3 | 2 | 10 | Discussion | Seminar |
| **11** | Lecture 11 Biopesticides | ELO 3 | IA3.3 | 1 | 0 |  | Lecture |
| **11** | LW 11 Molecular Detection of Fecal Coliforms (E. coli) in Water by PCR | ELO 3 | IA3.1 | 2 | 10 | Discussion | Seminar |
| **12** | Lecture 12 Environmental Monitoring | ELO 3 | IA3.3 | 1 | 0 |  | Lecture |
| **12** | LW 12 Molecular Detection of Fecal Coliforms (E. coli) in Water by PCR | ELO 3 | IA3.1 | 2 | 10 | Discussion | Seminar |
| **13** | Lecture 13. Silage making | ELO 3 | IA3.2 | 1 | 0 |  | Lecture |
| **13** | LW 13. Interaction of Plant Seeds with Diesel for Potential Use in the Remediation of Diesel fuel Contaminated Soils | ELO 3 | IA3.1  IA3.2 | 2 | 10 | Discussion | Online class lecture on MS Teams |
| **14** | Lecture 14. Bioenergy: bioproduction of renewable energy source | ELO 3  ELO4 | IA3.3  IA4.1  IA4.2 | 1 | 0 |  | Lecture |
| **14** | LW 14 Interaction of Plant Seeds with Diesel for Potential Use in the Remediation of Diesel fuel Contaminated Soils | ELO 4 | IA4.1  IA4.2 | 2 | 10 | Discussion | Online class lecture on MS Teams |
| **14** | ISWT Consultation and reception  ISWT 4.  Bioinsecticides as future mainstream pest control agents: opportunities and challenges | ELO 4 | IA4.1  IA4.2  IA4.3 | 1 | 15 | Presentation, discussion | Online class lecture on MS Teams |
| **15** | Lecture 15. Microbial enhanced oil recovery | ELO 4 | IA4.2 | 1 | 0 |  | Lecture |
| **15** | LW 15. Risks of Genetically Modified Organisms (GMOs) (Seminar) | ELO 4 | IA4.3 | 2 | 10 | Discussion | Seminar |
|  | **МТ (Midterm Exam)** |  |  |  | 100 |  |  |

Abbreviations:

L - lecture; S - seminar; SIW - student's independent work; ISWT – student independent work under the guidance of a lecturer; MC - midterm control; ELO - Expected Learning Outcomes; IA - Indicators of achievement.

Dean of biology and biotechnology faculty Zayadan B.K.

Chairman of the methodological council of the faculty Nazarbekova S.T.

Head of biotechnology department Kistaubaeva A.S.

Lecturer Yernazarova A.K.