**SYLLABUS**

**Fall semester 2023-2024 academic year**

**Educational program "6B05103 Biotechnology"**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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)** |
| 2150  Environmental Biotechnology | 4 | | 3 (15) | 3 (15) | 3 (15) | 9 | 6 |
| **ACADEMIC INFORMATION ABOUT THE COURSE** | | | | | | | |
| **Learning Format** | **Cycle,**  **component** | **Lecture**  **types** | | **Types**  **of practical classes** | | **Form and platform final control** | |
| *Offline* | Basic discipline University component | Presentations | | Seminars | | Written exam | |
| **Lecturer - (s)** | Yernazarova Aliya Kulakhmetovna | | | | |
| **e-mail :** | A.Yernazarova@kaznu.edu.kz | | | | |
| **Phone :** |  | | | | |
| **Assistant - (s)** | Sandybayeva Sandugash Kalzhanovna | | | | |
| **e-mail :** | Sandugash.Sandybayeva@kaznu.edu.kz | | | | |
| **Phone :** |  | | | | |
| **ACADEMIC COURSE PRESENTATION** | | | | | | | |
| **Purpose**  **of the course** | **Expected Learning Outcomes (LO) \*** | | | | | **Indicators of LO achievement (ID)** | |
| to form in students the ability to conceptualize the role of microorganisms in preserving the natural balance During the study of the discipline students will learn following aspects: biological methods of wastewater treatment and solid waste management; aerobic and anaerobic processes of wastewater treatment; solid waste recycling through composting, bioremediation; methods and technologies of bioremediation; bioremediation of contaminated soils and soils; bioremediation of environmental, environment; cleaning from oil and petroleum products, bioremediation of the atmosphere biotechnology in the solution of energy problems; biological production of hydrogen; new approaches to produce biofuels. biotechnology and the greening of agricultural technologies; biopesticides and biofertilizers. | 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. | | | | | 1.1 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 | |
| 1.2 Describe the role of plants and microorganisms in processes such as biodegradation, biofilm formation, biocorrosion, mineral leaching, composting, clean drinking water. | |
| 2. Demonstrate an understanding of the processes involved in small-scale and industrial scale bacterial fermentations | | | | | 2.1 Outline the principles of methods for quantification of organic carbon in wastewater | |
| 2.2 Describe the most commonly applied disinfection methods, and the steps typically involved in drinking water treatment process train.  2.3 Explain the microbial processes and growth requirements undelaying the activated sludge process, nitrification, denitrification, enhanced phosphorus removal, and anaerobic digestion. | |
| 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. | | | | | 3.1 Apply kinetics and basic chemostat theory to determine microbial growth rates, biomass yield, and substrate concentration and removal rate. | |
| 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 | |
| 4. Demonstrate advanced skills in performing literature searches in undertaking an in-depth case study of an environmental issue, and presenting a critical appraisal. | | | | | 4.1 Critically analyze relevant journal articles and investigate industrial application of the above concepts. | |
| 4.2 Appreciate the scientific, ethical and/or social issues associated with certain applications of biotechnology for alleviating the environmental concerns. | |
| 5. Justify the effectiveness of technologies based on bioobjects in obtaining products for environmental use | | | | | 5.1 Demonstrate the ability to use various instruments used in microbial biotechnology, their operating principles and application. | |
| 5.2 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 | | | | | | |
| **Postrequisites** | Modern methods in biotechnology | | | | | | |
| **Learning Resources** | **Literature**  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**  **course policy** | | The academic policy of the course is determined by [the Academic Policy](https://univer.kaznu.kz/Content/instructions/%D0%90%D0%BA%D0%B0%D0%B4%D0%B5%D0%BC%D0%B8%D1%87%D0%B5%D1%81%D0%BA%D0%B0%D1%8F%20%D0%BF%D0%BE%D0%BB%D0%B8%D1%82%D0%B8%D0%BA%D0%B0.pdf) and [the Policy of Academic Integrity of Al-Farabi Kazakh National University .](https://univer.kaznu.kz/Content/instructions/%D0%9F%D0%BE%D0%BB%D0%B8%D1%82%D0%B8%D0%BA%D0%B0%20%D0%B0%D0%BA%D0%B0%D0%B4%D0%B5%D0%BC%D0%B8%D1%87%D0%B5%D1%81%D0%BA%D0%BE%D0%B9%20%D1%87%D0%B5%D1%81%D1%82%D0%BD%D0%BE%D1%81%D1%82%D0%B8.pdf)  Documents are available on the main page of IS Univer .  **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 andassignments.  **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.  **Аcademic 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.  Compliance with academic honesty during the period of theoretical training and at exams, in addition to the main policies, is regulated by [the "Rules for the final control"](https://univer.kaznu.kz/Content/instructions/%D0%9F%D1%80%D0%B0%D0%B2%D0%B8%D0%BB%D0%B0%20%D0%BF%D1%80%D0%BE%D0%B2%D0%B5%D0%B4%D0%B5%D0%BD%D0%B8%D1%8F%20%D0%B8%D1%82%D0%BE%D0%B3%D0%BE%D0%B2%D0%BE%D0%B3%D0%BE%20%D0%BA%D0%BE%D0%BD%D1%82%D1%80%D0%BE%D0%BB%D1%8F%20%D0%9B%D0%AD%D0%A1%202022-2023%20%D1%83%D1%87%D0%B3%D0%BE%D0%B4%20%D1%80%D1%83%D1%81%D1%8F%D0%B7%D1%8B%D0%BA%D0%B5.pdf) , ["Instructions for the final control of the autumn / spring semester of the current academic year"](https://univer.kaznu.kz/Content/instructions/%D0%98%D0%BD%D1%81%D1%82%D1%80%D1%83%D0%BA%D1%86%D0%B8%D1%8F%20%D0%B4%D0%BB%D1%8F%20%D0%B8%D1%82%D0%BE%D0%B3%D0%BE%D0%B2%D0%BE%D0%B3%D0%BE%20%D0%BA%D0%BE%D0%BD%D1%82%D1%80%D0%BE%D0%BB%D1%8F%20%D0%B2%D0%B5%D1%81%D0%B5%D0%BD%D0%BD%D0%B5%D0%B3%D0%BE%20%D1%81%D0%B5%D0%BC%D0%B5%D1%81%D1%82%D1%80%D0%B0%202022-2023.pdf) , "Regulations on checking students' text documents for borrowings".  Documents are available on the main page of IS Univer .  **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.  All students, especially those with disabilities, can receive counseling assistance by phone / e- mail [A.Yernazarova@kaznu.edu.kz](mailto:A.Yernazarova@kaznu.edu.kz) or via video link in MS Teams *https://teams.microsoft.com/l/team/19%3aBmOi2n65yXV5PkSEKG8-WRNrr3L9x06J7l-JfKAvcHI1%40thread.tacv2/conversations?groupId=b05b0f65-00e6-4643-863f-24d4b45481f1&tenantId=b0ab71a5-75b1-4d65-81f7-f479b4978d7b.*  **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.  **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. | | | | |
| **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** | **Assessment according to the traditional system** | **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.  **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.  **Summative assessment** -type of assessment, which is carried out upon completion of the study of the section in accordance 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. | |
| A | 4.0 \_ | | 95-100 | Great |
| A- | 3.67 | | 90-94 |
| B+ | 3.33 | | 85-89 | Fine |
| B | 3.0 | | 80-84 | **Formative and summative assessment** | **Points % content** |
| B- | 2.67 | | 75-79 | Activity at lectures | 5 |
| C+ | 2.33 | | 70-74 | Work in practical classes | 30 |
| C | 2.0 | | 65-69 | Satisfactorily | Work in laboratory classes | 30 |
| C- | 1.67 | | 60-64 | Independent work | 25 |
| D+ | 1.33 | | 55-59 | Unsatisfactory | Final control (exam) | 20 |
| D | 1.0 | | 50-54 | TOTAL | 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 Use of bioobjects in solving environmental problems**  **.** | | | |
| **1** | **L 1.** Introduction to Environmental Biotechnology. Global Environmental problems | 2 |  |
| **PC 1.** Global Environmental problems | 2 | 2 |
| **LC 1.** General safety rules. Equipment and technique | 2 | 2 |
| **2** | **L 2.** The Role of Plants in Environmental Biotechnology. Phytoremediation of polluted land and soil. Phytoremediation of polluted water | 2 |  |
| **PC 2.** Phytoremediation technologies and their uses | 2 | 2 |
| **LC 2.** Isolation of algae from wastewater | 2 | 2 |
| **IWST 1.** Consultations on the implementation of **IWS 1** |  |  |
| **3** | **L 3.** Phytoremediation of polluted air | 2 |  |
| **PC 2.** Hydroponics: the soil-less sustainable agriculture | 2 | 2 |
| **LC 3.** Characterization of of algae from wastewater | 2 | 2 |
| **IWS 1.** Local Environmental Problems of my hometown (Project) |  |  |
| **4** | **L 4.** Environmental biotechnology providing the tool for using beneficial microbes. | 2 |  |
| **PC 4.** Microbial remediation of contaminated lands and water | 2 | 2 |
| **LC 4.** Isolation and Characterization of Bacteria from Crude Petroleum Oil Contaminated Soil | 2 | 2 |
| **5** | **L 5.** Wastewater treatment | 2 |  |
| **PC 5.** Microorganisms in wastewater treatment | 2 | 2 |
| **LC 5.** Isolation and Characterization of Bacteria from Crude Petroleum Oil Contaminated Soil | 2 | 2 |
| **IWST 2.** Consultations on the implementation of midterm control |  |  |
| **6** | **L 6.** Solid Waste Management | 2 |  |
| **PC 6.** Microbial Composting of Solid Wastes | 2 | 2 |
| **LC 6.** Isolation of Bacteria from solid wastes | 2 | 2 |
| **IWS 2.** Bioremediation of Heavy Metals |  |  |
| **7** | **L 7.** Biotransformation of pesticides | 2 |  |
| **PC 7.** Biotransformation of pesticides by microorganisms | 2 | 2 |
| **LC 7.** Characterization of Bacteria from solid wastes | 2 | 2 |
| **IWST 3.** Consultations on the implementation of |  |  |
| **Midterm control 1** | | | **100** |
| **8** | **L 8.** Vermiculture in Environmental Biotechnology | 2 |  |
| **PC 8.** Vermifiltration of Wastewater by Earthworms | 2 | 2 |
| **LC 8.** Earthworms as an indicator of soil contamination | 2 | 2 |
| **IWST 4.** Consultations on the implementation of **IWS 3** |  |  |
| **9** | **L 9.** Vermiremediation of Polluted Lands | 2 |  |
| **PC 9.** Vermiremediation of Polluted Lands by earthworms | 2 | 2 |
| **LC 9.** Earthworms as an indicator of soil contamination | 2 | 2 |
| **IWS 3.** Bioremediation of Radioactive Waste |  |  |
| **MODULE 2 The effectiveness of technologies based on bioobjects in obtaining products for environmental use** | | | |
| **10** | **L 10.** Renewable and nonrenewable energy resources: Bioenergy and biofuels | 2 |  |
| **PC 10.** Renewable alternatives to fossil fuel | 2 | 2 |
| **LC 10.** Cultivation of microalgae – the producer of biofuel | 2 | 2 |
| **IWST 5.** Consultation on the implementation of **IWS 4** |  |  |
|  |  |  |
| **11** | **L 11.** Microbial leaching and biomining | 2 |  |
| **PC 11.** Microorganisms in biomining processes | 2 | 2 |
| **LC 11.** Characterization of microalgae – the producer of biofuel | 2 | 2 |
| **12** | **L12.** Environmental Monitoring | 2 |  |
| **PC 12.** Indicators of Water Quality | 2 | 2 |
| **LC 12.** Cultivation of microorganisms using as a bioindicator | 2 | 2 |
| **13** | **L 13.** Biopesticides and Biofertilizers | 2 |  |
| **PC 13.** Bacterial pesticides and fertilizers | 2 | 2 |
| **LC 13.** Characterization of microorganisms using as a bioindicator | 2 | 2 |
|  | **IWS 4** Immobilization of Cells Application in Environmental Biotech |  |  |
| **14** | **L 14.** Bioplastics: A Green Approach Toward Sustainable Environment | 2 |  |
| **PC 14.** Benefits of bioplastics | 2 | 2 |
| **LC 14.** Cultivation of microorganisms producing polymers | 2 | 2 |
| **15** | **L 15.** Microbial enhanced oil recovery | 2 |  |
| **PC 15.** Metabolites of microorganisms useful for enhanced oil recovery | 2 | 2 |
| **LC 15.** Characterization of microorganisms producing polymers | 2 | 2 |
| **IWST 5.** Consultation on the implementation of the exam |  |  |
| **Midterm control 2** | | | **100** |
| **Final control (exam)** | | | **100** |
| **TOTAL for course** | | | **100** |

**Dean \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Head of Department \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Lecturer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**