

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Ecobiotechnology and Biodiversity

APPROVED

Faculty of Plant Protection, Biotechnologies and Ecology

June 19, 2026

WORK PROGRAM OF THE ACADEMIC DISCIPLINE

ENVIRONMENTAL BIOTECHNOLOGY

- **Field of Study:** E "Natural Sciences, Mathematics and Statistics"
- **Specialty:** E1 "Biology and Biochemistry"
- **Educational Program:** Biotechnology of Biological Systems
- **Faculty:** Faculty of Plant Protection, Biotechnologies and Ecology
- **Developers:** Doctor of Agricultural Sciences, Professor Kolomiiets Yu.V.

Kyiv - 2026

Description of the Academic Discipline

"Environmental Biotechnology"

The academic discipline "Modern Biotechnological Research Methods" is an elective component of the educational and scientific program "Biotechnology of Biological Systems" for the preparation of applicants for the third (educational and scientific) level of higher education in specialty E1 Biology and Biochemistry. The discipline aims to form deep theoretical knowledge and practical skills in using biotechnological methods for environmental protection; biotechnological foundations of bacterial preparations production; source material for the selection of plants and microorganisms; the impact of environmental factors on the genotype of plants and microorganisms to achieve their maximum productivity; methods for detecting antagonistic fungi and hyperparasites of phytopathogens; determination of the biological activity of a bacterial preparation.

Field of study, specialty, educational program, educational degree

Educational Degree	Doctor of Philosophy (PhD)
Specialty	E1 Biology and Biochemistry
Educational Program	Biotechnology of Biological Systems

Characteristics of the academic discipline

Type	Elective
Total number of hours	150
Number of ECTS credits	5
Number of content modules	2
Course project (work) (if applicable)	—
Form of control	Exam

Indicators of the academic discipline for full-time and part-time forms of higher education

Form of higher education	Full-time	Part-time
Course (year of preparation)	1	1
Semester	2	2
Lectures	15 hours	15 hours
Practical, seminar classes	— hours	— hours
Laboratory classes	30 hours	30 hours
Independent work	105 hours	105 hours
Number of weekly classroom hours for full-time form	3 hours	3 hours

1. Goal, Competences, and Program Learning Outcomes of the Academic Discipline

The **goal** of the academic discipline is to develop systematic theoretical knowledge and practical skills in conducting scientific research, and solving problems in the applied use of biotechnological methods and technologies.

Acquisition of Competences:

- **Integral competence:** Ability to solve complex problems in the field of biology during research and innovation activities, which involves rethinking existing and creating new holistic knowledge, mastering the methodology of scientific and scientific-pedagogical activity, conducting independent scientific research, the results of which have scientific novelty, theoretical and practical significance, and are integrated into the global scientific space through publications.
- **General competences:**

- **GC01.** Knowledge and understanding of the subject area and understanding of professional activity.
- **Special (professional) competences (SC):**
 - **SC02.** Ability to orally and in writing present and discuss the results of scientific research and/or innovative developments in Ukrainian and English, to understand English-language scientific texts in the direction of research.
 - **SC05.** Ability to identify, formulate, and solve research problems in the field of biology, evaluate and ensure the quality of the research being conducted.
 - **SC09.** Ability to develop new and improve existing biotechnologies based on the understanding of modern scientific facts, concepts, theories, principles, and methods of biotechnology.

Program Learning Outcomes:

- **PLO01.** Possess conceptual and methodological knowledge in biology and at the borderline of subject areas, as well as research skills sufficient to conduct scientific and applied research at the level of world achievements in the relevant field, obtain new knowledge and/or implement innovations.
- **PLO03.** Formulate and test hypotheses; use appropriate evidence to substantiate conclusions, in particular, the results of literature source analysis, experimental research (surveys, observations, experiment), and mathematical and/or computer modeling.
- **PLO04.** Develop and study conceptual, mathematical, and computer models of processes and systems, effectively use them to obtain new knowledge and/or create innovative products in biology and related interdisciplinary fields.
- **PLO05.** Plan and perform experimental and/or theoretical research in biology and related interdisciplinary fields using modern tools, critically analyze the results of one's own research and the results of other researchers in the context of the entire complex of modern knowledge regarding the problem under study.
- **PLO06.** Apply modern tools and technologies for searching, processing, and analyzing information, in particular, statistical methods for analyzing large volumes and/or complex structures data, specialized databases, and information systems.
- **PLO07.** Develop and implement scientific and/or innovative projects that make it possible to rethink existing and create new holistic knowledge and/or professional practice and solve important theoretical and practical problems of biology in compliance with academic ethics norms and taking into account social, economic, environmental, and legal aspects.
- **PLO09.** Have advanced knowledge of biotechnology, research skills sufficient to conduct scientific and applied research at the level of biological systems.

2. Program and Structure of the Academic Discipline

Names of content modules and topics	Weeks	Full-time form (Hours)				Part-time form (Hours)			
		Total	Lec	Lab	Ind	Total	Lec	Lab	Ind
Module 1	Methods of modern cellular biotechnologies								
Topic 1. Biotechnology in agriculture	1-2	20	2	4	14	20	2	4	14
Topic 2. Biotechnology and biological plant protection. Biotechnology in the fight against plant diseases	3-4	20	2	4	14	20	2	4	14
Topic 3. Infectious plant diseases and control measures. Biotechnology in the fight against insect pests of plants	5-6	20	2	4	14	20	2	4	14
Topic 4. Cellular biotechnologies in agricultural science and practice	7-8	20	2	4	14	20	2	4	14
Total for Module 1		80	8	16	56	80	8	16	56
Module 2	Modern methods of industrial biotechnology								
Topic 5. Utilization of organic waste and obtaining new products	9-10	20	2	4	14	20	2	4	14
Topic 6. Biotechnology and agricultural microbiology	11-12	20	2	4	14	20	2	4	14

Topic 7. Plant immunity and environmentally safe disease control measures	13-14	20	2	4	14	20	2	4	14
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Topic 8. Disruption of natural regulation mechanisms in agrobiocenoses	15	10	1	2	7	10	1	2	7
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Total for Module 2		70	7	14	49	70	7	14	49
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Total Hours		150	15	30	105	150	15	30	105
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3. Lecture Topics

No.	Topic Name	Number of Hours
1	Biotechnology in agriculture	2
2	Biotechnology and biological plant protection. Biotechnology in the fight against plant diseases	2
3	Infectious plant diseases and control measures. Biotechnology in the fight against insect pests of plants	2
4	Cellular biotechnologies in agricultural science and practice	2
5	Utilization of organic waste and obtaining new products	2
6	Biotechnology and agricultural microbiology	2
7	Plant immunity and environmentally safe disease control measures	2
8	Disruption of natural regulation mechanisms in agrobiocenoses	1

4. Laboratory Class Topics

No.	Topic Name	Number of Hours
1	Methods for detecting biopreparation producers. Methods for selecting biopreparation producers. Methods for storing biopreparation producers	4

2	Biomethod for evaluating plant resistance against bacterial disease pathogens using cellular selection	4
3	Determination of plant antioxidant activity under the action of phytotoxic metabolites of pathogens	4
4	Studying the effect of fungicides on pathogens	4
5	Studying the effect of microbiological preparations on pathogens	4
6	Studying the influence of natural inducers in forming plant resistance to pathogens	4
7	Studying the antagonistic activity of biologically active substances of bacteria of the genus <i>Bacillus</i>	4
8	Studying the cellulolytic activity of bacterial strains	2

5. Independent Work Topics

No.	Topic Name	Number of Hours
1	Biotechnology in agriculture	14
2	Biotechnology and biological plant protection. Biotechnology in the fight against plant diseases	14
3	Infectious plant diseases and control measures. Biotechnology in the fight against insect pests of plants	14
4	Cellular biotechnologies in agricultural science and practice	14
5	Utilization of organic waste and obtaining new products	14
6	Biotechnology and agricultural microbiology	14
7	Plant immunity and environmentally safe disease control measures	14
8	Disruption of natural regulation mechanisms in agrobiocenoses	7

6. Methods and Tools for Diagnosing Learning Outcomes:

- Oral or written questioning;
- Interview;

- Testing;
- Defense of laboratory works;
- Peer assessment, self-assessment.

7. Teaching Methods:

- Problem-based learning method;
- Practice-oriented learning method;
- Case method;
- Project-based learning method;
- Flipped classroom method, blended learning;
- Learning through research method;
- Educational discussions and debates method;
- Teamwork method, brainstorming.

8. Evaluation of Learning Outcomes

Evaluation of the higher education applicant's knowledge is carried out on a 100-point scale and is converted into a national grade according to the current "Regulations on Exams and Credits at NUBiP of Ukraine".

8.1. Distribution of Points by Types of Academic Activity

Type of Academic Activity	Learning Outcomes	Evaluation
Module 1		
Laboratory work 1 Laboratory work 2	PLO01, PLO03, PLO04, PLO05, PLO06, PLO07, PLO09 (<i>Full texts of PLOs are identical to Section 1</i>)	10 10
Laboratory work 3		10
Laboratory work 4		10
Independent work 1		30
Module control work 1		30
Total for Module 1		100
Module 2		

Laboratory work 1	Laboratory work 2	Laboratory work 3	Laboratory work 4	PLO01, PLO03, PLO04, PLO05, PLO06, PLO07, PLO09 (<i>Full texts of PLOs are identical to Section 1</i>)	10	10	10	10
Independent work 2					30			
Module control work 2					30			
Total for Module 2					100			
Academic Work					$(M1+M2)/2 \times 0.7 \leq 70$			
Exam/Credit					30			
Total for the Course					(Academic Work + Exam) 100			

8.2. Grading Scale for Higher Education Applicants' Knowledge

Rating of the higher education applicant, points	Grade according to the national system (exams/credits)
90-100	Excellent
74-89	Good
60-73	Satisfactory
0-59	Unsatisfactory

8.3. Evaluation Policy

- **Policy on deadlines and retakes:** EXAMPLE: works submitted in violation of deadlines without valid reasons are evaluated with a lower grade. Retaking modules takes place with the permission of the lecturer in the presence of valid reasons (for example, sick leave).
- **Policy on academic integrity:** EXAMPLE: cheating during control works and exams is prohibited (including the use of mobile devices). Courseworks and essays must have correct textual references to the literature used.
- **Attendance policy:** EXAMPLE: class attendance is mandatory. For objective reasons (for example, illness, international internship), training can take place individually (in online form as agreed with the dean of the faculty).

9. Educational and Methodological Support:

- Electronic training course of the academic discipline (on the training portal of NUBiP of Ukraine eLearn - nubip.edu.ua)
- Kliachenko O.L., Kolomiiets Yu.V., Yanse L.A., Postoienko V.O. *Environmental Biotechnology and Bioengineering: textbook. Part 1: Bioengineering*. Kyiv: Agrarna Nauka, 2020. 136 p.
- Kliachenko O.L., Kolomiiets Yu.V., Yanse L.A., Postoienko V.O. *Environmental Biotechnology and Bioengineering: textbook. Part 2: Cellular Technologies*. Kyiv: Agrarna Nauka, 2021. 276 p.
- Kliachenko O.L., Kolomiiets Yu.V., Yanse L.A., Postoienko V.O. *Environmental Biotechnology and Bioengineering: textbook. Part 3: Industrial and Environmental Biotechnology*. Kyiv: Agrarna Nauka, 2021. 340 p.
- Kolomiiets Yu., Klyachenko O. *Biotechnology*. K.: Yamchinskiy O.V. NPE, 2021. 260 p.
- Kolomiiets Yu., Klyachenko O., Subin O. *Biotechnology*. K.: Comprint, 2022. 420 p.
- Kliachenko O.L., Kolomiiets Yu.V., Subin O.V. *Plant Biotechnology. Study guide*. Kyiv: Editorial and Publishing Department of NUBiP of Ukraine. 2023. 352 p.

10. Recommended Sources of Information:

1. Rudyshyn S.D. *Basics of Plant Biotechnology*. Vinnytsia, 2022. 272 p.
2. Rudyshyn S.D. *Plant Biotechnology*. Sumy: Korpunkt, 2024. – 200 p.
3. Butenko Ye.Yu. *Basics of Plant Biotechnology*. Sumy: SNAU, 2022.
4. Butsenko L.M., Pyroh T.P. *Biotechnological Methods of Plant Protection: textbook*. K.: Lira-K Publishing House, 2018. 346 p.
5. *Environmental Biotechnology: study guide: in 2 books. Book I*. O.V. Shved, R.O. Petrina, O.Z. Komarovska-Porokhniavets, V.P. Novikov. Lviv: Lviv Polytechnic Publishing House, 2018. 424 p.
6. *Environmental Biotechnology: study guide: in 2 books. Book II*. O.V. Shved, R.O. Petrina, O.Z. Komarovska-Porokhniavets, V.P. Novikov. Lviv: Lviv Polytechnic Publishing House, 2018. 368 p.
7. Vernadsky National Library of Ukraine. Access mode: www.nbuv.gov.ua
8. National Parliamentary Library of Ukraine. Access mode: www.nplu.kiev.ua
9. Scientific Library of the University. Access mode: nubip.edu.ua
10. Electronic Library of Ukraine. Access mode: www.ELibUkr.org
11. Electronic libraries of higher education institutions of Ukraine "For everyone who studies".

12. Large library of educational and methodological literature. Access mode:
<http://metodportal.net>
13. Scientific Electronic Library. (Books, textbooks, dissertations, author's abstracts). Access mode: nbuv.gov.ua