NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department ecobiotechnology and biodiversity

APPROVED
Faculty of Plant Protection, Biotechnology and Ecology
May 21, 2026

CURRICULUM OF ACADEMIC DISCIPLINE "MICROBIAL BIOTECHNOLOGY AND VIROLOGY (MICROBIAL BIOTECHNOLOGY)"

Area of knowledge 16 "Chemical and bioengineering"
Specialty 162 "Biotechnology and bioengineering"
Academic program "Biotechnology and bioengineering"
Faculty plant protection, biotechnology and ecology
Developed by: head of ecobiotechnology and biodiversity department, PhD, Associate professor Olena Kvasko

Kyiv – 2026

Description of the discipline
"Microbial biotechnology and virology (Microbial biotechnology)"

"Microbial biotechnology and virology (Microbial biotechnology)" is compulsory discipline.

Aim to form a system of knowledge and skills for students to ensure their professional activity, in particular, about the morphology, ultrastructure and genetics of prokaryotic cells, features of their metabolism, reproduction, distribution, participation in the cycle of basic biogenic elements in nature, the ability to affect plants and cause diseases; methods of diagnosis and prevention of mycoplasmosis and bacterial plant diseases.

Objectives to acquaint students with the technique and basic principles of evaluation of microbiological research results; to develop some practical skills in laboratory diagnosis of infections caused by microorganisms; to study microorganisms as the main objects of biotechnological research.

Academic degree, specialty, academic programme		
Academic degree	*bachelor's*	
Specialty	*162 «Biotechnology and bioengineering»*	
Academic programme	*Biotechnologies and bioengineering*	
Characteristics of the discipline		
Type	compulsory	
Total number of hours	75	
Number of ECTS credits	2,5	
Number of modules	2	
Course project (work) (if any)		
Form of assessment	*exam*	
Indicators of the discipline for full-time and part-time forms of university study		
	Full-time	Part-time
Year of study	2	
Semester	3	
Lectures	*15 hours*	*hours*
Practical classes and seminars		*hours*
Laboratory classes	*30 hours*	*hours*
Self-study	*30 hours*	*hours*
Number of hours per week for full-time students	*3 hours*	

1. Aim, objectives, competences and expected learning outcomes of the discipline

Aim to form a system of knowledge and skills for students to ensure their professional activity, in particular, about the morphology, ultrastructure and genetics of prokaryotic cells, features of their metabolism, reproduction, distribution, participation in the cycle of basic biogenic elements in nature, the ability to affect plants and cause diseases; methods of diagnosis and prevention of mycoplasmosis and bacterial plant diseases.

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Acquisition of competences:

Integral competence (IC): ability to solve complex specialised tasks and practical problems characterised by complexity and uncertainty of conditions in biotechnology and bioengineering, or in the process of learning that involves the application of theories and methods of biotechnology and bioengineering.

General competences (GC):

C01. Ability to apply knowledge in practical situations.

C03. Ability to communicate in a foreign language.

C05. Ability to learn and master modern knowledge.

C06. Skills to carry out safe activities.

C09. Ability to preserve and enhance moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, to use various types and forms of physical activity for active recreation and healthy lifestyle.

Special (professional) competences (SC):

C13. Ability to work with biological agents used in biotechnological processes (microorganisms, fungi, plants, animals, viruses, their individual components).

C25. Development of technologies for the creation of cell and tissue culture as biological systems, modification of the genome of plants and microorganisms to improve their quality characteristics and properties, expansion of the genetic diversity of the source material for breeding, labelling, certification and examination, theoretical justification of research areas.

Expected Learning Outcomes (ELO):

ELO 03. To be able to calculate the composition of nutrient media, determine the features of their preparation and sterilisation, to control the quality of raw materials and finished products based on knowledge of the physical and chemical properties of organic and inorganic substances.

ELO 07. To be able to apply knowledge of the composition and structure of

cells of various biological agents to determine the optimal conditions for cultivation and the potential for the use of the studied cells in biotechnology.

ELO 08. To be able to isolate from natural substrates and identify microorganisms of different systematic groups. Determine the morphological, cultural, physiological and biochemical properties of various biological agents.

ELO 09. Be able to prepare basic nutrient media for the cultivation of various biological agents. Evaluate the growth characteristics of biological agents on media of different composition.

ELO 10. To be able to conduct experimental studies to determine the influence of physicochemical and biological factors of the environment on the vital activity of cells of living organisms.

ELO 11. To be able to carry out basic genetic and cytological studies to improve and increase the biosynthetic capacity of biological agents, taking into account the principles of biosafety, biosecurity and bioethics (induced mutagenesis using physical and chemical mutagenic factors, selection and accumulation of auxotrophic mutants, transfer of genetic information, etc.)

ELO 12. Using microbiological, chemical, physical, physicochemical and biochemical methods, be able to carry out chemical control (determination of the concentration of disinfectant solutions, titration agents, concentration of culture medium components, etc.), technological control (concentration of carbon and nitrogen sources in the culture liquid during the process; concentration of the target product); microbiological control (determination of the microbiological purity of culture media after sterilisation, microbiological purity of a biological agent, etc).

ELO 13. To be able to carry out a feasibility study for the production of biotechnological products for various purposes (determination of the need for the target product and calculation of production capacity).

ELO 14. To be able to justify the choice of biological agent, composition of the culture medium and method of cultivation, necessary auxiliary works and the main stages of the technological process.

ELO 20. To be able to calculate the main criteria for evaluating the effectiveness of a biotechnological process (growth parameters of biological agents, rate of synthesis of the target product, synthesis ability of biological agents, economic coefficient, yield of the target product from the substrate, productivity, cost of the culture medium, etc.).

ELO 22. To be able to take into account social, environmental, ethical, economic aspects, occupational health and safety requirements, industrial sanitation and fire safety in the formation of technical solutions. Be able to use different types and forms of physical activity for active recreation and healthy lifestyle.

ELO 25. To be able to use methods of microscopic research, technologies of monoclonal antibodies, antigens, immunodiagnostics, identification of antigens in plant tissues, isozymes and reserve proteins, DNA markers, basic principles of PCR, DNA probes, molecular genetic markers.

2. Programme and structure of the discipline for:

- full-time (part-time) form of study

Modules and topics	Number of hours												
	full-time							part-time					
	weeks	total	including					in total	including				
			l	p	lab	ind	s.st		l	p	lab	ind	s.st
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Module 1: Microorganisms as objects of biotechnological research													
Topic 1: Introduction. Stages of formation and development of microbiology	2	12	2		4		2						
Topic 2. Morphology and systematics of of microorganisms	3	18	2		6		2						
Topic 3. Cellular organisation of microorganisms. Growth and reproduction of bacteria	2	16	2		4		2						
Topic 4.Microbial genetics	1	10	2		2		2						
Total for module 1	30		8		14		8						
Module 2. ***Ecology and metabolism of microorganisms***													
Topic 1. Metabolism of microorganisms	2	16	2		4		5						
Topic 2. Participation of microorganisms in the carbon cycle in nature. Processes of of fermentation	2	16	2		4		5						
Topic 3. Microorganisms and the microorganisms and the environment.	1	16	2		2		5						
Topic 4. Ecology of of microorganisms	2	12	1		4		7						
Total for module 2	45		7		16		22						
Total hours	75		15		30		69						
Course project (work) _____ (if included in the curriculum)	82		-	-	-		-		-	-	-		-
Total hours	157												

3. Topics of laboratory (practical, seminar) classes

№	Topic title	Hours
1	Safety, organisation, equipment and rules of work in the microbiological laboratory.	2
2	Microscope and rules for working with it. Microscopy technique.	2
3	Study of bacterial morphology	2
4	Morphology of moulds, yeasts and actinomycetes	4
5	Methods of microscopic examination of microorganisms. Preparation of live microbial cell preparations	2
6	Preparation of fixed preparations of microorganisms: Gram staining. Working with an immersion lens	2
7	DNA extraction	2
8	Sterilisation methods	2
9	Culture media for microorganisms and their types. Production of the main types of culture media	2
10	Preparation of the test material for sowing	2
11	Methods of cultivation of microorganisms (for example soil suspension)	2
12	Accounting for the number of soil microorganisms	2
13	Isolation of pure cultures of aerobic bacteria	2
14	Study of the cultural characteristics of microorganisms	2

4. Topics for self-study

№ s/n	Topic title	Hours
1	Use of microorganisms in biotechnology	2
2	Variety of types of microbial nutrition.	2
3	Growth of bacteria in batch and continuous modes.	2
4	Energy processes in microorganisms. The main metabolic pathways of carbohydrate metabolism.	2
5	Biosynthetic processes in microorganisms. Assimilation of CO2 by autotrophs and heterotrophs.	2
6	Regulation of microbial metabolism.	2
7	Genetic apparatus of bacteria. Genetic maps. Phenotypic and genotypic variability of prokaryotes.	2
8	Genetic recombination in bacteria: transformation, conjugation, transduction. Practical application of achievements in microbial genetics.	2
9	Microorganisms as components of ecosystems. Air microflora and methods of its study. Water microflora, drinking and	2

	wastewater treatment. Soil microflora and its role in the formation of humus.	
10	Microorganisms and higher plants (rhizosphere, mycorrhiza, epiphytic microorganisms).	2
11	Fermentation and its types. Aerobic processes and their importance	2
12	Production of fermented milk products and cheeses. Microorganisms - pests of butter and margarine production. Microbiological control of production of milk and fermented milk products.	2
13	Influence of environmental factors on the development of microorganisms in milk and dairy products.	2
14	Microbiological aspects of baking.	2
15	Characteristics of the most important for the industry of the most important yeast genera for the industry and their use.	2

5. Tools for assessing expected learning outcomes:

- exam;
- module tests;
- presentation of laboratory and practical works.

6. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory, practical classes);
- visual method (illustration, demonstration);
- processing learning resources (note-taking, summarising, reviewing, writing an abstract);
- video method (remote, multimedia, web-based, etc.);
- self-study (completing assignments);
- individual research work.

7. Assessment methods:

- exam;
- oral or written assessment;
- module tests;
- team projects;
- presentation of laboratory and practical works;
- presentations at academic events.

8. Distribution of points received by students

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades according to Table 1 of the current *Exam and Credit Regulations at NULES of Ukraine*.

Student's rating, points	National grading of exams and credits	
	exams	credits
90-100	excellent	pass
74-89	good	
60-73	satisfactorily	
0-59	unsatisfactorily	fail

To determine a student's rating in the discipline $\mathbf{R_{DIS}}$ (up to 100 points), the received assessment rating $\mathbf{R_A}$ (up to 30 points) is added to the academic performance raiting $\mathbf{R_{AP}}$ (up to 70 points): $\mathbf{R_{DIS}} = \mathbf{R_{AP}} + \mathbf{R_A}$.

9. Teaching and learning aids

- e-learning course of the discipline (*https://elearn.nubip.edu.ua)*;
- lectures and presentations (in electronic form);
- textbooks, manuals, tutorials;
- guidelines for studying a discipline by full-time and part-time students;
- internship programmes of the discipline (if included in the curriculum).

10. Recommended sources of information

1. Microbiology with the basics of virology: Textbook. K.: Lybid, 2001. 312 p.

2. Hudz S.P. Microbiology: Textbook: / S.P. Hudz, S.O. Hnatush, I.S. Bilinska - Lviv: Ivan Franko National University of Lviv, 2009. 360 p.

3. Iutynska H.O. Soil microbiology: Study guide. - K.: Aristey, 2006. - 284 p.

4. Microbiology: Textbook / M.G. Serhiychuk, V.K. Pozur, T.M. Furzikova and others - Kyiv: Kyiv University Publishing and Printing Centre, 2008. 541 p.

5. Pirog T.P. General microbiology: Textbook. - K.: NUHT, 2004. - 471 c.

6. Ibatullina F.J., Kozlovska G.V., Melnyk M.V., Skibitsky V.G.. Microbiology: Textbook / Edited by V.G. Skibitsky - K.: , 2015. 475 p.

7. Kharchenko S.M. Microbiology: Textbook. -K.: Selhozosvita, 1994. - 352 c.

8. Yastremska L.S. General microbiology and virology: a textbook / L.S. Yastremska, I.M. Malynovska - K.: NAU, 2017. 232 p.

9. Klymniuk S.I. Practical microbiology: A manual / S.I. Klymniuk, I.O. Sytnyk, M.S. Tvorako, V.P. Shirokobokov - Ternopil: Ukrmedkniga, 2004. 440 p.

10. Shatrovsky O.G. Lecture notes on the discipline 'Microbiology' (for 1st year full-time and 2nd year part-time students of the educational qualification level of bachelor of the training direction 6.140101 GOT) / Kharkiv National Academy of Municipal Economy; compiled by O. Shatrovsky - Kharkiv: KhNAMG, 2011. 134 p.

11. Yavorska H.V. Industrial microbiology: a textbook / H.V. Yavorska, S.P. Hudz, S.O. Hnatush - Lviv: Ivan Franko National University of Lviv Publishing Centre, 2008. 256 p.