



SYLLABUS OF AN ACADEMIC DISCIPLINE
«Microbial biotechnology and virology (Microbial biotechnology)»

Degree of higher education - Bachelor
Specialization 162 «Biotechnology and bioengineering »
Educational programme «Biotechnology and bioengineering »
Academic year 2 , semester 3
Form of study compulsory (full-time)
Number of ECTS credits 4
Language of instruction English

Lecturer of the course
Lecturer's contact information of the lecturer (e-mail)
URL of the e-learning course on the NULES elearning portal

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ACADEMIC DISCIPLINE DESCRIPTION

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.

Competences of the discipline:

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.

ACADEMIC DISCIPLINE STRUCTURE

Topic	Hours (lecture/ laboratory)	Learning outcomes	Tasks	Assessment
Module 1: Microorganisms as objects of biotechnological research				
Topic 1. Introduction. Stages of formation and development of microbiology	2/4	To know: the subject and objectives of microbiology; its place and role in modern biology; the main features of microorganisms and their distribution in nature; the history of microbiology; the conditions that should be in the microbiological laboratory, safety precautions when working in the laboratory; the structure and rules for using a microscope with immersion and dry lenses.	Working in laboratory work: 'Safety, organisation, equipment and rules of work in a microbiological laboratory', 'Microscope and rules of work with it. Microscopy technique'.	Tests, self-control of knowledge, oral questioning.
Topic 2. Morphology and systematics of microorganisms	2/6	Know: the morphology of bacteria, their main forms; morphological features of other groups of microorganisms (fungi, actinomycetes, yeasts, viruses, rickettsia, bacteriophages); morphological features of myco-, mixo- and coryne-bacteria; morphology of eukaryotes (fungi, algae, lichens, protozoa); systematics of microorganisms.	Submission of laboratory works: 'Study of bacterial morphology', 'Morphology of moulds, yeasts and actinomycetes'.	tests, individual tasks, oral questioning, self-control of knowledge.
Topic 3. Cellular organisation of microorganisms. Growth and reproduction of bacteria	2/4	To know: the structure of prokaryotic and eukaryotic cells, the peculiarities of bacterial reproduction and the growth of bacterial populations.	Passing laboratory work: 'Methods of microscopic examination of	tests, individual tasks, oral questioning self-control of knowledge.

		Be able to: make a fixed stained slide, a live 'crushed drop' slide, fix a smear, work with an immersion microscope.	microorganisms. Preparation of live microbial cell preparations', 'Preparation of fixed microbial preparations: Gram staining. Work with an immersion lens'.	
Topic 4. Microbial genetics	2/2	To know: the organisation of genetic material in bacteria; forms of microbial variability; features of genetic recombination and the practical importance of bacterial genetics, stages of DNA isolation and the PCR mechanism.	Passing the laboratory work: 'Extraction of DNA'	tests, individual tasks, oral questioning.
Total from educational work of module 1				70
Module 1		Assessment of the results of learning knowledge and skills in accordance with the topics included in module 1	Test	30
Total for Module 1				100
Module 2. Ecology and metabolism of microorganisms				
Topic 1. Metabolism of microorganisms	2/4	Know: chemical composition of microbial cells, organogenic and macro- and microelements, enzymes microorganisms, the state of microbial cells depending on the concentration of substances outside and inside the cell, methods of nutrition of organisms, the mechanism of nutrient supply to the microbial cell, metabolism of microorganisms, the	Passing laboratory work: 'Methods of Methods of sterilisation', 'Nutrient media for cultivation of microorganisms and their types.' Preparation of the main types of culture media'.	tests, individual tasks, oral questioning, self-control of knowledge.

		relationship between chemical reactions of microbes, types of nutrition of microorganisms and energy metabolism, the concepts of aseptic, antiseptic, sterilisation, disinfection; methods of sterilisation, classification of culture media. Be able to: disinfect, flambé, use a dry heat oven and an autoclave, prepare materials for sterilisation, prepare the main types of culture media.		
Topic 2. Participation of microorganisms in the carbon cycle in nature. Processes of fermentation	2/4	Know: general information about the carbon cycle in nature and features of the processes of transformation of basic carbon compounds by microorganisms; processes of transformation of cellulose, hemicellulose, lignin, pectin substances, starch, chitin, lipids, hydrocarbons; processes of humus formation, glycolysis, fermentation (alcohol, lactic acid, butyric acid, acetic acid, etc.), features of microbiological seeding Be able to: prepare samples for analysis, make tenfold dilutions, perform microbiological seeding on beveled agar and in a column, on a Petri dish using basic methods.	Submission of laboratory work: 'Preparation of the test material for sowing', 'Methods of cultivation of microorganisms (on the example of soil suspension'	tests, individual tasks, oral questioning, self-control of knowledge.
Topic 3. Microorganisms and the environment.	2/2	Know: the main (chemical, physical and biological) environmental factors that affect microorganisms, the impact of environmental factors on the functioning of	Passing laboratory work: 'Accounting of soil microorganisms'	tests, individual tasks, oral surveys, self-control of knowledge.

		microorganisms; methods of accounting for soil microorganisms. Be able to: count the number of microorganisms on agar plates, using the bacterioscopic method and the method of fouling plates.		
Topic 4. Ecology of of microorganisms	1/4	To know: soil and air microflora; peculiarities of the relationship between microorganisms and plants. Be able to: isolate pure cultures of microorganisms and determine their purity, evaluate the cultural and morphological characteristics of microorganisms.	Submission of laboratory work: 'Isolation of pure cultures of aerobic bacteria', 'Study of the cultural characteristics of microorganisms'.	tests, individual tasks, oral questioning, self-control of knowledge.
Total from educational work of module 2				70
Module 1		Assessment of the results of learning knowledge and skills in accordance with the topics included in module 1	Test	30
Total for Module 1				100
Total for the semester				70
Exam				30
Total for course				100

ASSESSMENT POLICY

<i>Deadlines and exam retaking policy:</i>	Works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g. a sick leave). Assignments submitted after the deadline without valid reasons will be graded lower. Resetting of modules will be allowed with the permission from the lecturer and in the presence of valid reasons (e.g. medical reasons).
<i>Academic integrity policy:</i>	Cheating during tests and exams is strictly prohibited (including the use of mobile devices). Term papers and essays must contain correct citations for all sources used.
<i>Attendance policy:</i>	Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent) Class attendance is mandatory. In case of objective reasons (such as illness or international internships), individual learning may be allowed (in online format by the approval of the dean of the faculty).

SCALE OF ASSESSMENT OF STUDENT KNOWLEDGE

Student rating, points	National grade based on exam results	
	exams	credits
90-100	excellent	passed
74-89	good	
60-73	satisfactory	
0-59	unsatisfactory	not passed

RECOMMENDED SOURCES OF INFORMATION

1. Hudz S.P. Microbiology: Textbook: / S.P. Hudz, S.O. Hnatysh, 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.: Selхозosvita, 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. Hnatysh - Lviv: Ivan Franko National University of Lviv Publishing Centre, 2008. 256 p.