NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Ecobiotechnology and Biodiversity

"APPROVED"
Dean of the Faculty of Plant Protection,
of Biotechnology and Ecology
YULIA KOLOMIETS
"28" 05 2024

"APPROVED"
at the meeting of Department of
Ecobiotechnology and Biodiversity
Minutes № 5 "13" 05. 2024
Head of the Department
of Ecobiotechnology and Biodiversity
OLENA KVASKO

«REVIEWED"
Guarantor of the AP "Biotechnology and Bioengineering"
OLENA KVASKO

CURRICULUM OF ACADEMIC DISCIPLINE " INDUSTRIAL BIOTECHNOLOGY"

Field of knowledge 16 Chemical and bioengineering
Specialty 162 "Biotechnology and bioengineering"
Academic programme Biotechnology and bioengineering
Faculty of Plant rotection, Biotechnology and Ecology
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Description of the discipline "Industrial Biotechnology"

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	120	
Number of ECTS credits	4,0	
Number of modules	2	
Course project (work)	30	
Form of assessment	Exam	
Indicators of the discipline for full-time and part-time forms of university study		
	Full-time	Part-time
Course (year of study)	3	
Semester	6	
Lecture classes	45	
Practical, seminar classes	-	
Laboratory classes	45 h	
Self-study	30 h	
Individual assignments	-	
Number of weekly classroom hours for the full-time form of study	6,0 h	

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

"Industrial Biotechnology"

The aim of study of discipline is a capture to knowledge and abilities of cultivation of separate strains of industrial microorganisms students, by the methods of selection of biological agents for the receipt of separate products, government of cultivation of microorganisms, control of quality of the got product, directions of application of products of biotechnology, determination of them processes bases ecological safety, especially created on the basis of the genetically modified microorganisms. A course foresees preparation of bachelor and leans against knowledge of disciplines which form a specialist for different industries of national economy, including agroindustrial production.

An objectives to the course is making for the students of ability to manage the processes of cultivation of microorganism's pilot-scale by collection, working and analysis of information; experimental mastering of methods of work with different industrial microorganisms in the conditions of laboratory and during educational practices in research establishments and biochemical enterprises.

Acquisition of competences:

Integral Competence (IC): The ability to solve complex specialized tasks and practical problems characterized by complexity and uncertainty in biotechnology and bioengineering, or in a learning process involving the application of theories and methods of biotechnology and bioengineering.

General competences (GC):

К01. Ability to apply knowledge in practical situations

К05. Ability to learn and master modern knowledge

Special (professional, subject) competences (SC):

К13. Ability to work with biological agents used in biotechnological processes (microorganisms, fungi, plants, animals, viruses, their individual components).

К16. Consideration of the commercial and economic context in the design of biotechnological products for various purposes (industrial, food, pharmaceutical, agricultural, etc.).

К18. Ability to select and use appropriate equipment, tools and methods for the implementation and control of biotechnological products for various purposes.

К19. Ability to draw up technological schemes for the production of biotechnological products for various purposes.

К22. Ability to evaluate the effectiveness of the biotechnological process.

К24. Ability to comply with biosafety, biosecurity and bioethics requirements

Programme learning outcomes (PLOs):

PLO03. To be able to calculate the composition of nutrient media, determine the features of their preparation and sterilization, to control the quality of raw materials and finished products based on knowledge of the physical and chemical properties of organic and inorganic substances.

PLO04. To be able to apply the provisions of regulatory documents governing the procedure for product certification, production certification, requirements for the

organization of quality management systems at enterprises, rules for the preparation of technical documentation and technological process, based on the knowledge gained during practical training.

PLO08. Be able to isolate and identify microorganisms of different systematic groups from natural substrates. Determine the morphological, cultural, physiological and biochemical properties of various biological agents.

PLO09. 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.

PLO 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,)

PLO 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).

PLO 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.

PLO 16. Based on the knowledge gained during internships at enterprises and institutions, be able to make product calculations and calculations of technological equipment.

PLO 22. To be able to take into account social, environmental, ethical, economic aspects, labour protection, occupational health and safety and fire safety requirements when formulating technical solutions. Be able to use different types and forms of physical activity for active recreation and healthy lifestyle.

2. Programme and structure of the discipline for "Industrial biotechnology"

Modules and topics	Number of hours													
	Full-time							Part-time						
	weeks	total	including					weeks	total	including				
			Lec	lab	ind	ind	s.st			Lec	pr	lab	ind	ind
Content Module 1. Enzymatic processes in the biotechnology industry														
Topic 1. History and achievements of industrial biotechnology.	1,2		8		5		5							
Theme 2. General characteristics of industrial strains of microorganisms.	3,4		7		5		5							
Total for module 1	32		15		10		30							
Content module 2. Scheme and main stage biotech industries.														
Topic 1. Classification and characterization of the	5,6		8		5		15							

fermentation process.														
Theme 2. Characteristics of the main stage biotech industries	7,9		7		5		15							
Total for module 2	32		15		10		10							
Topic 3. Biotechnology products of microbial synthesis.	10-12		8		5		5							
Theme 4. Industrial biotechnology in agriculture.	13-15		7		5		5							
Course project	32													
Total for module 3	31		15		10		30							
Total	120		45		30		45							

3. Topics of laboratory classes

Number	Title theme	Hours
Lab 1,2	Principles and methods for culturing microorganisms-producers on media. Equipment and Materials of Laboratory of Industrial Biotechnology. Methods of sterilization equipment and culture media	4
Lab 3,4	Preparation of nutrient media for culturing bacteria and fungi in the laboratory. Principles of nutrient media in biotech manufacturing	4
Lab 5,6	Getting a batch culture *Bacillus subtilis, Bacillus subtilis var mesentericus, Aspergillus niger*	4
Lab 7	Initial screening of microorganisms - antagonists in rhizosphere of plants. Isolation of pure cultures of microorganisms - antagonists	2
Lab 8	Cultivation of yeast on nutrient media containing carbon substrates	2
Lab 9-11	Cultivation of microorganisms - antagonists on selective nutrient media	6
Lab 12	The investigation of microbial antagonism by perpendicular strokes. Determination of the sensitivity of microorganisms to antibiotics by paper disc	2
Lab 13	Determination of enzymatic activity of oxidase and catalase microorganisms. Cultivation of *Aspergillus niger* on media of different composition of macro-and micronutrients	2
Lab 14	The formation of citric acid by the fungus *Aspergillus niger* through cultivation on liquid medium superficial way	2
Lab 15	The efficacy of biological products against bacterial blight pathogen of plants *Pectobacterium* spp. Standardization and quality assessment of biological titer determination by the drug. Standardization and quality assessment of biopharmaceuticals by determining the biological activity of microorganisms - producers	2

4. Topics for self-study

№	Topic title	Hours
1	Transformation of organic compounds. Examples of transformations and advantages of using microbial transformations compared to chemical synthesis methods.	14
2	Types of microbial transformations. Microorganisms that carry out transformations.	10
3	Production of steroid preparations. Production of isolimic, ketoglutaric, malic, succinic acids.	10
4	Protein production. Producer strains. Raw material base. The process of	10

	growing microorganisms. Requirements for the quality of the finished product.	
5	Microbiological production of renewable energy sources. Production of lower alcohols, acetone, methane by bioconversion of organic waste and vegetable raw materials.	10
6	Methane producing bacteria. Prospects of hydrogen production. Heat production by aerobic oxidation of organic substances (waste).	10
7	Use of microorganisms for oil and coal extraction. Microbiological extraction of metals.	10
8	Food toxic infections and toxicosis. General principles of microbiological control of finished products in the food industry.	10
9	Microscopic control. Accounting on special media. Sanitary and hygienic control of equipment, production materials, hands and clothing of workers. Control scheme, principles of scheme construction depending on the specificity of production.	10

5. Tools for assessing expected learning outcomes: (select necessary or add)

- exam;
- credit.
- module tests;
- abstracts;
- 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;**
- credit;
- oral or written assessment;
- module tests;
- essays and reports;
- 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,	National grading of exams and credits

points	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 R_{DIS} (up to 100 points), the received assessment rating R_A (up to 30 points) is added to the academic performance raiting R_{AP} (up to 70 points): $R_{DIS} = R_{AP} + R_A$.

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.

10. Recommended sources of information

1. Boroday V.V. Industrial biotechnology: text book for "Bachelor" students of speciality 162 «Biotechnology and bioengineering. Publishing house "Komprint", 2020. 267 p.
2. Laboratory Manual for Industrial biotechnology. Boroday V.V. et al. Київ: ТОВ «Аграр Медіа Груп», 2022. 300 с.(Затверджені на засіданні Вченої ради НУБіП України 23 листопада 2022 р., протокол № 6).
3. Біотехнологія мікробного синтезу: навчальний посібник. НУБіП України. Патика Т.І., Патика М.В. Вінниця: ТОВ «Нілан-ЛТД», 2018: 272.
4. Загальна (промислова) біотехнологія: навчальний посібник/ М.Д. Мельничук, О.Л.Кляченко, В.В.Бородай, Ю.В.Коломієць. – Вінниця: ТОВ «Нілан-ЛТД», 2014. 253 с.
5. Буценко Л.М., Пенчук Ю.М., Пирог Т.П. Технології мікробного синтезу лікарських засобів: навч. посіб. К.: НУХТ, 2010.- 323 с.
6. Біотехнологія: Підручник / В.Г. Герасименко, М.О. Герасименко, М.І. Цвіліховський та ін.; Під общ. ред. В.Г. Герасименка. К.: Фірма «ІНКОС», 2006. 647 с.
7. Пирог Т.П. Загальна мікробіологія: підручник / Пирог Т.П. К.: НУХТ, 2004. 471 с.
8. Пирог Т.П. Загальна біотехнологія: підручник / Т.П. Пирог, О.А. Ігнатова. К.: НУХТ, 2009. 336 с.
9. Юлевич О. І., Ковтун С. І., Гиль М. І. Біотехнологія : навчальний посібник. Миколаїв : МДАУ, 2012. 476 с.
10. Пономарьов П. Х., Донцова І. В. Генетично модифікована продовольча сировина і харчові продукти, вироблені з її використанням. К. : Центр учбової літератури, 2009. 124 с.
11. Закон України «Про державну систему біобезпеки при створенні, випробуванні, транспортуванні та використанні генетично

модифікованих організмів : Закон України від 31 травня 2007 р. // Відомості Верховної Ради України. 2007. № 35. Ст.484.
12. https://galychyna.com.ua/
13. https://obolon.ua/ua
14. https://zakon.rada.gov.ua/laws/show/771/97-%D0%B2%D1%80#Text