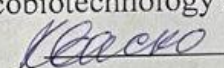
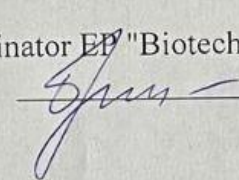


**NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL
SCIENCES OF UKRAINE**

Department of Ecobiotechnology and Biodiversity

“CONFIRMED”
Dean of the Faculty of plant protection,
biotechnologies and ecology
 **JULIA KOLOMIETS**
06 2023 p.

“APPROVED”
at the meeting of the department
of Ecobiotechnology and Biodiversity
Protocol № 6 dated “29” May 2023
Head of Department
of Ecobiotechnology and Biodiversity
 **Olena Kvasko**

“REVIEWED”
Program Coordinator of "Biotechnologies and bioengineering"
 **OKSANA KLYACHENKO**

PROGRAM OF THE COURSE

“ INDUSTRIAL BIOTECHNOLOGY”

Specialization 162 "Biotechnologies and bioengineering"
Educational program Biotechnologies and bioengineering
Faculty of plant protection, biotechnologies and ecology
Developer: Associate professor, Doctor of Agr.Science Boroday V.V.

Kyiv – 2023

1. Description of the course
"Industrial Biotechnology"

Industrial Biotechnology		
Field of knowledge, specialization, educational program, educational degree		
Educational program	Biotechnology	
Specialization	162 «Biotechnology and bioengineering »	
Educational degree	«Bachelor»	
Characteristics of the course		
Type	regulatory	
Total number of hours	120	
Number of ECTS credits	4,0	
Number of content modules	2	
Course project (work)	32	
Form of assessment	Exam	
Indicators discipline for full-time and distance learning		
	full-time form of education	external form of education
Course (year of study)	3	3
Semester	6	5
Lecture classes	45	2
Practical, seminar classes	-	-
Laboratory classes	30 h	-
Self-study	45 h	115 h
Individual assignments	-	-
Number of weekly classroom hours for the full-time form of study	6/4 h 6,0 h	

2. Purpose and Objectives and competencies of the course "Industrial Biotechnology"

The purpose 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 competence:

integrated competency (IC): The ability to solve complex tasks in the field of biology in the process of conducting research and innovation activities, which involves rethinking existing and creating new holistic knowledge. The ability to generate new scientific-theoretical and practically oriented ideas, develop and implement scientific projects and programs in the field of biology to solve both general biological problems and correct the state of biological objects under the action of substances of natural and synthetic origin, biologically active substances and their application in practice agriculture, nature conservation, veterinary sciences, biomedicine and zooengineering, as well as the implementation of innovative technologies in professional activities.

general competencies (GC): GC 01. Ability to search, process and analyze information from various sources; GC 02. Ability to abstract thinking, analysis and synthesis; GC 03. Ability to work in an international scientific context; GC 05. Ability to generate new ideas (creativity), conduct scientific research at the appropriate level; GC 06. The ability to form a systematic scientific outlook.

professional (special) competencies (PC): PC 09. Ability to conduct theoretical and experimental research, mathematical and computer modeling of biotechnological processes; PC 10. Ability to demonstrate knowledge and understanding of scientific facts necessary for the development of modern biotechnologies; PC 11. The ability to demonstrate creative and innovative potential in the synthesis of solutions and in the development of environmental biotechnologies.

Program learning outcomes (PLO) of the educational programme: PLO 03. Knowledge and understanding of problematic issues of modern biotechnology (including on the border subject areas) to create the latest biotechnologies; PLO 04. Knowledge and use of modern physiological, biochemical and genetic approaches for improvement of biological agents and regulation of biotechnological processes.

3. Program and structure of the course for “Industrial biotechnology”

Structure of discipline "General (industrial) biotechnology"

Names of content modules and topics	Number of hours											
	Full-time form						Part-time form					
	Total	including					Total	including				
		Lec	pr	lab	ind			Lec	pr	lab	ind	
Content Module 1. Enzymatic processes in the biotechnology industry												
Topic 1. History and achievements of industrial biotechnology.	15	8		5		5						
Theme 2. General characteristics of industrial strains of microorganisms.	17	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 fermentation process.	15	8		5		15						
Theme 2. Characteristics of the main stage biotech industries	17	7		5		15						
Total for module 2	32	15		10		10						
Topic 3. Biotechnology products of microbial synthesis.	16	8		5		5						
Theme 4. Industrial biotechnology in agriculture.	16	7		5		5						
Course project	32											
Total for module 3	31	15		10		30						
Total	120	45		30		45						

4. Seminar topics

№	Title theme	Number of hours
1	Don't provide curriculum	

5. Practical class topics

№	Title theme	Number of hours
1	Don't provide curriculum	

6. Laboratory topics

Module 1. Enzymatic processes in the biotechnology industry

Number	Title theme	Number of 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	2
Lab 3,4	Preparation of nutrient media for culturing bacteria and fungi in the laboratory. Principles of nutrient media in biotech manufacturing	2
Lab 5,6	Getting a batch culture <i>Bacillus subtilis</i> , <i>Bacillus subtilis</i> var <i>mesentericus</i> , <i>Aspergillus niger</i>	2
Lab 7	Initial screening of microorganisms - antagonists in rhizosphere of plants. Isolation of pure cultures of microorganisms - antagonists	4

Module 2. Scheme and main stage biotech industries.

Lab 8	Cultivation of yeast on nutrient media containing carbon substrates	5
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	5
Lab 13	Determination of enzymatic activity of oxidase and catalase microorganisms. Cultivation of <i>Aspergillus niger</i> on media of different composition of macro-and micronutrients	7
Lab 14	The formation of citric acid by the fungus <i>Aspergillus niger</i> through cultivation on liquid medium superficial way	8
Lab 15	The efficacy of biological products against bacterial blight pathogen of plants <i>Pectobacterium</i> 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	7

7. Independent work topics

№	Topic title	Number of 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 growing microorganisms. Requirements for the quality of the finished product.	10
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

8. Samples of control questions, tests for assessing the level of knowledge acquisition by students.

Module 1

Department of Ecobiotechnologies and Biodiversity

Branch of knowledge 16 "Chemical and bioengineering"

Specialty 162 "Biotechnology and Bioengineering"

Educational degree Bachelor

Module 1

1. Which of the following are mismatched?

1	Acidophiles : low pH
---	----------------------

2	Psychrophiles : 0°C
3	Extreme thermophiles : 100°C
4	Hyperthermophiles : no water
5	Extreme halophiles : 30% salt

2. Functional components of the gene are:

A	cells, chromosomes;
Б	exons, introns;
В	apical meristem;
Г	macro solutions;
Д	kalus;

3. Determination of nucleotide sequence is called

Fill in the form of answers correct answer

4. Which the metabolic products related to primary and secondary products of catabolism and anabolism?

A. Первинні продукти анаболізму	1. Lipids, vitamins, biomass, polysaccharides and cellular biosynthesis intermediates: nucleotides and amino acids
Б. Вторинні продукти анаболізму	4. Acetone, butanol.
В. Первинні продукти катаболізму	3. Ethanol, acetic acid, CO ₂ , ATP.
Г. Вторинні продукти катаболізму	4. Antibiotics, alkaloids, toxins.

5. In which phase of the growth curve is the population doubling time fastest?

1	Death phase.
2	decline phase.
3	Stationary phase.
4	Log phase.
5	Lag phase.

6. Mustard gas, nitrosamines, carbon tetrachloride are

Fill in the form of answers correct answer

7. During the lag phase:

1	cells are engaged in intense enzymatic activity
2	changes in pH occur.
3	cells are decreasing in number.
4	nutrients are depleted.
5	cells are growing in number.

8. Bacteria require nitrogen for the synthesis of:

1.	fatty acids.
2.	lipids.
3.	sugars.
4.	carbohydrates.
5.	proteins.

9. Teaching methods

The success of learning as a whole depends on the intrinsic activity of students, the nature of their activities, it is the nature of the activity, degree of autonomy and creativity should be important criteria in choosing a method.

Explanatory and illustrative technique. Students acquire knowledge by listening to the story, lecture on educational or instructional materials through the on-screen guide in the "ready" form. Perceiving and interpreting facts, evaluations,

conclusions, they remain within the reproductive thinking. This method is used widely as possible to transmit large amount of data. It can be used for presentation and assimilation of facts, approaches, assessments and conclusions.

Reproductive method. This refers to the application of learned from sample or regulations. Activities of trainees is algorithmic, corresponding instructions, orders, rules - similar to the present sample situations.

The method of problem presentation. Using any source and means lecturer before teaching material, poses the problem, formulating cognitive tasks, and then exposing the system is proved by comparing the views, different approaches shows way to solve the problem. Students are like witnesses and accomplices in scientific research.

Partly-search or heuristic method. Its essence - to organize the active solver nominated teacher (or self-contained) or cognitive tasks under the supervision of the teacher or based on heuristic programs and guidelines. The process of thinking becomes productive nature, but it gradually directs and supervises the teacher or the students on the basis of the above programs (including computer) and manuals. This method is one of the varieties of which are heuristic conversation - a proven way to enhance thinking and motivation to learning.

The research method. After reviewing the material, production problems and tasks and short oral or written instruction by those who teach self-study literature sources are monitoring and measurements and perform other search action. Initiative, independence, creativity manifested in research activities fully. Methods of training is directly transferred to the methods which mimic and sometimes implement scientific research.

So, considered the six approaches to the classification of teaching methods.

10. Forms of assessment

Control of students' knowledge and skills (current and final) in the discipline is carried out according to the credit-module system of the organization of the educational process. The student's rating for mastering the discipline is determined on a 100-point scale. It consists of a rating for academic work, for the assessment of which 70 points are assigned, and a rating for attestation (exam) - 30 points.

Criteria for assessing the level of knowledge in laboratory, seminar and practical classes. In laboratory classes, each student performs individual tasks on each topic. The level of knowledge is assessed as: "excellent" - the student gives comprehensive, substantiated, theoretically and practically correct answers to at least 90% of questions, solutions to problems and laboratory exercises are correct, demonstrates knowledge of textbooks, manuals, instructions, makes generalizations and conclusions, and accurately prepares tasks, was present at the lectures, has a synopsis of the lectures or essays on the main topics of the course; "good" - when the student has knowledge of the material, but makes minor mistakes in the formation of terms, categories and calculations, but with the help of the teacher quickly orients himself and finds the right answers, has attended lectures, has a synopsis of lectures or essays on the main topics of the course; "satisfactory" - when the student gives the correct answer to at least 60% of the questions, or gives insufficiently substantiated, incomplete answers to all questions, makes gross mistakes, which are corrected with the help of the teacher. At the same time, the

availability of a synopsis on the topic of tasks and independence is taken into account; "unsatisfactory with the possibility of retaking" - when the student gives the correct answer to at least 35% of the questions, or gives unreasonable, incomplete answers to all questions, makes gross mistakes. It has an incomplete synopsis of lectures.

Final (general assessment) course of the academic discipline. It is the sum of ratings (points) obtained for separate evaluated forms of educational activity: current and final testing of the level of mastery of theoretical material during classroom classes and independent work (modular control); assessment (points) for performing laboratory studies. The final grade is issued after a full study of the academic discipline, which is derived as the sum of intermediate grades for the content modules. The final assessment of the level of knowledge consists of a rating from the academic work, for the assessment of which 70 points are assigned, and a rating from the attestation (exam) - 30 points.

11. Distribution of grades received by students.

Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated 26.04.2023, protocol №10)

Student rating, points	National grade based on exam results	
	Exams	
90-100	Excellent	90-100
74-89	Good	74-89
60-73	Satisfactory	60-73
0-59	Unsatisfactory	0-59

In order to determine the rating of a student (listener) in the discipline R_{dis} (up to 100 points), the rating from the exam R_{ex} (up to 30 points) is added to the rating of a student's academic work R_{aw} (up to 70 points): $R_{dis} = R_{aw} + R_{ex}$.

12. Educational and methodological support.

Scientific and methodological support of the educational process includes: state educational standards, curricula, curricula in all normative and elective disciplines; programs of training, production and other types of practices; textbooks and manuals; instructional and methodical materials for seminars, practical and laboratory classes; individual educational and research tasks; control works; text and electronic versions of tests for current and final control, methodical materials for the organization of independent work of students.

13. Recommended sources of information

Basic

1. Boroday V.V. Industrial biotechnology: text book for "Bachelor" students of speciality 162 «Biotechnology and bioengineering. Publishing house "Komprint", 2020. 267 p.

2. Навчальний посібник для дисципліни "Industrial biotechnology", Бородай В.В., Кляченко О.Л., Мельничук М.Д. «Laboratory Manual for Industrial biotechnology». Київ: ТОВ «Аграр Медіа Груп», 2022. 300 с.
1. Біотехнологія мікробного синтезу: навчальний посібник. НУБіП України. Патики Т.І., Патики М.В. Вінниця: ТОВ «Нілан-ЛТД», 2018: 272.
2. Загальна (промислова) біотехнологія: навчальний посібник/ М.Д. Мельничук, О.Л.Кляченко, В.В.Бородай, Ю.В.Коломієць. – Вінниця: ТОВ «Нілан-ЛТД», 2014. - 253 с.
3. Буценко Л.М., Пенчук Ю.М., Пирог Т.П. Технології мікробного синтезу лікарських засобів: навч. посіб. – К.: НУХТ, 2010.- 323 с.
4. Біотехнологія: Підручник / В.Г. Герасименко, М.О. Герасименко, М.І. Цвіліховський та ін.; Під общ. ред. В.Г. Герасименка. — К.: Фірма «ІНКІОС», 2006. — 647 с.
5. Пирог Т.П. Загальна мікробіологія: підручник / Пирог Т.П. — К.: НУХТ, 2004. — 471 с.
6. Пирог Т.П. Загальна біотехнологія: підручник / Т.П. Пирог, О.А. Ігнатова. — К.: НУХТ, 2009. — 336 с.
7. Юлевич О. І., Ковтун С. І., Гиль М. І. Біотехнологія : навчальний посібник. - Миколаїв : МДАУ, 2012. - 476 с.
8. Пономарьов П. Х., Донцова І. В. Генетично модифікована продовольча сировина і харчові продукти, вироблені з її використанням. - К. : Центр учбової літератури, 2009. – 124 с.
9. 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.
- 10.<https://galychyna.com.ua/>
11. <https://obolon.ua/ua>
- 12.<https://zakon.rada.gov.ua/laws/show/771/97-%D0%B2%D1%80#Text>