

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

Department of physiology, biochemistry of plants and bioenergetics

"APPROVED"

Dean of Faculty of Plant protection,
Biotechnology and Ecology



Kolomiets Y.V.

23 " May 2024

“ APPROVED”

on the meeting of physiology, biochemistry of plants
and bioenergetics department
Protocol № 10 from «22» May 2024

Head of Department
Svitlana Prylutska

”REVIEWED”

Guarantor EO 162 «Biotechnology and bioengineering»

Olena Kvasko

Guarantor EO

PROGRAM OF THE COURSE

OBJECTS OF BIOTECHNOLOGICAL PRODUCTION

Field of knowledge 16 “Chemical and bioengineering”

Specialization 162 «Biotechnology and bioenergetic»

Educational program «Biotechnology and bioenergetic»

Faculty of Plant Protection, Biotechnology and Ecology

Developers: docent, Ph.D. Babytskiy A.I., docent PhD Drozd P.Yu.

Kyiv – 2024

1 Description of the course

«OBJECTS OF BIOTECHNOLOGICAL PRODUCTION»

Branch of knowledge, training direction, specialty, education level		
Educational degree	Bachelor	
Specialization	162 «Biotechnology and bioenergetic»	
Educational program	«Biotechnology and bioenergetic»	
Characteristics of the course		
Type	<u>Compulsory</u>	
Total number of hours	120	
Number of credits ECTS	4	
Number of content modules	3	
Course project (work) (if any)	None	
Form of control	Exam	
Indicators of the discipline for full-time higher education		
	full-time form of higher education	part-time form of higher education
Course (year of study)	2	3
Semester	3	6
Lecture classes	30 hours	2 hours
Practical, seminar classes	15 hours	-
Laboratory classes	-	-
Self-study	75 hours	92 hours
Number of weekly classroom hours for the full-time form of study:		
auditory	3 hours	
Self-study	4 hours	

1. Purpose, tasks, competencies and program outcomes of the discipline

"Objects of Biotechnological Production" is a course **aimed** at studying the principles of biotechnological processes, the technical means that provide them, and ways to determine the main parameters of raw materials and products of the biotechnological process, and the objectives are to familiarize students majoring in Biotechnology and Bioengineering with the target group of organisms used in biotechnological production.

The **aim** is to study the general morphological structure of plants, the diversity of morphostructures of plant organs and their metamorphoses, the anatomical organization of plant biosystems and to familiarize students with the systematic diversity of the plant world.

Course objectives:

- plan and organize technological processes, choose optimal conditions for the implementation of biotechnology and manage them in accordance with modern methods of controlling technological operations and finished products;

- design production in accordance with the requirements of safety, labor protection and civil defense;

- identify problems in biotechnology production and ensure their elimination in cooperation with specialists from related industries;

- to formulate tasks in the development of new and improvement of existing biotechnologies and technological equipment for their implementation in accordance with the needs of the industry, taking into account the commercial effect;

- to conduct scientific, theoretical and experimental research in accordance with the fundamental principles and provisions using computer software and modeling technologies;

- to create a proper creative and psychologically favorable atmosphere in the team for the successful solution of the task.

Acquisition of competencies:

Integral competence (IC): Ability to solve complex specialized problems and practical problems characterized by complexity and uncertainty in biotechnology and bioengineering, or in the process of learning that involves the application of theories and methods of biotechnology and bioengineering.

General competencies (GC):

K05. Ability to learn and master modern knowledge.

K09. Ability to preserve and increase 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) competencies (SC):

K12. Ability to analyze regulatory documents necessary to ensure engineering activities in the field of biotechnology.

K13. Ability to work with biological agents used in biotechnological processes (microorganisms, fungi, plants, animals, viruses, their individual components).

Program learning outcomes (PLOs):

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.

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.

PO15. Based on knowledge of the laws of mechanical, hydromechanical, heat and mass transfer processes and basic design features, be able to choose the appropriate equipment in the design of biotechnological products for various purposes to ensure their maximum efficiency.

PO20. To be able to calculate the main criteria for evaluating the effectiveness of a biotechnological process (growth parameters of biological agents, synthesis rate of the target product, synthesizing ability of biological agents, economic coefficient, yield of the target product from the substrate, productivity, cost of the culture medium, etc.)

PLO21. Be able to formulate tasks for the development of automation systems for the production of biotechnological products for various purposes.

2. Program and structure of the discipline for:

- full-time (part-time) higher education;
- reduced term of full-time (part-time) higher education

Names of content modules and topics	Number of hours													
	full-time education							correspondence form of training						
	weeks	total	included					total	included					
			lec	prac	lab.	ind.	in.w		lec	prac	lab.	ind.	in.w	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Content module 1: Morphological features of plant objects of biotechnological production														
1. Morphological structure and diversity of shoots, buds and stems.	1	8	2	1			5	8	2					6
2. Morphological structure of leaves. Metamorphosis of leaves.	2	8	2	1			5	6						6
3. Morphological structure and metamorphosis of the root.	3	8	2	1			5	6						6
4. Features of morphological organization of flower and inflorescence	4	8	2	1			5	6						6
5. Morphological diversity of seeds and fruits.	5	8	2	1			5	6						6
Total for content module 1:		40	10	5			25	32						30
Content module 2: Anatomical features of plant objects of biotechnological production														
6. Features of the organization of meristems and integumentary tissues.	6	8	2	1			5							6
7. Basic, mechanical, conducting tissues and excretory structures of plants.	7	8	2	1			5							6
8. Anatomical structure of the stem.	8	8	2	1			5							6
9. Anatomical structure of the leaf and root.	9	8	2	1			5							6
10. Anatomy of	10	8	2	1			5							6

generative organs.												
Total for content module 2:		40	10	5			25					30
Content module 3: Diversity of plant objects of biotechnological production												
11. Bryophytes.	11	8	2	1			5					6
12. Lycopodiophyta and Equisetophyta.	12	8	2	1			5					6
13. Polypodiophyta.	13	8	2	1			5					6
14. Pinophyta.	14	8	2	1			5					7
15. Magnoliophyta.	15	8	2	1			5					7
Total for content module 3:		40	10	5			25					32
Total hours:		120	30	15			75	94	2			92

3. Topics of practical classes

№	Topic title	Number of hours
1.	Morphological features and diversity of shoots and their constituent organs.	2
2.	Morphological features and diversity of roots, their metamorphoses and modified shoots.	2
3.	Morphological features of generative organs of plants.	2
4.	General introduction to plant tissue types.	1
5.	Anatomical structure of generative organs of plants	2
6.	Diversity of bryophytes. Biotechnologically promising representatives of the group.	2
7.	The diversity of higher spore plants.	2
8.	Biotechnologically important representatives of seed plants.	2
	Total	15

4. Topics for individual work

№	Topic title	Number of hours
1.	The shoot and its components.	5
2.	Root and metamorphosis.	5
3.	Morphological features and generative organs of plants.	5
4.	Morphological variability of stems in plants.	5
5.	Morphological variability of leaves in plants.	5
6.	Morphological variation of flowers in plants.	5
7.	Morphological variation of fruits in plants.	5
8.	Features of the anatomical organization of plant tissues and excretory structures.	5
9.	Anatomical structure of vegetative organs of plants.	5
10.	Anatomical structure of plant genetic organs.	5

11.	Biotechnologically promising representatives of bryophytes.	5
12.	Biotechnologically promising representatives of the Plaunaceae and Horsetails.	5
13.	Biotechnologically promising representatives of ferns.	5
14.	Biotechnologically promising representatives of the gymnosperms.	5
15.	Biotechnologically promising representatives of the angiosperms.	5
	Total	75

5. Means of diagnosing learning outcomes:

- exam;
- module tests;
- abstracts;
- defense of practical works;
- presentations and oral reports.

6. Teaching methods:

- verbal method (lecture, discussion, interview, etc.)
- practical method (laboratory, practical classes);
- visual method (method of illustrations, method of demonstrations);
- work with educational and methodological literature (note-taking, abstracting, annotating, reviewing, writing an abstract, preparing a presentation and report);
- video method (remote, multimedia, web-based, etc.);
- independent work (completion of tasks).

7. Methods of evaluation:

- examination;
- oral or written questioning;
- module testing;
- team projects;
- abstracts, essays;
- defense of practical work;
- presentations and speeches at scientific events.

8. Distribution of points,

that higher education applicants receive. The assessment of the knowledge of higher education applicants is based on a 100-point scale and is converted into national grades in accordance with Table 1 of the current "Regulations on Exams and Tests in NULES of Ukraine"

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

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): $R_{dis} = R_{aw} + R_{ex}$

9. Educational and methodological support:

- electronic training course of the discipline (on the educational portal of NULES of Ukraine eLearn - <https://elearn.nubip.edu.ua/course/view.php?id=2299>);
- lecture notes and presentations (in electronic form);
- textbooks, manuals, workshops;
- methodological materials for studying the discipline for full-time and part-time students.

12. Educational and methodological support

Scientific methods of teaching includes: state educational standards, curricula and training programs for all standard and optional subjects; program of educational, industrial and other practices; textbooks and teaching aids; instructional and teaching materials for seminars, practical and laboratory lessons; individual educational and research objectives; tests; text and electronic versions of tests for current and final control, teaching materials for the students individual work.

10. Recommended sources of information

Main literature

1. Bobkova I.A., Varlakhova L.V. Botany: textbook (for universities of I-II years of study). K.: VSV "Medicine", 2015. 304 p.
2. Bolokhovska T.O., Bobruk V.P., Kryklyva S.D. Medical botany. Anatomy and morphology of plants: Methodical instructions for laboratory classes and independent work for first-year students. - Vinnytsia, 2003. - 125 p.
3. Bolokhovska T.O., Bobruk V.P., Kryklyva S.D. Medical botany. Systematics of plants: Methodical instructions for laboratory classes and independent work for second-year students. - Vinnytsia, 2004. - 78 p.
4. Bolokhovska T.O., Bobruk V.P., Kryklyva S.D. Medical botany: Study guide to field practice in medical botany for 1st year students of the Faculty of Pharmacy. - Vinnytsia, 2002. - 66 p.
5. Bryon O.V., Chykalenko V.G. Anatomy of plants. - K.: Higher school, 1992. - 272 c.
6. Goncharenko I.V. Structure of the plant organism: Textbook. - 2nd ed. Sumy: University Book Publishing House, 2004. 200 p.

7. Kryklyva SD, Kremenska LV, Bobrovska OA Pharmaceutical botany. Part I. Anatomy and morphology of plants: Study guide. - Vinnytsia - 2012. - 162 p.
8. Kryklyva SD, Kremenska LV, Bobrovska OA Pharmaceutical botany. Part II. Systematics of plants: Study guide. - Vinnytsia - 2013. - 130 p.
9. Marchyshyn S.M., Nechai R.E., Shanayda M.I. Botany. Educational field practice. - Ternopil: TSMU, 2006. - 200 p.

Supporting literature

1. Barna M.M. Botany. Terms. Concepts. Personalities. Biology. - K.: Academia Publishing Center, 1997. - 272 p.
2. Goncharenko I.V. Structure of a plant organism: Study guide. - Sumy: University Book Publishing House, 2004. - 200 c.
3. Grigora I.M., Solomakha V.A. Vegetation of Ukraine (ecological, cenotic, floristic and geographical essay) - Kyiv: Phytosociocenter, 2005. 452 p.
4. Grodzynskyi D.M. Four-language dictionary of plant names (Ukrainian-Russian-English-Latin). - Kyiv: Phytosociocentre, 2001. - 312 p.
5. Gulko R.M. Garden of medicinal plants in Lviv. Study guide. - Vinnytsia: Nova Knyha, 2006. 240 p.
6. Ivchenko I.S., Kapustian V.V. Ethnobotanical aspects of phytodiversity research on the example of woody plants of the flora of Ukraine. - Kyiv: Phytosociocenter, 2003. - 140.
7. Moroz I.V., Hryshko-Bohmenko B.K. Botany with the basics of ecology: Study guide. - K.: Higher school, 1994. - 240 p.
8. Nechytailo V.A., Badanina V.A., Hrytsenko V.V. Cultivated plants of Ukraine. Study guide. - K.: Phytosociocenter, 2005. - 351 p.

Information resources

International Plant Names Index (IPNI) <https://www.ipni.org/>
World Flora Online <https://about.worldfloraonline.org/>