

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

Department of physiology, biochemistry of plants and bioenergetics

**«APPROVED»**

Faculty of Plant protection, Biotechnology and Ecology  
«21» May 2025

**CURRICULUM OF ACADEMIC DISCIPLINE  
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.

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### **Description of the course «Objects of biotechnological production»**

"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.

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	Compulsory	
Total number of hours	120	
Number of credits ECTS	4	
Number of content modules	3	
Course project (work)	-	
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
Individual tasks	-	-
Number of weekly classroom hours for full-time higher education	3 hours	-

### **Purpose, tasks, competencies and program outcomes of the discipline**

The **purpose** of the discipline «Objects of biotechnological production» is to study the principles of biotechnological processes, technical means that provide them, and ways to determine the main parameters of raw materials and products of the biotechnological process, as well as to study the general morphological structure of plants, the diversity of morphological structures of plant organs and their metamorphoses, the anatomical organisation of plant biosystems and to familiarise students with the systematic diversity of the plant world.

### ***Acquisition of competencies:***

### Integral competence (IC):

Ability to solve complex specialised tasks and practical problems characterised 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):

K13. Ability to analyse regulatory documents required to support engineering activities in the field of biotechnology.

K14. 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.

PLO14. 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.)

PO22. Be able to take into account social, environmental, ethical, economic aspects, occupational health and safety requirements, industrial sanitation and fire safety when formulating technical solutions. Be able to use various types and forms of physical activity for active recreation and healthy lifestyle.

## **2. Program and structure of the discipline**

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
<b>Content module 1: Morphological features of plant objects of biotechnological production</b>													
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
<b>Total for content module 1:</b>		<b>40</b>	<b>10</b>	<b>5</b>			<b>25</b>	<b>32</b>					<b>30</b>
<b>Content module 2: Anatomical features of plant objects of biotechnological production</b>													
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 generative organs.	10	8	2	1			5						6
<b>Total for content module 2:</b>		<b>40</b>	<b>10</b>	<b>5</b>			<b>25</b>						<b>30</b>
<b>Content module 3: Diversity of plant objects of biotechnological production</b>													
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
<b>Total for content</b>		<b>40</b>	<b>10</b>	<b>5</b>			<b>25</b>						<b>32</b>

<b>module 3:</b>												
<b>Total hours:</b>		<b>120</b>	<b>30</b>	<b>15</b>			<b>75</b>	<b>94</b>	<b>2</b>			<b>92</b>

### 3. Lecture topics

№	Topic title	Number of hours
1	Morphological structure and diversity of shoots, buds and stems	2
2	Morphological structure of leaves. Metamorphosis of leaves	2
3	Morphological structure and metamorphosis of the root	2
4	Features of morphological organization of flower and inflorescence	2
5	Morphological diversity of seeds and fruits	2
6	Features of the organization of meristems and integumentary tissues	2
7	Basic, mechanical, conducting tissues and excretory structures of plants	2
8	Anatomical structure of the stem	2
9	Anatomical structure of the leaf and root	2
10	Anatomy of generative organs	2
11	Bryophytes	2
12	Lycopodiophyta and Equisetophyta	2
13	Polypodiophyta	2
14	Pinophyta	2
15	Magnoliophyta	2
	<b>Total:</b>	<b>30</b>

### 4. Topics of laboratory (practical, seminar) classes

#### 4.1. Topics of the seminars

№	Topic title	Number of hours
1.	Morphological features and diversity of shoots and their constituent organs.	1
2.	Morphological features and leaf metamorphosis.	1
3.	Morphological features and diversity of roots, their metamorphoses and modified shoots.	1
4.	Morphological features of generative organs of plants.	1
5.	Different approaches to the classification of fruits in plants. The variety of fruits.	1
6.	General introduction to plant tissue types.	1
7.	Structure and functions of plant meristems, their role in biotechnology of plant cultivation.	1
8.	Anatomical structure of generative organs of plants.	1
9.	Diversity of bryophytes. Biotechnologically promising representatives of the group.	1
10.	A variety of plaunus and horsetail plants. Biotechnologically	1

	promising representatives of the group.	
11.	A variety of ferns. Biotechnologically promising representatives of the group.	1
12.	Diversity of naked-seeded plants. Biotechnologically promising representatives of the group.	1
13.	Biotechnologically important representatives of seed plants.	1
14.	The main biotechnologically important plants of the dicotyledonous class.	1
15.	The main biotechnologically important plants of the monocotyledonous class.	1
	<b>Total:</b>	<b>15</b>

#### 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
	<b>Total</b>	<b>75</b>

#### 5. Tools for diagnosing learning outcomes

- - exam;
- - module tests;
- - oral and written questioning;
- - defence of laboratory work;
- - abstracts;
- - peer assessment, self-assessment.

#### 6. Teaching methods:

- Problem-based learning method;
- Practice-based learning method;
- Research-based learning method;
- Discussion and debate method;
- Teamwork method;

## 7. Assessment methods:

- exam;
- module testing;
- oral and written questioning;
- defence of laboratory work;
- presentations and speeches at scientific events;
- abstracts.

## 8. Assessment of learning outcomes.

The assessment of the knowledge of the applicant for higher education is carried out on a 100-point scale and is converted into a national grade in accordance with the current 'Regulations on exams and tests in NUBiP of Ukraine'

Type of learning activity	Learning outcomes	Evaluation
<b>Module 1. Morphological features of plant objects of biotechnological production</b>		
S. c. 1. Morphological features and diversity of shoots and their constituent organs	PLO04	10
S. c. 2. Morphological features and leaf metamorphosis		10
S. c. 3. Morphological features and diversity of roots, their metamorphoses and modified shoots		10
S. c. 4. Morphological features of generative organs of plants		10
S. c. 5. Different approaches to the classification of fruits in plants. The variety of fruits		10
Individual work 1. Morphological features of plant objects of biotechnological production		20
Modular test work 1.		<b>30</b>
<b>Total by module 1</b>		<b>100</b>
<b>Module 2. Anatomical features of plant objects of biotechnological production</b>		
S. c. 6. General introduction to plant tissue types	PLO14, PLO15	10
S. c. 7. Structure and functions of plant meristems, their role in biotechnology of plant cultivation		10
S. c. 8. Anatomical structure of generative organs of plants		10
S. c. 9. Diversity of bryophytes. Biotechnologically promising representatives of the group		10
S. c. 10. A variety of plaunus and horsetail plants. Biotechnologically promising representatives of the group		10

Individual work 2. Anatomical features of plant objects of biotechnological production		20
Modular test work 2.		30
<b>Total by module 2</b>		<b>100</b>
<b>Module 3. Diversity of plant objects of biotechnological production</b>		
S. c. 11. A variety of ferns. Biotechnologically promising representatives of the group	PLO20, PLO22	10
S. c. 12. Diversity of naked-seeded plants. Biotechnologically promising representatives of the group		10
S. c. 13. Biotechnologically important representatives of seed plants		10
S. c. 14. The main biotechnologically important plants of the dicotyledonous class		10
S. c. 15. The main biotechnologically important plants of the monocotyledonous class		10
Individual work 3. Diversity of plant objects of biotechnological production		20
Modular test work 3.		30
<b>Total by module 3</b>		<b>100</b>
<b>Educational work</b>	<b><math>(M1 + M2 + M3)/3 \cdot 0,7 \leq 70</math></b>	
<b>Exam / test</b>	<b>30</b>	
<b>Total for the course</b>	<b><math>(\text{Academic work} + \text{exam}) \leq 100</math></b>	

## 8.2. Scale for assessing the knowledge of a higher education student

Rating of higher education applicants, points	Grading according to the national system (exams/tests)
90-100	Exams
74-89	Excellent
60-73	Good
0-59	Satisfactory

## 8.3. Assessment policy

<b>Policy on deadlines and retakes</b>	Works that are submitted late without valid reasons will be assessed with a lower grade. Modules may be retaken with the permission of the lecturer if there are valid reasons (e.g. sick leave).
<b>Policy on academic integrity</b>	Cheating during tests and examinations is prohibited (including using mobile devices). Essays must have correct textual references to the literature used
<b>Attendance policy</b>	Attendance is compulsory. For objective reasons (e.g. illness, international internship), training can take place individually (online in agreement with the dean of the faculty)

## **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.

## **10. Recommended sources of information**

- 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/](https://www.ipni.org/)  
[World Flora Online https://about.worldfloraonline.org/](https://about.worldfloraonline.org/)