NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Plant Science

APPROVED
Agrobiological Faculty
"10" June 2025

CURRICULUM OF ACADEMIC DISCIPLINE

PLANT SCIENCE

Area of knowledge _____
Specialty **201 Agronomy**
Academic programme **Agronomy**
Faculty **Agrobiological**
Developed by: **Svitlana Kalenska,** Doctor of Agricultural Sciences, professor
Bohdan Mazurenko, Ph. D in Agronomy, As. Professor;
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Kyiv – 2025

Description of the discipline Plant science

On a global scale, the main task of plant cultivation is to meet the growing needs of the population for food products, the livestock sector for feed, and various branches of industry such as textiles, food, and others for raw materials. Plant cultivation as a science studies various types, forms, and varieties of field crops, the theoretical foundations, and practical measures for obtaining high and sustainable yields with minimal labor and material resources. In a broad sense, plant cultivation involves the cultivation of various cultivated plants. The main goal of the discipline is to prepare the student for future independent professional work with the generalized object of activity: agricultural crops, soil, fertilizers, machinery, land reclamation, and plant protection. As a result of studying the discipline, a young specialist should be able to: develop, improve, and effectively implement cultivation technologies for field crops under various forms of ownership and management; monitor crop conditions and manage crop yield formation processes; ensure high economic efficiency of implemented technologies; develop and implement measures to improve the quality and reduce losses of crop production.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	*Bachelor's*	
Specialty	201 “Agronomy”	
Academic programme	Agronomy	
Characteristics of the discipline		
Type	Core	
Total number of hours	300	
Number of ECTS credits	10	
Number of modules	6	
Course project (work) (if any)	+	
Form of assessment	*exam*	
Indicators of the discipline for full-time and part-time forms of university study		
	University study	
	Full-time	**Part-time**
Year of study	2–3	
Term	4–6	
Lectures	*90 hours*	*hours*
Practical classes and seminars	*105 hours*	*hours*
Laboratory classes	- *hours*	*hours*
Self-study	*105 hours*	*hours*
Number of hours per week for full-time students	*4–6–3 hours*	

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

of the academic discipline "Plant Science" is to provide students with knowledge about field crops, their growth and development characteristics, requirements for external environmental factors, modern techniques and technologies of cultivation aimed at obtaining sustainable high-quality yields with minimal labor, resource, and financial inputs. "Plant Science" is a specialized discipline taught at agronomic faculties, which ensures the formation of students' knowledge and skills in conducting technological practices for maximizing the realization of the biological potential of crop yields. It is an essential sector of the Ukrainian economy.

Competences acquired:

Integral competence (IC):_ Ability to solve complex specialized tasks and practical problems in agronomy, which involve the application of theories and methods of the relevant science and are characterized by complexity and uncertainty of conditions.

General competence (GC):
GC 6. Knowledge and understanding of the subject area and professional activities.
GC 7. Ability to apply knowledge in practical situations.
Special (professional) competence (SC):
SC 1. Ability to apply fundamental knowledge of key areas of agricultural science, including crop production, farming systems, plant breeding and seed production, agrochemistry, fruit growing, vegetable production, soil science, forage production, mechanization in crop production, and plant protection.
SC 3. Knowledge and understanding of core biological and agrotechnological concepts, principles, and theories related to the cultivation of agricultural and other plant species.
SC 4. Ability to apply knowledge and understanding of physiological processes in agricultural crops to solve production-related technological problems.
SC 9. Ability to manage complex activities or projects, assuming responsibility for decision-making under specific production conditions.

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Expected learning outcomes (ELO):
ELO 4. Compare and evaluate current scientific and technological achievements in the field of agronomy.
ELO 6. Demonstrate knowledge and understanding of fundamental disciplines to the extent necessary for acquiring practical skills in agronomy.
ELO 7. Demonstrate knowledge and understanding of the principles of plant physiological processes at a level sufficient for mastering fundamental and professional disciplines.
ELO 9. Possess operational-level skills in observation, description, identification, classification, as well as cultivation of biological objects and maintenance of agrocenosis stability while preserving natural biodiversity.
ELO 10. Analyze and integrate knowledge from general and specialized professional training to the extent necessary for specialized professional work in agronomy.
ELO 11. Initiate timely and appropriate solutions to production problems in accordance with local agroecological conditions.
ELO 13. Design and organize crop production measures to ensure high-quality agricultural products in compliance with current standards.
ELO 14. Integrate and improve production processes for crop cultivation in accordance with current regulations and best practices.
ELO 15. Plan economically efficient agricultural production.
ELO 16. Organize effective and safe working conditions.

Programme and structure of the discipline

Modules and topics	**Number of hours**												
	full-time							**part-time**					
	weeks	total	including					total	including				
			l	p	lab	in.	s.st.		l	p	lab	ind.	s.st.
Module 1. **Fundamentals of Crop Production and Yield Programming**													
Topic 1. Crop production as a branch of agricultural production.		4	2	2									
Topic 2. Ecological and		8	2	2			4						

biological foundations of crop production.													
Topic 3. Agrobiological foundations of intensive cultivation technologies for agricultural crops.		4	2	2									
Topic 4. Agrotechnological foundations of crop production.		8	2	2			4						
Topic 5. Fundamentals of crop yield programming.		4	2	2									
Topic 6. Fundamentals of seed science.		8	2	2			4						
Total for module 1	**36**		**12**	**12**			**12**						
Module 2. **Grain Crops of the First and Second Groups**													
Topic 7. Winter cereals		30	12	14			4						
Topic 8. Spring cereals		24	6	4			14						
Total for module 2	**54**		**18**	**18**			**18**						
Module 3. **Minor Cereals and Grain Legumes**													
Topic 9. Flake crops		14	6	12			4						
Topic 10. Legumes		12	6	4			8						
Topic 11. Cultivation maps		14	8	4			8						
Total for module 3	**60**		**20**	**20**			**20**						
Module 4. **Major Legumes, Tuber, and Root Crops**													
Topic 13. Main grain legumes		23	10	8			5						
Topic 14. Minor legumes		14	2	6			6						
Topic 15. Tuber crops		19	6	5			8						
Topic 16 Root crops		19	7	6			6						
Total for module 4	**75**		**25**	**25**			**25**						
Module 5. **Oilseed Crops**													
Topic 17. Oil crops			6	10			6						
Topic 18. Sugar crops			2	6			10						
Total for module 5	40		**8**	**16**			**16**						
Module 6. **Special-Use Crops**													
Topic. 19. Essential oil crops		12	2	2			8						
Topic 20. Fiber crops		12	2	8			2						
Topic 21. Bioenergy crops		11	3	4			4						
Total for module 6			**7**	**14**			**14**						
Total hours	**300**		**90**	**105**			**105**						
Course project (work) _____ **(if included in the curriculum)**													
Total hours	**300**		**90**	**105**			**105**						

2. **Topics of lectures**

No.	Topic	Hours
Module 1. Fundamentals of Crop Production and Yield Programming		
1	Introduction to plant science and crop production as a branch of agriculture	2
2	Factors affecting crop yield: ecological, genetic, agrotechnical	2
3	Photosynthesis and radiation use efficiency in crops	2
4	Programming and forecasting crop yields	2

5	Fertilizer use efficiency and nutrient uptake coefficients	2
6	Structure and content of the agronomic section of a technological map	2
	Module 2. Grain Crops of the First and Second Groups	
7	Cereal crops: classification, systematics, and grain anatomy	2
8	Morphological and biological features of cereals during organogenesis	2
9	Wheat: types, morphological features, and cultivation technology	2
10	Rye and triticale: biology, economic importance, and growing techniques	2
11	Barley: classification, varieties, and best practices in cultivation	2
12	Oats and millet: systematics and cultivation under various soil-climatic conditions	2
13	Maize: biological features, productivity assessment, and hybrid cultivation	2
14	Specifics of seed quality control in cereal crops	2
15	Key indicators for selecting cereal crop varieties for different agroecological zones	2
	Module 3. Minor Cereals and Grain Legumes	
16	Sorghum and rice: morphology, varietal classification, and cultivation requirements	4
17	Buckwheat: species characteristics, agroecological preferences, and technologies	2
18	Grain legumes: general characteristics, identification, and role in sustainable systems	4
19	Biological nitrogen fixation in legumes and its agronomic importance	2
20	Compilation of technological maps for selected cereal and grain legume crops	6
21	Crop rotation and compatibility of cereals and legumes in field systems	2
	Module 4. Major Legumes, Tuber, and Root Crops	
22	Peas, soybeans, beans: classification, varietal traits, and cultivation technologies	6
23	Lupins, chickpeas, lentils, cowpeas: biology and adaptation to marginal lands	4
24	Cultivation technologies for forage legumes in modern production systems	2
25	Potato: biological structure, technological aspects of cultivation, and quality evaluation	4
26	Jerusalem artichoke: biological features and cultivation for food and energy use	2
27	Root crops (fodder beet, carrot, turnip): classification, sowing density, and yield	2
28	Sugar beet I: biological characteristics, root formation, and cultivation techniques	3
29	Sugar beet II: bolting, second-year development, and sugar yield calculation	2
	Module 5. Oilseed Crops	
30	Oil crops: classification and diagnostic features	2
31	Sunflower: botanical features, seed quality indicators, and production technologies	2
32	Rapeseed, mustard, safflower: adaptation, oil content, and cultivation specifics	2
33	Flax, poppy, castor bean: multipurpose oil crops and their production	2
	Module 6. Special-Use Crops	
34	Essential oil crops: economic value and technological requirements	2
35	Bast fiber crops (flax, hemp, kenaf): morphology and harvesting technologies	2
36	Phytoenergy crops: characteristics, productivity, and use for biomass energy	3
Total hours		**90**

3. Topic of laboratory (practical, seminars) classes

No.	Topic	Hours
	Module 1.	
1	Forecasting crop yield. Calculation of assimilation coefficients of fertilizers by crops and potential yield based on solar radiation input.	2
2	Calculation of phytometric indicators for targeted crop yield.	2
3	Compilation of the agronomic section of the technological map for programmed cultivation of field crops.	2
4	Determination of seed quality characteristics. Sampling.	2
5	Determination of seed quality characteristics: purity and impurities, germination rate, viability, moisture content, 1000-seed weight, disease infestation, pest infestation. Determination of seed authenticity (varietal laboratory control).	2
6	Determination of seed viability and preparation of seed quality documents.	2
	Module 2	
7	General characteristics of cereal crops. Morphological and biological differences in grains of the first and second groups. Genus differences in grains of the first and second groups in terms of kernel anatomy.Genus differences in grains of the first and second groups in terms of sprouts, shoots, ears, and awns. Growth stages and phases of organogenesis in cereal crops.	4
8	Wheat. Systematics and morphological characteristics. Types of wheat. Determination of varieties of soft and hard wheat. Economic and biological characteristics of the most common and promising wheat varieties.	2
9	Rye. Systematics and morphological characteristics of plants. Species and varieties. Economic and biological characteristics of the most common varieties.	2
10	Triticale. Systematics and morphology of plants.	2
11	Barley. Systematics and morphological characteristics. Subspecies and groups. Determination of barley varieties. Economic and biological characteristics of varieties.	2
12	Oats. Systematics and morphology of plants. Species of oats. Determination of oat grain type, color, and huskiness. Varieties and their economic and biological characteristics.	2
13	Millet. Systematics and morphological characteristics. Species, subspecies, and varieties of millet. Economic and biological characteristics of common millet varieties.	2
14	Maize. Botanical characteristics. Systematics and morphological characteristics of plants. Features of ear and tassel structure. Determination of productivity based on tassels. Determination of maize subspecies and varieties. Economic and biological characteristics of maize hybrids and varieties.	2
	Module 3	
15	Sorghum. Botanical characteristics. Systematics and morphology. Economic and biological characteristics of groups, varieties, and hybrids.	4
16	Rice. Systematics and morphological characteristics. Features of root system structure. Subspecies, groups, varieties. Varieties.	4
17	Buckwheat. Systematics and morphology of plants. Determination of species and varieties. Economic and biological characteristics of varieties.	4
18	Development of agronomic sections of technological maps for the cultivation of grain crops: winter wheat, spring barley, maize, buckwheat, and others using specific farms in Ukraine as examples.	4
19	General characteristics of cereal legume crops. Morphological features. Identification of cereal legume crops based on seeds, seedlings, leaves, and	4

	fruits.	
Module 4		
20	Peas. Systematics and morphological characteristics. Identification of species and varieties. Economic and biological characteristics of cultivars.	2
21	Soybeans. Systematics and plant morphology. Subspecies, varieties, and testing groups. Economic and biological characteristics of cultivars.	2
22	Kidney beans. Systematics and morphological characteristics. Species and varieties. Economic and biological characteristics of cultivars.	2
23	Lupin. Systematics and morphology. Species and varieties. Determination of seed alkaloid content. Cultivars and their economic and biological characteristics.	2
24	Forage legumes, lentils. Systematics and morphological characteristics. Species, subspecies, varieties, and their characteristics.	2
25	Chickpeas, cowpeas. Systematics and morphological features. Species, subspecies, varieties, and their characteristics.	2
26	Development of agrotechnical sections of cultivation technology cards for peas, soybeans using a specific farm as an example.	2
27	Fodder beets, fodder carrots, rutabagas, turnips. Systematics and morphological characteristics. Anatomical structure of root crops. Identification of root crops based on seedlings, fruits, and seeds. Determination of stand density, biological yield, and its structure.	3
28	Potato. Systematics and morphological characteristics of organs. Structure of tubers. Economic and biological characteristics of potato varieties. Determination of dry matter and starch content in tubers.	2
29	Jerusalem artichoke. Morphological characteristics. Development of the agronomic section of the technological map for potato cultivation using a specific farm as an example.	2
30	General characteristics. Determination of pumpkins, watermelons, and melons based on seeds, sprouts, and fruits.	2
31	General characteristics of root crops. Sugar beets. Morphological and anatomical features of first-year sugar beet plants.	2
Module 5		
32	Sugar beets. Morphological and anatomical features of second-year sugar beet plants.	2
33	Sugar beets. Technological map for growing sugar beets. Biological yield and its structure, determination of plant density, sowing rate, seeding unit, juice purity, and sugar yield.	4
34	General characteristics of oil crops. Determination of oil crops based on fruits, seeds, sprouts, stems, leaves.	2
35	Botanical-morphological characteristics of sunflower. Features of sunflower plant structure, determination of sunflower groups, seed hulling and shelling. Technological map for sunflower cultivation.	2
36	Botanical-morphological characteristics of mustard, rapeseed, and safflower.	2
37	Botanical-morphological characteristics of poppy, castor oil plant, and flax.	2
38	Botanical-morphological characteristics of sesame, peanuts, pearl millet, and quinoa.	2
Module 6		
39	Botanical-morphological characteristics of essential oil crops.	2
40	Bast fiber crops. Botanical-morphological characteristics of flax.	2
41	Botanical-morphological characteristics of hemp, cotton, and kenaf.	2
42	Botanical-morphological characteristics of tobacco, snuff, and hops.	2
43	Botanical-morphological characteristics of medicinal crops.	2
44	Botanical-morphological characteristics of phytoenergy crops.	4

Total hours	105

4. Topics of self-study

No.	Topic	Hours
	Module 1.	
1	Ecological and biological foundations of crop production.	2
2	Agrobiological foundations of intensive cultivation technologies for agricultural crops.	2
3	Agrotechnological foundations of crop production.	2
4	Basics of yield programming for agricultural crops.	2
5	Fundamentals of seed science.	2
	Module 2.	
6	Winter cereals. General characteristics.	8
	Module 3	
7	Spring cereals and cereal crops.	8
	Module 4	
8	Grain legume crops.	8
	Module 5	
9	Tuber crops.	4
10	Root crops.	3
11	Vegetable crops.	2
12	Sugar crops.	2
13	Sugar beets.	6
14	Oil crops.	8
	Module 6.	
15	Essential oil crops.	8
16	Fiber crops. Cotoon cultivation	2
17	Aromatic crops and Medicinal plants.	2
18	Phytoenergy crops. Poplar, willow and miscanthus	2
	Total hours	**105**

5. Methods of assessing expected learning outcomes:

– oral or written survey;
– test;
– defending laboratory/practical, design/graphical works, projects;
– peer-to-peer assessment, self-assessment.

6. Teaching methods *(select necessary or add):*

– problem-based method;
– practice oriented studying method;
– case method;
– research based method;
– learning discussions and debates method;

7. Results assessment.

The student's knowledge is assessed by means of a 100-point scale converted into the national grades according to the "Exam and Credit Regulations at NULES of Ukraine" in force

8.1. Distribution of points by types of educational activities

Educational activity	Results	Assessment
Module 1. ***Fundamentals of Crop Production and Yield Programming***		
Practical work 1.	**ELO 6, 7, 10, 13** Students will understand the fundamental principles of crop physiology and agronomy, analyze crop productivity factors, and develop components of technological maps. They will apply theoretical knowledge to model yield potential and nutrient assimilation efficiency, gaining practical skills in planning and managing crop systems.	**5**
Practical work 2.		**5**
Practical work 3.		**10**
Practical work 4.		**10**
Practical work 5.		**10**
Practical work 6.		**10**
Self-study 1.		**10**
Self-study 2.		**10**
Module control work 1.		**30**
Total for module 1		**100**
Module 2. ***Grain Crops of the First and Second Groups***		
Practical work 7.	**ELO 4, 6, 9, 11, 13** Students will master identification and classification of major cereal crops, evaluate varietal traits and morphology, and analyze their suitability for specific agroecological zones. They will also learn how to apply modern agronomic technologies for wheat, barley, and maize production under real-world conditions.	**10**
Practical work 8.		**5**
Practical work 9.		**5**
Practical work 10.		**5**
Practical work 11.		**5**
Practical work 12.		**5**
Practical work 13.		**10**
Practical work 14.		**10**
Self-study 3.		**5**
Self-study 4.		**10**
Module control work 2.		**30**
Total for module 2		**100**
Class work	**(M1 + M2)/2*0,7 ≤ 70**	
Credit	**30**	
Total for semester	**(Class work + credit) ≤ 100**	
Module 3. ***Minor Cereals and Grain Legumes***		
Practical work 15.	**ELO 6, 9, 10, 11, 14** Students will gain skills in morphological identification and classification of non-mainstream cereals and legumes. They will be able to develop adapted cultivation strategies for these crops, optimize their use in crop rotations, and assess their ecological and economic roles in sustainable systems.	**10**
Practical work 16.		**10**
Practical work 17.		**10**
Practical work 18.		**10**
Practical work 19.		**10**
Self-study 5.		**10**
Self-study 6.		**10**
Module control work 3.		**30**
Total for module 3		**100**
Module 4. ***Major Legumes, Tuber, and Root Crops***		
Practical work 20.	**ELO 6, 9, 13, 14, 15** Students will learn the cultivation technologies of legumes, potatoes, and root crops, including selection of suitable varieties and economic assessment. They will integrate biological knowledge with technological practices to	**5**
Practical work 21.		**5**
Practical work 22.		**5**
Practical work 23.		**5**
Practical work 24.		**5**
Practical work 25.		**5**

Practical work 26.	develop cost-effective production systems that meet quality and yield standards.	**5**
Practical work 27.		**5**
Practical work 28.		**5**
Practical work 29.		**5**
Practical work 30.		**5**
Practical work 31.		**5**
Self-study 7.		**10**
Self-study 8.		**10**
Module control work 4.		**30**
Total for module 4		**100**
Class work	**(M3+M4)/2*0,7 ≤ 70**	
Credit	**30**	
Total for semester	**(Class work + credit) ≤ 100**	
Module 5. Oilseed Crops		
Practical work 32.	**ELO 4, 9, 13, 14, 15** Students will be able to identify and classify oilseed crops, analyze varietal traits, and design appropriate cultivation schemes. They will also evaluate the technological and economic aspects of oil crop production and apply best practices to improve productivity and profitability.	**5**
Practical work 33.		**10**
Practical work 34.		**10**
Practical work 35.		**10**
Practical work 36.		**5**
Practical work 37.		**10**
Practical work 38.		**10**
Self-study 9.		**10**
Module control work 5.		**30**
Total for module 5		**100**
Module 6. Industrial, and Special-Use Crops		
Practical work 39.	**ELO 4, 10, 14, 15, 16** Students will explore the technologies for cultivating technical, medicinal, and energy crops. They will develop strategies for safe and effective production management, evaluate economic efficiency, and apply technological innovation to expand the use of underutilized crops in diverse agro-industrial sectors.	**10**
Practical work 40.		**10**
Practical work 41.		**10**
Practical work 42.		**10**
Practical work 43.		**10**
Practical work 44.		**10**
Self-study 10.		**10**
Module control work 6.		**30**
Total for module 6		**100**
Class work	**(M5+M6)/2*0,7 ≤ 70**	
Exam	**30**	
Total for semester	**(Class work + exam) ≤ 100**	

8.2. Scale for assessing student's knowledge

Student's rating, points	National grading (exam/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Assessment policy

Deadlines and exam retaking rules	• *Tasks must be submitted on time, according to the delivery schedule.* • *Penalty for delay:* - *10% – less 1 month* - *20% – more 1 month* • *Re-assessment will be allowed if you pass all tasks in module*
Academic integrity rules	*Plagiarism and re-delivery tasks don`t allow*
Attendance rules	*Attendance is mandatory. For objective reasons (for example, illness, international internship) training can take place individually (in online form in consultation with the dean of the faculty)*

8. **Teaching and learning aids:**

- e-learning course of the discipline (*https://elearn.nubip.edu.ua) MANDATORY* – https://elearn.nubip.edu.ua/course/view.php?id=24

- CROP PRODUCTION GUIDE AGRICULTURE. Tamil Nadu Agricultural University. Link: https://www.freebookcentre.net/biology-books-download/gotoweb.php?id=13855

Petrichenko V.F., Lykhochvor V.V. Roslynnytstvo. Novi tekhnolohii vyrashchuvannia polevykh kultur: pidruchnyk. - 5-te vid., vyrav., dopov. Lviv: NVF "Ukrainski tekhnolohii", 2020. 806 p. (Title: Crop Production. New Technologies for Field Crop Cultivation: Textbook)

9. Recommended sources of information

1. Graham Thiele, Michael Friedmann, Hugo Campos, Vivian Polar, Jeffery W. Bentle. Root, Tuber and Banana Food System Innovations. Springer, 2022. DOI: https://doi.org/10.1007/978-3-030-92022-7
2. Kalenska S., Dmytrishak M., Antal T., Mazurenko B., Crop production with basis of fodder production, Kyiv, 2021. [In Ukrainian]
3. Crop production manual. FAO. 2020. Available at: https://www.fao.org/3/ca7556en/CA7556EN.pdf
4. Statistics in Agriculture. Available at: https://fao.org/faostat
5. Ministry of Agriculture Politics http://www.minagro.kiev.ua/
6. Technology of cultivation (field crops) http://agro-business.com.ua/
7. Technology of cultivation (field crops) https://www.agronom.com.ua/